Towards a Resilience Concept

Humans are not the only ones critically disrupting the complex ecosystem of planet Earth. Not addressing the methane production by cattle herds: humans are responsible for it too. However, even during the Anthropocene, processes independent of humans are underway that can affect the Earth's ecosystem with intensity and magnitude unmatched by the externalities of human existence. Resilience to these processes and events renders an essential condition for a perspective of the Earth's ecosystem that we call sustainable.

In April 1815, during a volcanic eruption, the Tambora volcano in southeast Asia blew itself up. The volcanic gases in the high troposphere then disrupted the alternation of the seasons of global climates and the sun's rays ceased not only to reach the Earth's surface but also to pass through the atmosphere. What the eruption aerosols could not do in the stratosphere, the ash produced completed in less than half a year, spreading across all longitudes and latitudes. The average temperature plummeted at least by 1.5°C the decade 1810 to 1820 was the coldest period in at least 500 years, in which years of extreme rainfall were interspersed with years of extreme drought. The most destructive period of sustained extreme weather in human history had begun. In New England, 1816 earned the nickname 'the year without the sun' or 'eighteen-hundred-and-freeze-to-death'; in the German lands, 1817 became 'the year of the beggars'. To be alive during the three years after the eruption almost anywhere on the globe was to be hungry: crops froze before there was anything to harvest, or were washed away by downpours and floods. People ate rodents, nettles, or clay; in Europe, desperate crowds clogged the roads in a vain attempt to find something to eat. In Switzerland and Germany, cases of cannibalism and killing of one's children as a more humane alternative to starvation have been recorded. Sailing on sea and on lakes was extremely risky due to the sudden, destructive storms that alternated between periods of no wind.

Catastrophic events, of which the eruption of the Tambora volcano in 1812 is an example, can repeat today and in future. The 8.9 magnitude earthquake with its epicenter in the sea to the east of the Japanese island of Honshu is not two hundred years old 'pre-history': most of us watched almost live the counting of the victims of the tsunami that the earthquake triggered and the struggle to deal with the subsequent Chernobyl-sized nuclear accident at the Fukushima power plant in 2011. As a consequence, the total number of deaths in Japan reached 15,889, 2,601 people remain missing, and the economy suffered US$ 300 billion in damage. Tsunamis hit other coastlines, too, causing damage and killing people: on virtually all the Pacific coasts, even on the 17,000 kilometers distant Chilean coast. Immediately after the Fukushima accident, Germany decided to shut down all its nuclear power plants, not to mention build new ones, and it did not retract this decision even when emotions had subsided. Such a decision was undoubtedly taken as an act of support for the use of renewable energy sources - in Germany's case, wind in particular - but were other, preferably all, contexts considered responsibly and rationally?

After the eruption of Tambora and the subsequent three-year global 'solar eclipse', a catastrophic famine struck the entire planet. What would be the consequences of a geophysical event of similar magnitude today? In areas and populations dependent on agricultural production, probably the same as two hundred years ago. And where would economically advanced countries import food from? Would they remain economically advanced at all if consumers and governments lost interest in any products that do not very directly address the basic needs of life? What about energy supplies? Solar power would cease to exist, wind power would be available rarely - in the brief interludes between hurricanes and no wind. Anyone would take credit for good old fossil and nuclear fuels - as long as the transmission grids, sorely tested by extreme winds, worked, of course. Nor would shipping be

relied upon, and the resilience of oil and gas pipeline structures to the flooding and landslides that would undoubtedly result would undergo rigorous tests.

In addition to this, let us consider how much more spoiled, less hardy, less resilient - physically and mentally - each of us and our society are compared to our ancestors ten generations back. The saying that civilization is three hot meals away from chaos and disruption may be a sad truth. The current SARS-CoV-2 pandemic shows how risk-averse rulers and leaders almost everywhere in the world are: and what if the risk becomes a reality, the threat becomes a disaster? Are we even capable of acting rationally in such a situation?

Impacts of a natural disaster such as the eruption of the Tambora volcano in 1815 would probably be uneven today, specific to the nature of the economies of individual countries and regions and their food and energy resources. They would be least in most countries in the middle of the global economic development ladder: their advantage would be (still) fossil fuel-based energy; European energy supplies would be most affected by the failure of photovoltaic and wind resources: quite possibly fatally. The divider of the nuclear-free energy systems of Germany and Austria would be hydroelectricity: but national energy grids are robustly interconnected in Europe - could Austria or Switzerland maintain their partial advantage? A relative advantage would be given to countries that already carry out part of their agricultural production off-farm - in greenhouses with electric lighting, better still in vertical farms: in Europe, for example, the Netherlands. But would this segment of food production saturate at least a basic supply of essential calories to all the inhabitants of a country or a region? Fishing could remain relatively unaffected - temporarily - as long as fishing boats can sail, catch and return to ports between extreme storms, and as long as extreme storms do not put out of action equipment for which ports cannot provide sufficient protection.

All of these are just unprofessional deductions and inductions, indeed: but they are so grave that we cannot be content with a flatly dismissive response from experts. Even the author of this essay would like the experts to rule out the catastrophic scenarios outlined as impossible - based on robust facts and constructs, interconnected in a complex, holistic structure, confirmed by qualified opposition in which the individual claims and their structure as a whole stand up. But nothing of the sort is happening.

Until both the illustrated and the as yet unsuspected threats beyond human control are competently excluded, let us replace the magic word of our time - sustainability - with the concept of resilience. The reasoning is as apparent as it has so far been in many ways overlooked: without structural resilience, no system is truly sustainable.

At the turn of the second and third millennium of the Christian era, the man declares himself a humble part of the earthly ecosystem – again, for the first time after tens of millennia of development focusing on breaking free from its uncertainties and threats. But he forgets that he is no longer willing to endure some of the vicissitudes of life in this ecosystem, regardless of his declared humility and considerateness. Yes, man is able to deny himself meat, but he does not want to endure famines or epidemics, droughts, floods, or earthquakes - even though these are unquestionably inherent parts of the past and future history of the earth's ecosystem. Dystopias as the result of forces we cannot predict, let alone control, have their place in cinema, literature, and other arts, but not in our view of the future. For climate, pollution, and limited resources, we have found - have we really found? - the solution: reducing our consumption, abandoning our current economic, cultural, and social practices, and finding and implementing better, 'smarter' alternatives. We link all these self-limitations and 'smart solutions' with the adjective 'sustainable'. The goal is clear - really clear? Just achieve 'plus 1.5 ^{o}C' and we are 'out of the woods': are we? How satisfied will

we be with the sustainability of terrestrial life when the next self-defeating catastrophic volcanic eruption hides the Sun behind clouds of volcanic ash for a few years?

Regardless of what has and has not been agreed in Glasgow in recent weeks, humanity as a whole is not passive in relation to the goal of stabilizing the rise in the temperature of the Earth's troposphere at plus 1.5 ^{o}C compared to pre-industrial times. Should we not also urgently begin to do something to ensure that all our efforts and plans are not wasted if a catastrophic geophysical event blocks our path to this goal? Should we not begin to address our resilience in relation to such an - unknown - event? New challenges and new urgent actions will emerge once we realize, with all the implications, that resilience precedes sustainability, that structural resilience is an indispensable condition, the sustainable method of sustainability.

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