

What Are We Talking About When We Talk About Collapse?

Collapse is likely to come in waves, knowing why and when they happen could save your life



[Steve Genco](#) Jun 17, 2024



[Source](#) (cropped)

When it comes to writing about climate change ... or energy transition ... or resource depletion ... the new “it” word seems to be COLLAPSE. [Collapse is everywhere](#). But collapse is an inherently fuzzy concept. We are often assured that it won’t happen all at once, like [in the movie](#) *The Day After Tomorrow*. But beyond that, we find very little guidance as to precisely how it might play out over a longer stretch of time. All that most people seem to agree on is this: it’s going to be really, really bad.

One school of thought, which I’ve called [End-Times Doomism](#), tells us there is no need to worry, because we lack [agency](#) to do anything about it. We are as powerless as a bunch of [ants on a log](#), floating down a river, caught in its current, heading toward a waterfall we can’t avoid. So we might as well embrace “[radical acceptance](#)” and enjoy the ride (if not the destination).

For those of us who choose to believe that life after collapse is both possible and likely, radical acceptance will not do. I want to be explicit about why. It is because, whatever world we find ourselves in during and after collapse, we will aspire to be among its survivors. As individuals, we may not be able to save modern civilization as a whole from its self-inflicted death spiral, but **each of us will want to save ourselves and those we love, especially our children and grandchildren, who did not ask to be born into this damaged world we have created for them.** So each of us will inevitably ask:

How can I best navigate the next several decades of uncertainty, crisis, and collapse in order to maximize my own and my family's chances of survival?

My personal view is that human beings might intellectually embrace the idea of radical acceptance, but few of us (excepting the sociopaths in our midst) would be willing and able to lean over and tell our three year old granddaughter to do the same.

If you want to be among those who survive collapse, you need to understand collapse.

- The first thing you need to understand is that collapse of a civilization happens in *waves*. (I'm not claiming originality for this idea. Richard Lowenthal, for example, presented a similar sequential narrative of collapse in [a 2023 Medium post](#).)
- Next, you need to understand how each wave is likely to play out. You need to be aware of the *early warning signs* of sequential collapse within each wave, so you can identify *where you are* in the unfolding flow of events.
- And finally, you need to be able to assess *how the damage* you are observing (including damage at global, national, regional, and local levels) is likely to impact *what you should do next*.

Armed with this information, you can start making some strategic personal decisions: what goals to pursue, what skills to acquire, what assets to keep, what communities to join, what people to trust ([source](#)).

The four waves of civilization collapse

Our global civilization is already in collapse. It's just that the first wave of collapse we are experiencing right now is happening very unevenly around the planet, so many of us are not fully aware of the devastation already occurring. But many others are in the thick of it ([source](#), [source](#)). Just not everywhere. Not yet.

Environmental collapse

The first wave of civilization collapse is **environmental**. And it is happening [faster](#), it is fair to say, than anyone expected. Many observers saw 2023 as our wake-up call, the first year in which the ravages of climate change became frighteningly real. Globally, 2023 was the hottest year on record; indeed, probably the hottest year in the last 100,000 ([source](#)). On several occasions and in many different parts of the world, temperatures burst through the line-in-the-sand drawn by the UN's IPCC climate watchdog: 1.5°C (3.3°F) above preindustrial temps ([source](#)). These increases were accompanied by severe storms and escalating environmental disasters: unprecedented wildfires in Canada and the Western US; catastrophic flooding in China, Greece, Libya, and Southern Europe;

severe droughts in the Southern Amazon, China, India, Sub-Saharan Africa, Southern Europe, and Southwest US; devastating hurricanes, cyclones, and typhoons in Mexico, Myanmar, Bangladesh, and Guam; debilitating heat waves in India, Europe, China, and parts of the US ([source](#)). This is a partial list. According to the [Yale Climate Connections](#) project, the world experienced 63 billion-dollar weather events in 2023, at an estimated cost of US\$300 billion.

What is clear to those who are paying attention is that certain thresholds have now been crossed. As climate scientist Andrew Dessler [explains](#), climate change is a nonlinear phenomenon:

... the correct mental model is not one of impacts slowly getting worse over decades. Rather, the correct way to understand climate change is that things are fine until they're not, at which point they're really terrible. And the system can go from "fine" to "terrible" in the blink of an eye.

We are now experiencing what nonlinear climate change looks like. Yet, we remain surprisingly sanguine about the implications. If you ask Americans what they see as the biggest problems facing the country, "climate change" barely registers, ranking below 10 other issues (the top 5: inflation, healthcare, dysfunction in government, gun violence, and violent crime) in a mid-2023 *Pew Research Center* [poll](#).

The reason for this lack of concern is fairly obvious. Although ordinary citizens tend to be aware of changes in the weather, which they can see and feel, most are not yet connecting those changes to the climate changes that are causing and amplifying them. And the reason for that is also fairly obvious. The connection is not only *not made*, it is *actively denied and obfuscated* by governments, corporations, and mainstream media; all powerful institutions that are either still in denial themselves, or want the public to be left in the dark about our true predicament, hoping not to disturb the consumer spending that drives today's global economy ... an economy that greatly benefits those very institutions.

As a consequence, climate disasters in the rich Global North are still treated as *one-offs*, one-time events that can be cleaned up and "undone" with enough money and resources. Climate disasters in the poor and underfunded Global South, in contrast, tend to be treated with "thoughts and prayers" and charitable relief efforts that address the post-event needs of impacted populations, but not the root causes of disaster.

This state of affairs is likely to persist until the world's environmental damage starts to disrupt the profitability of global and domestic economic activity. As it does so — again, this will occur in a cascade of interconnected crises — we enter the second wave of civilization collapse, the undoing to economic growth and the collapse of the global economic order.

Economic collapse

The second wave of civilization collapse is **economic**. The extent of economic collapse, and its severity, will be determined by two driving forces: the ferocity and geographic reach of climate change disasters and the "phasing out" of fossil fuels. Some observers believe that resource scarcity, driven by overshoot, may tank the economy sooner than climate change can achieve the same result, but this is a bit of a *chicken-or-egg* problem: as the next few decades unfold, we can expect resource scarcity and climate disruption to remain deeply intertwined.

Key to the transition from environmental collapse to economic collapse is the declining availability of fossil fuels as oil becomes lower in quality, harder to find, and more expensive to extract and process. As many observers have noted, fossil fuels will not “dry up”. The metaphorical spigot will not simply run dry. Rather, the energy-dense fuels and derivatives we produce from oil will decline in availability due to a process called *energy cannibalism*. Futurologist and blogger “B” explains how energy cannibalism and a related concept, *peak net energy*, work:

Peak net energy means that no matter how hard we try to replace our declining easy-to-tap traditional oil reserves with tar sands, or ultra-deep wells drilled into the seafloor, beyond a certain point we will no longer be able to increase the amount of oil available for other uses (like manufacturing, transport, mining, agriculture, etc.). “Energy cannibalism” does not stop at the peak though: it will continue to take ever more energy to maintain oil extraction as existing fields “mature”. Operating drilling equipment, pumping seawater or CO₂ into ageing wells to uphold production, delivering sand used in re-fracking existing wells etc. will continue take up an ever larger portion of the oil produced — as well as other forms of energy — leaving less and less for the rest of the economy ([source](#))

This is how our current Age of Oil will come to an end. When it does, our global economy will be forced to adjust to what remains: renewable energy sources that are less energetically dense, less geographically available, and built atop less established infrastructures for energy production, storage, and transmission. But *less* is not *none*. As energy experts DJ White and Nate Hagens put it:

“Solar panels and wind turbines can power a perfectly good civilization for quite some time, just not this one.” ([source](#))

Here is how economic collapse is likely to follow from climate change and energy cannibalism (see also [source](#)). Although presented as a sequence, some of these milestones may occur simultaneously or in a slightly different order. But they are cumulative. As more of them come to pass, the closer we get to an eventual collapse of the global economic system. Think of these as *mini-waves* that arrive one after another, eventually swamping the system as a whole.

(1) Escalating extreme weather events disrupt economic flows and destroy resource stocks.

These are the direct economic costs imposed by rising temperatures and diminishing resources. To date, we are still treating these disasters, at least in the rich Global North, as independent, repairable events. But as long as we keep burning fossil fuels, temperatures will continue to rise, and the frequency and severity of these events will increase. So soon, we will be facing Category 6-equivalent hurricanes, inundated coastal cities due to sea level rise, and disappearing economic output from large populations assaulted by droughts, floods, wildfires, and wet-bulb temperatures.

From the point of view of the global economy, only one signal emanating from this litany of horrors matters: *is it causing the rate of economic growth to decrease?* When the system determines that growth is in trouble, it will leap into action (but not before).

(2) Some industries start to suffer direct damage due to climate change. Even before we reach the point of permanently declining growth, some industries that are directly impacted by climate will begin to suffer. The first of these, predictably, is the *insurance industry*. Already, insurance companies are cancelling existing policies and refusing to write new ones in climate-vulnerable regions, basically admitting they can no longer afford to provide protection for homes and businesses in those areas. Over time, these decisions will have significant economic repercussions,

impacting home sales, property values, tax bases, and regional migration. As one observer has noted: “A malfunctioning or non-existent insurance market will have ripple effects, destabilizing housing markets, undermining economies, and disrupting societal structures.” ([source](#))

A second industry already at risk due to climate change is *agriculture*. Here the primary culprits are extreme heat and extreme weather. As noted in a recent [EPA report](#), “more extreme temperature and precipitation can prevent crops from growing. Extreme events, especially floods and droughts, can harm crops and reduce yields.” Extreme heat also negatively affects livestock; it increases disease, lowers fertility, and decreases milk production as temperatures rise. Fisheries are also impacted, due to overfishing, water pollution and rising ocean and river temperatures. These effects are currently moderate enough to be ignored or viewed as “manageable”, but they are still inflicting significant economic damage, which can only be expected to increase as temperatures continue to rise.

(3) Prices spike due to supply-driven inflation. We are in the midst of a great debate about inflation. Have we tamed the inflation that emerged from the COVID pandemic? Is the inflation we are experiencing today temporary, or will it be permanent? Is it best described as *profit-driven* (a function of corporate price gouging), *demand-driven* (a function of consumers spending too much), or *supply-driven* (a function of scarcity)?

In the post-pandemic inflation that peaked in 2022, economists have found evidence of all three types. Nobel Prize recipient Joseph Stiglitz (along with co-author Ira Regmi) [identified](#) five major sources of post-pandemic inflation: energy and food price spikes; changes in the kinds of goods consumers wanted; supply interruptions (mostly for cars); higher rents (resulting from *work-from-home* moves); and “market power” (aka price gouging).

While the price gouging and changing demand patterns (e.g., a jump in demand for residential toilet paper due to all those suddenly *at-home-all-day* workers) were relatively short-term effects due to supply chain inefficiencies and monopolistic exploitation of a temporary situation, the other causes of inflation were all supply-driven: supply of energy, supply of food, supply of manufactured components, supply of housing.

Today, supply-driven price increases are proving stubbornly difficult to reverse. In the food sector, where prices in the US have increased by over 20% since 2021 ([source](#)), grocery business advisors are predicting what shortages grocers and consumers can expect in 2024 (see, e.g., [here](#), [here](#), [here](#)). What is significant about these projections is not just *what* food products are likely to be in short supply, but *why*. A partial list:

- *Canned tuna* (due to overfishing, regulatory changes, and an aluminum shortage)
- *Coffee* (due to increasing heat and persistent pest infestations in major coffee plantations)
- *Rice* (due changing weather patterns, droughts, and geopolitically-driven trade restrictions)
- *Chicken and eggs* (due to rising feed costs and a looming threat of avian flu)
- *Beef and milk* (due to rising feed costs and water scarcity in cattle-raising and dairy-farming regions)
- *Spices* (due to climate change impacting spice-producing regions, potentially shrinking supply of staples like black pepper, cinnamon, nutmeg, and garlic powder)
- *Wheat and wheat products* (due to severe droughts in breadbasket regions and war in Ukraine)
- *Salmon* (due to climate change and overfishing producing significant declines in salmon populations and habitats)

- *Cooking oils, seed oils, and olive oil* (due to erratic weather patterns, climate-related pest infestations, and production disruptions in Ukraine)

Clearly, these shortages and price spikes are not responses to consumer demand, they are external conditions that diminish what is available to meet consumer demand. To the extent they are all linked to climate change in one way or another, we must expect them to get worse as temperatures increase and weather disruptions become even more frequent and severe.

How will we know when the resulting inflation is starting to be seen as a serious threat to overall economic growth? That will be when the central banks decide to step in.

(4) Growth slows, central banks get more interventionist. Central banks, like America's Federal Reserve, have a wide range of monetary tools at their disposal to fight inflation. For the most part, these are tools to fight *demand-driven* inflation. We are familiar with how they work. If the causes of an economic contraction are themselves economic (e.g., business cycles), they can be corrected with *demand-focused* policies that make money more expensive and consumption and business expansion more costly. Later, when inflationary pressures have eased, the policies can be reversed and growth can resume. Because these kinds of interventions have worked in the past, we tend to think of economic contractions as *temporary* (and fixable) conditions. However, if an economic contraction is driven by *permanent and non-economic factors* (like food shortages or fossil fuel depletion), we are facing something new, a *supply-driven* contraction that cannot be corrected with the usual monetary tools.

Stiglitz and Regmi make the case that monetary policies are only appropriate for fighting inflation produced by excessive aggregate demand. If the inflation is supply-driven, then those same policies can be expected to make matters worse, not better:

Monetary policy, then, is too blunt an instrument because it will greatly reduce inflation only at the cost of unnecessarily high unemployment, with severe adverse distributive consequences.

... increases in interest rates will not substantially lower inflation unless they induce a major contraction in the economy, which is a cure worse than the disease. ([source](#), pp. 3, 5)

Stiglitz and Regmi are not alone in their views (see, e.g., [source](#) and [source](#)) and they may be wrong, of course. But if they are right, and if traditional monetary interventions fail to vanquish supply-driven inflation, we can expect to see more frequent and more severe shortages, permanently rising prices (as consumers fight over shares of a shrinking pie), and a transition that all capitalists fear more than death itself — an end to growth.

(5) Growth goes negative. What if the central bank interventions fail to roll back increasing out-of-reach prices for increasingly scarce goods? What if growth slips from *declining* to *negative*? This is the capitalist's nightmare, because capitalism as it operates today cannot exist without growth. At the most basic level, the global economy is a system whereby capital (money) is invested, debt is incurred, and repayment (with interest) is obligated. In order for that system to operate, capitalists must be confident they can achieve a positive return on their investment. Similarly, debtors must be confident they can grow to meet their obligations as debtors. If they cannot make that case, investors will have no reason to invest, so won't.

This is how the global economy will “seize up” like an engine that runs out of oil. That is a fitting analogy because the loss of affordable fossil fuels will be a key factor in the timing of this milestone. As oil executives are quick to remind us, they do not provide their products as a public service to the world. When oil is no longer profitable to produce, they will stop producing it. Ultimately, this will be a good thing from a purely environmental point of view (see below), but when it first happens, the economic shocks will be swift, immense, and unprecedented.

As the economy continues to sink, unemployment will rise, disposable income will shrink, consumption will drop off, consumers will take on more debt, businesses will pause borrowing and stop growing, energy demand will drop, and suffering and deprivation will become more acute and visible on the lower rungs of the economic ladder.

Because this contraction will be a function of *resource depletion*, both finite resources like affordable oil and minerals, and replenishable resources like adequate food supply, fresh water, and breathable air, it will not be correctable by traditional monetary measures like lowering interest rates or pumping money into the economy, as was done during the pandemic. All these efforts will simply make matters worse, further spiking prices as more money chases fewer goods ... goods that, if climate scientists are to be believed, are not coming back, at least not in any form or quantity that consumers in the Global North would recognize as “back to normal”.

(6) Economies slip into recession, then depression. Economists have provided us with semi-formal definitions of *recession* and *depression*. A *recession* is an economic contraction in which GDP declines for two consecutive quarters. A *depression* is a severe and ongoing recession that lasts for at least two years and results in a GDP decline of at least 10% ([source](#)). What these definitions fail to provide is a sense of what it feels like to live through these events. For that, we often turn to fiction. To fully appreciate the depths and deprivations of the Great Depression of the 1930s, for example, we can read Steinbeck’s [The Grapes of Wrath](#) or, Kristin Hannah’s more recent epic, [The Four Winds](#).

What turns a recession into a depression? In the simplest terms, a depression is an runaway recession, it is a recession that resists “fixing”. If we look at the Great Depression as an example, it only ended when the environmental conditions that caused the [Dust Bowl](#) in the American Midwest to finally abate. The rains returned.

What climate scientists have been warning us about for decades is the fact that climate change is now producing “dust bowl” conditions in multiple locations around the world, including in some of our most critical [breadbaskets](#). In addition, the scientific consensus is that these conditions will continue to get worse as long as we continue to burn fossil fuels and pollute the atmosphere with CO2 and other heat-trapping greenhouse gases ([source](#), [source](#)).

In other words, as long as we fail to address the direct causes of global warming, we will have no way to “fix” the global economy’s slide into recession and subsequent depression.

Once we reach this point in economic collapse, governments will finally have to accept that economic growth is not returning. As I’ve argued [elsewhere](#), this is probably the earliest point at which governments in the Global North will begin to consider [Voluntary Degrowth](#) policies as viable options for coping with the intractable economic crisis they find their nations in.

As climate disasters and the global economy collide, the old capitalist order will descend into a self-induced death spiral. When growth goes negative, capital can no longer achieve a profitable return on investment, so capitalists will stop lending. When capitalists stop lending, the global economy will grind to a halt. Businesses will fail. Outstanding loans will go unpaid. Consumers will face wider and deeper shortages. Prices for increasingly scarce goods will continue to skyrocket.

How to equitably distribute goods and services in this context of scarcity and shortages will become a major challenge for the world's governments, especially in the relatively rich Global North.

(7) Rationing becomes necessary to deal with shortages of all kinds. Although our current system of *late capitalism* (aka *neoliberalism*) has produced unprecedented wealth for some, that wealth has been very unevenly distributed. We now understand, thanks to the work of French economist [Thomas Piketty](#) and others, that this is a structural feature of modern capitalism: capital accumulation inevitably increases the gap between rich and poor because *return on capital* historically grows faster than *return on labor*. So wealth accumulated by capitalists' investments will always outpace wealth produced by workers' wages. Over time, more and more of a society's wealth ends up in the hands of its richest citizens, and the gap between rich and poor widens ([source](#)).

This state of affairs will become extremely problematic in a world of growing scarcity and multiplying shortages. In a country like the United States, in which the wealthiest 10% of citizens own 67% of the nation's wealth, and the bottom 50% own only 3% ([source](#)), distributional justice will become a major point of contention. Absent some government-mandated system to fairly distribute scarce goods — *rationing* — the rich will simply buy up whatever is available at inflated prices, while the poor (defined as those unable to pay those inflated prices) will go without.

Rationing, therefore, will be a necessary adaptation to scarcity. However implemented, it will be far from a perfect solution, because history tells us rationing can only moderate, not eliminate, unequal access to scarce goods and services (think *black markets*). Whether the scarce resource in question is food, energy, healthcare, or toilet paper, the rich will find ways to get more of it. And this will lead to anger and resentment throughout the rest of society. Governments will find it more and more difficult to maintain control over increasingly volatile and dissatisfied publics.

(8) Distributional inequality leads to social conflict, civil unrest, and political instability.

Rationing is essentially how *de-consumption* will come to the Global North. If history is any guide, citizens who previously enjoyed unrestricted access to unlimited goods and services are unlikely to *voluntarily* embrace a new regime of altruistic sharing of scarce resources. A more likely response is widespread resentment and anxiety, escalating competition between *haves* and *have-nots*, and an inevitable increase in civil unrest and political instability.

When rationing finally arrives in the Global North, it will not be the only source of stress and anxiety governments and their citizens will be facing. As climate-driven disasters continue to escalate in both the North and South, all governments will become more preoccupied with climate damage and economic shocks *within their own borders*. This may weaken international commitments to collective and coordinated climate mitigation actions and cause governments to prioritize domestic emergencies over international obligations.

As governments turn their attention inward, as civil unrest grows, and as climate disasters multiply, politically-acceptable "solutions" to climate breakdown and resource depletion are likely to become *more interventionist* externally and *more repressive* domestically. Externally, we can expect to see

the powerful take what their populations demand from the less powerful, whether those demands are for food, fresh water, arable land, strategic minerals, or some other scarce resource. Domestically, we can expect to see democracies struggle to survive, as rationing, de-consumption, and escalating natural disasters cause populations to lose trust and confidence in their governments, creating conditions ripe for the rise of repressive authoritarian regimes. (see also [source](#))

Political collapse

Once the world has reached this point of combined environmental and economic collapse, it is possible that governments will still be functioning pretty much as they do today. Although we don't know exactly when this moment will come — maybe by 2030, 2040, or 2050, estimates vary widely — we can summarize the world these governments will be facing. Because we will have failed to end fossil fuels voluntarily, *average* global temperatures will be hovering around 2.5–3.5°C above preindustrial levels, and will continue rising. Because land masses heat up faster and to higher temperatures than oceans, this will translate into increases of 5–6°C over lands where billions of humans live and work. At the same time, a phenomenon called “Arctic amplification” will ensure that the Arctic gets even hotter, possibly up to four times the global average ([source](#)), causing widespread melting of Arctic and Greenland ice, sea-level rise, a possible disruption of ancient ocean currents, and an increasing risk of additional devastating “[tipping points](#)”.

As the planet continues to heat up, governments in many countries, especially those in the Global South, may find it necessary to permanently depopulate large land areas and climate-vulnerable cities due to wet-bulb temperatures, droughts, floods, and other natural disasters. Even in the richest nations, governments will be battling waves of climate catastrophes with no end in sight. Accompanying all this destruction and disruption will be angry and impoverished populations in the formerly rich Global North, trapped in depression-like economies, demanding a return to a life of over-consumption that is simply no longer attainable. Populations in Global South will face a much worse fate: famine, abandonment of ravaged cities and towns, and forced migration for a lucky few who able to find the means to escape.

In such a world, how long can the center hold? Probably not for long.

The third wave of civilization collapse is **political**. While both environmental and economic collapse are likely to play out over years in a long and dreary sequence of incremental descents and localized disasters, political collapse will occur much more rapidly. If we look at political collapses in the past — for example, the fall of South Vietnam, the collapse of the Soviet Union and the Warsaw Pact, the ending of apartheid in South Africa — all these governments seemed to be functioning normally one day and gone the next.

We tend to think of political collapse as a failure of legitimacy. When a populace no longer believes in a government's right to rule, the government's legitimacy vanishes and it falls. That's true as far as it goes. But it doesn't explain *why* governments fall. In “normal” times, governments are able to rule over populations and territories because they hold a monopoly on the legitimate use of force within their borders. That force, at bottom, is ultimately based on access to energy.

Quite literally, a government's capacity to maintain order within its borders is a function of the energy it has at its disposal to carry out its functions.

When its access to energy shrinks, its ability to project power shrinks, and its capacity to maintain order within its territory shrinks. Over time, this inability to maintain order triggers the crisis of legitimacy that eventually leads to the government's collapse.

Nation-states are complex social systems (as is the global economy). When complex systems can no longer be supported by available energy sources, they *descend* to [lower levels of complexity](#). For a system like a modern nation-state, it is likely to decompose into smaller units that can meet the needs of *some* humans with less energy than was previously available. The government's geographic reach shrinks, political control becomes more localized, and these smaller units settle into lower levels of complexity that are sustainable using whatever sources of energy are now at their disposal, such as locally-accessible wind-, water-, and solar-powered energy production and storage ([source](#)).

In this way, large nation-states may devolve rather quickly into simpler, smaller, largely autonomous political units that provide their own legal and enforcement institutions. This is how a world of large, complex nation-states can rather suddenly turn into a world of small, localized communities and regional power centers, each essentially responsible for its own survival.

Population collapse

The fourth wave of civilization collapse is **population collapse**. When commentators talk about civilization collapse, they usually mean human extinction or, at best, a steep decline in human population. But population collapse doesn't just happen. If such a catastrophe is in our future, we will see it coming long before it arrives, because we will first have to pass through the three waves of destruction reviewed above: environmental poisoning followed by economic stagnation followed by political collapse.

As I've reported [before](#), we are at a disadvantage when it comes to anticipating the impact of climate change and energy descent on human populations, because most of the climate models we use to investigate possible future scenarios treat population size as a *source* of climate change and resource depletion, but fail to include it as an *effect* of those same developments ([source](#)). This is why today's climate models don't show population declines in the face of unprecedented global warming: they don't include population as an output variable in their models. If they did, they would probably find that world and regional population projections based solely on birth and death rates, such as those [recently produced](#) by the UN's Population Division, are wildly overoptimistic for the hotter world we are entering.

What we do know is that humans need three things to survive on this planet: breathable air, drinkable water, and edible food. If any individual human is denied minimal amounts of any of these basic ingredients of life, that human dies.

- If we experience *wet-bulb temperatures* for more than a few hours, we die of heatstroke ([source](#), [source](#)).
- If we go without water for more than three days, we die from dehydration ([source](#)).
- If we go without food for more than one to two months, we die from starvation ([source](#)).

The question of population collapse essentially comes down to this: given the environmental damage we continue to inflict on the planet's atmosphere, arable lands, oceans, and fresh water resource, given the likely breakdown of the economic systems by which we produce and distribute

food and goods around the world, and given the coming energy descent that will leave governments unable to maintain order among their increasingly fractious citizens, how many mouths can this new, damaged world feed, and where are those lucky survivors likely to be located?

An environment's *carrying capacity* is defined by ecologists as the maximum number of individuals that environment can support sustainably at a given level of activity. *Sustainably* means the environment can support the population indefinitely — the resources it provides that maintain the population can be replenished faster than the population can consume them. If the population is larger than the environment's carrying capacity, it will consume the environment's resources faster than they can be replenished, producing a condition ecologists call *overshoot*.

A population in overshoot is, by definition, unsustainable. It may manage to increase its carrying capacity to support larger populations (perhaps the best example of this is the [Green Revolution](#) of the 1970s), but eventually, when carrying capacity has been maximized as far as it can go, or when carrying capacity has been artificially diminished due to environmental degradation and/or over-consumption, there is only one way to correct overshoot: shrink the population back to a level its environment can support sustainably.

For humans, the Earth's carrying capacity has many components, but chief among them is the global *food supply* ([source](#)). Currently, we are told humanity produces enough food to [feed 10 billion people](#), the number the UN (ignoring potential climate-related impacts on mortality) expects to be alive in 2050 ([source](#)). But we also know that much of that capacity is either wasted or never reaches the mouths of humans. As a result, in a world of relative food abundance, global relief organizations estimate that a billion people do not have enough to eat ([source](#)) and perhaps 2.4 billion more live in circumstances of *food insecurity*, a condition defined by the UN as “*a lack of regular access to enough safe and nutritious food for normal growth and development and an active and healthy life*” ([source](#)). That means about 40% of the 8 billion people alive today are *already* struggling to feed themselves.

If that is the state of the food supply today, consider what impact these projections included in the IPCC's 2022 Sixth Assessment Report ([source](#)) will have on food supply and human mortality over the next several decades:

- Climate change will increasingly put pressure on food production and access, especially in vulnerable regions, undermining food security and nutrition.
- Global warming will progressively weaken soil health and ecosystem services such as pollination, increase pressure from pests and diseases, and reduce marine animal biomass, undermining food productivity in many regions on land and in the ocean.
- Global hotspots of high human vulnerability are found particularly in West Africa, Central Africa, East Africa, South Asia, Central America, South America, Small Island Developing States and the Arctic.
- Future human vulnerability will be concentrated where the capacities of local, municipal and national governments, communities and the private sector are least able to provide infrastructures and basic services.
- Risks are highest where species and people exist close to their upper thermal limits (i.e., in already-hot climates), along coastlines, or in close association with ice (which will melt) or seasonal rivers (which will dry up and/or flood).

- At approximately 2°C global warming, snowmelt water available for irrigation is projected to decline in some areas by up to 20%, and global glacier melt is projected to diminish water availability for agriculture, hydropower, and human settlements in the mid- to long-term, with these impacts projected to double with 4°C global warming.

Just about everyone acknowledges that these are conservative projections made by an inherently conservative, consensus-constrained organization ([source](#)). *Whathowwhy*

And not just any people. What the IPCC is saying pretty clearly is that the impacts of climate change are going to be felt first and most severely by the most vulnerable among us. This is where the deadly heat will strike human bodies first, where governments and economies are most fragile, where the famines will first appear, and where the droughts, floods, and ecosystem collapses will be most devastating.

Climate scientists don't like to use unscientific terms like "die off" or "mass death". When they talk about the impacts of climate change and energy descent on human population, they tend to talk in terms of "sustainable" populations. If the concept of carrying capacity is indeed applicable to the world's human population, then there must be a number of humans that this planet can sustain without continuing to incur overshoot and environmental destruction. And if ecological science is indeed applicable to the human species, all the pain and suffering we are about to endure in our 21st Century multi-wave collapse scenario may simply be the natural process by which our species is being brought into alignment with our planet's carrying capacity.

Nature does not indulge in mercy.

What is a sustainable world population? Here are some recent quotes to ponder.

From the [Planetary Boundaries](#) project:

"Physical needs (that is, nutrition, sanitation, access to energy and elimination of poverty below the US\$1.90 line) could likely be met for 7 billion people at a level of resource use that does not significantly transgress planetary boundaries. However, if thresholds for the more qualitative goals (that is, life satisfaction, healthy life expectancy, secondary education, democratic quality, social support and equality) are to be universally met then provisioning systems — which mediate the relationship between resource use and social outcomes — must become two to six times more efficient". ([source](#), p. 92)

From William Rees, Canadian population ecologist and founder of the [Global Footprint](#) project:

"The long-term human carrying capacity of Earth — after ecosystems have recovered from the current plague ["plague phase" is a term used by ecologists to describe the peak of a population boom-bust cycle] — is probably one to three billion people, depending on technology and material standards of living." ([source](#))

From Johan Rockström, former director of the [Potsdam Institute for Climate Impact Research](#):

... if global warming is not in any way mitigated, and we go into a six or eight degrees [Fahrenheit] warmer world, then our planet will probably only be able to support a billion people." ([source](#))

We can only hope that this population collapse, which seems inevitable if the first three waves of environmental, economic, and political collapse play out as anticipated, will be achieved as much by *gradually declining birth rates* as by *explosively increasing death rates*. This is not an idle hope, as we know that birth rates are already plummeting in many developed countries ([source](#)). In addition, we know how to lower birth rates in less developed countries through policy interventions such as better access to contraception, better educational opportunities for women, and better child healthcare systems ([source](#)).

A [recent study](#) in *The Lancet* projects that by 2050 over 75% of the world's countries will have shrinking populations and by 2100 that number will increase to 98%. Although these changes can be expected to have vast societal implications, both good (lower GHG emissions) and [bad](#) (aging populations and shrinking workforces), from the perspective of climate change and resource depletion, they can only lower the demands humans will continue to make on our planet's resources, both finite and replenishable.

Whether we shrink the human footprint on this planet gradually through declining fertility, precipitously through carrying-capacity collapse, or most likely, through a combination of the two, the world our descendants will inherit at the end of this century will be vastly different from the one we enjoy today — fewer people, less energy, smaller settlements, economic stagnation, huge abandoned wastelands, wild wild weather. I suspect our descendants will do what humans have always done. They will observe, they will learn, they will rebuild, and they will carry on as best they can.

As each of these waves roll over us, we will have many opportunities to make things better, or worse

This has been a crazy long piece, but I want to end it by returning to the idea of *radical acceptance*. Perhaps the most pernicious aspect of radical acceptance is the notion that we [don't have agency](#) to make positive change in the face of our current predicament. I strongly disagree. It was obviously through agency that we got here: billions and billions of decisions, large and small, over centuries, produced the world we live in today. If we succeed in extinguishing ourselves, it will be through our own agency. If we manage to eke out a smaller, less energetic, but more sustainable civilization after the collapse of this one, that will also be an act of agency.

To drive this point home, during each wave of the civilization collapse we are facing, we will have choices at our disposal to make the next wave more or less tolerable, if not avoidable altogether. We could choose to end environmentally-damaging practices, or not. We could choose to end over-consumption in the Global North, or not. We could choose to tackle inequality, or not. We could choose to act collectively and collaboratively, or not. These are all choices open to us.

We should not be deceived by the siren-song of radical acceptance. **Everything that happens to humanity from here on out will be a function of free choices we have made and will make.** We may be [ants on a log](#) unable to avoid the waterfall ahead but, if we are smart, we may be able to survive the fall and rebuild something lasting, if more humble, in its wake.