RESEARCH AND PUBLICATIONS DEPARTMENT

A SUMMARY OF THE GLOBAL CATASTROPHIC RISKS 2021 REPORT

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The Global Catastrophic Risks 2021, developed by the Global Challenge Foundation, gives an overview of the current main greatest threats to humanity, highlights their interconnectedness as they reinforce each other, and explores how they are being managed at the global level. The report focuses on seven current main global catastrophic risks: **weapons of mass destruction**, **catastrophic climate change**, **ecological collapse, pandemics, asteroid impact, super-volcanic eruption and Artificial Intelligence**. It also examines three next global risks: the **formation of a black hole, nanotechnology and quantum computing**. The warning signs have been increasingly strong and the report aims to guide better long-term strategy and support the design of more efficient governance models

1. **Weapons of mass destruction**

- **Nuclear warfare**

The explosion of a nuclear bomb in Hiroshima on 6 June 1945 killed a total of 150 000 people, with other destructive consequences. A nuclear warfare would have important effects: destruction of lives and cities, debilitation, illness and deaths from radiation, planet might be plunged into a mini ice-age with dramatic consequences (a nuclear winter at the point of impact for months or years). The largest nuclear arsenals are currently held by the US and Russia, plus seven other States known. Various scenarios of nuclear warfare are imaginable, but nuclear weapons could also be released by accident, triggering an inadvertent nuclear war with devastating effects. The tension between nuclear States has reduced since the end of Cold War, but is still present. Arsenal reduction, global conflict management, controlling and limiting proliferation, good control systems, increased awareness and understanding of its grave multidimensional effects could mitigate the risk of a nuclear warfare.

States currently manage the risks of nuclear weapons through a range of measures that have prevented the worldwide spread of these weapons of mass destruction. The 1970 Nuclear Non-Proliferation Treaty as well as the establishment of an International Atomic Energy Agency aimed to promote the non-proliferation of nuclear weapons beyond the original five, but other countries (India, Pakistan, North Korea and probably Israel) successfully developed theirs. Many other countries have not complied with their nuclear non-proliferation Treaty obligations, like Iraq and recently Iran, despite international sanctions. Nuclear weapons have not been used in any conflict since 1945, suggesting a key role of political and moral restraint, but the planned development of new nuclear weapons by the United States and Russia

however make it more likely to happen especially with their changing rhetoric as the two States say they are ready to use nuclear weapons even if they are not used against them first, contrary to the deterrence military strategy. We therefore witness a new arms race with a reluctance from countries to cooperate. Despite the ambition of the 2017 UN Treaty banning all nuclear weapons, that entered into force on 22 January 2021, the probability of a catastrophic nuclear war is still perceived.

- **Biologic and chemical warfare**

Toxic chemicals or infectious micro- organisms have been used as weapons to harm or kill for millennia. They cause not only death or sickness, but panic. Developed at a low cost, unlike nuclear weapons, they are very accessible with great risks as well. Highly lethal and infectious agents, created by technology, can be released accidentally or intentionally in large population centres. A global framework controlling research on chemical or biological weapons may reduce the risk. However, the availability of dangerous information especially on internet and the lack of public health preparedness in quickly tackling any potential outbreak of a pathogen are factors aggravating the risk. The 1993 Chemical Weapons Convention is under strain as for instance in the Syria civil war, there is a potential use of chemical weapons by terrorist organisations. The weakening consensus could lead to more advanced toxic chemical weapons of mass destruction.

Two international treaties are banning the use of biological and chemical weapons, namely the Biological Weapons Convention of 1975 (BWC) and the Chemical Weapons Convention of 1993 (CWC). What is also at stake is the either positive or negative use of those components. Most of the time, their peaceful purposes are destroyed or diverted. Four countries (Egypt, Israel, North Korea and South Sudan) are not party to the CWC. The highest risk concerns North Korea possessing chemical weapons that could be sold to unscrupulous non-State actors. The existence of large stocks of chemical weapons remains a risk, as they can be released intentionally or inadvertently due to lack of laboratory security.

2. Catastrophic climate change

It has been associated with an increase in global average temperature of 3°C with a wide range of devastating effects on climate, people, human activities, biodiversity and ecosystems. We have identified Tipping points on the Earth Climate System, crossing one of them may result in long term irreversible changes. Unfortunately, political discussion about climate

change rarely acknowledge catastrophic climate risk. What we know actually is that greenhouse gases (specifically carbon dioxide and methane emanating from human activities) are currently at their highest concentration levels since millenaries. Extreme weather, ice loss, sea level rise, ocean heat and acidification have accelerated. Under current policies, global temperatures are expected to exceed 2.9°C by 2100. Limiting the Earth's temperature rise to 1.5°C – the aspirational goal of the Paris Climate Agreement – is essential in preventing climate tipping points, but requires more efforts from countries. Countries' carbon budget would be depleted by around 2030. The release of greenhouse gases in the atmosphere is the main cause of climate change, so our capacity for global coordination to reduce emissions is determinant. The risk is increased by insufficient knowledge and understanding of impacts and vulnerability.

With the Covid19 pandemic, there is a serious risk in the long term that political and public attention to climate issues will dramatically decline in the face of the pressing severe economic and social consequences of the crisis; putting aside emission standards to boost their economy. Covid19 could also be an opportunity for a greener future, to rebuild economies and societies towards sustainable modes of production and consumption. Today, the link between climate change and our health is undeniable. Global warning makes conditions more favourable to the spread of some infectious diseases, air pollution makes people more vulnerable to infections, and interferences on the natural world creates more opportunities for pathogens to get into new hosts, and for new bacteria or viruses to be released.

The challenge of climate change is intricately linked to everything else. Solving it requires unprecedented collective action by countries with heterogenous interests, priorities and circumstances. The Paris Climate Agreement signed in 2015 and in force since November 2016 is the current action catalyst in tackling climate change. It is however very weak due to its content failing to bring a consensus on capital issues. The fact that the US re-joined the Paris Agreement brings more hope. The recent disasters linked to climate change are creating more awareness and we will see if people are more opened to abrupt. More research is needed to better reach the public and pressure political actors to act.

3. Ecological collapse

Ecosystems are the foundation of human life, they are resilient, but till a certain threshold. The disruption of ecosystems could drastically compromise the planet's capacity to support growing human population. Humans changing the nature of nature itself, many elements that ensure the habitability of the planet have been degrading at accelerating pace. Latest research indicates that we have now exceeded the safe limits for four of the nine identified planet boundaries, and we are likely to exceed all of them. Lake Chad is an example of ecological disaster. It was the sixth largest lake in the world in the 1960s, but its size has decreased by 90% as a result of human action and climate change. A recent study also assessed evidence of ecological collapse in 19 ecosystems in Australia and terrestrial Antarctica. New technologies less resource-intensive and/or less polluting, shift towards more sustainable lifestyles and effective global governance mechanisms could reduce the risks on ecosystems.

Actions have to be taken at both global and national levels. Many international institutions are dedicated to environment. The first one since 1977 is the United Nations Environment Program (UNEP). There are several global environmental conventions and about a dozen of legal instruments for promoting collective action towards managing ecological risk. However, there is no overarching judicial system or coercive penal system that could ensure effective enforcement of the agreements that deal with environmental issues. Everything relies on countries' good will. If many countries try to implement their obligations, many others are lagging behind. Implementation levels are assessed based on national reports. Reporting is however a challenge because of low capacity, poor data and inadequate reporting systems. We count on scorecard diplomacy to foster action and implementation of good policies, in a context where progress is very slow.

4. Pandemics

For centuries, humanity has been affected by many pandemics, such as plague, smallpox, rinderpest in animals, guinea worm and polio (close to be eradicated), influenza, yellow fever, malaria, typhus or cholera, HIV/AIDS, Ebola, which killed so many people. Vaccines allowed us to eradicate some, while progress in medical treatment and public health systems has significantly reduced the prevalence and impact of others. The emergence of new infectious diseases in humans remains a risk, with particular high mortality and rapid spread in our densely populated, urbanised and interconnected world, intensifying its spreading.

Catastrophic pandemics (diseases that spread globally with high levels of mortality) are extremely disruptive. Three main risks determine the potential danger of an outbreak: the

virulence (ability of a micro-organism to damage human tissues and cause illness), the infection risk (probability that a micro-organism will spread in a population) and the incubation period which determines the unwittingly spread of micro-organisms depending also on the infection rate. Some pandemics are generally arising from disruption of biodiversity and close contacts with some animal species, like experts explain for HIV and Covid19. Access to healthcare and broad adoption of hygiene practices can significantly reduce the impact of a pandemic. After a year and a half of varied national response and remarkable accomplishments in research and development the world is learning to live with COVID-19, as it becomes more and more evident that SARS CoV2 is becoming endemic. The world has learned much about pandemics from the example of COVID-19.

Antibiotics allowed us to contain most bacterial infections and diseases, thereby saving millions of lives. However, as a result of random mutations, improper use and the build-up effects of evolution, some strains of bacteria have become resistant to traditional antibiotics. Efforts should be made to curtail resistance to antibiotics or develop new antibiotics in order to save more lives.

The WHO established in 1948 is the global body in charge of governing the risk of pandemics. It does this mainly through a governance mechanism called the International Health Regulation since 1969 and revised in 2005. It is a binding agreement under international law, though with no enforcement mechanism, aiming at stopping public health event having the potential to spread internationally. Emphasis is placed on the requirement that countries rapidly detect and respond to outbreaks and other public health events with potential to spread internationally. In such cases, they are reported to WHO as a potential public health emergency of international importance (pphEic). The governance of pandemics involves collaboration between the WHO, ministries of health and public health institutions.

5. Asteroid impact

Near-Earth asteroids or objects (NEO) may have different impacts on Earth, depending on their size. While largest ones (1km) could result in the extinction of our species, smallest ones (20 to 50 m) generally disintegrate in Earth's atmosphere but can cause localized blast and impact effects. Surveys of NEO since the 1990s have discovered more than 26 000 as of June 2021, which is only a relatively small percentage of total NEO existing. Impactors of 50 to 140 m have an average frequency of one per 1000 years. The risk presented by a NEO is related to the probability of impact with Earth, its size and composition and the location of

impact. Observational assessment program, accurate orbital knowledge is required to establish the "impact corridor". With vigilance and sufficient warning, an asteroid impact is a devastating natural disaster that can be prevented.

International cooperation and coordination in the area of NEO is crucial, given the potential global consequences of an impact and significant resources that would be needed to mitigate such a collision event, space activities are coordinated by the Peaceful Uses of Outer Space (COPUOS) established in 1959 and supported by the Office of Outer Space Affairs (UNOOSA). Its work led to the establishment in 2014 of the International Asteroid Warning Network (IAWN) and the Space Mission Planning Advisory Group (SMPAG) which provide mechanisms at the global level to address the challenges posed by the NEOs. Important linkages are being made with civil protection communities in order to sensitise their governments and relevant national authorities about the existence of NEOs as potential natural disaster hazards. IAWN links institutions already performing many of its proposed missions, and recommends policies for gauging an emerging impact threat, and support governments in this line. As of June 2021, there are 32 official signatories of the IAWN Statement of intent. The SMPAG is composed of member States with space agencies or intergovernmental entities that coordinate and fund space activities. It has 19 members. As part of the effort to raise awareness about this topic, 30 June has been proclaimed International Asteroid Day.

6. Super volcanic eruption

These are events in which at least 400 km^3 of bulk material is expelled. Eruptions of such magnitude may happen at any time in the future, with catastrophic consequences: killing of human/animal population, devastation of local agriculture, severe environmental effects. Existing data suggest that a super-volcanic eruption will occur every 17 000 on average, with the last known event occurring 26 500 years ago in New Zealand. Though we are currently unable to anticipate volcanic eruptions beyond a few weeks or months, scientists are monitoring some areas. There is no current prospect of reducing the probability of a super-volcanic risk, but there may be ways to mitigate its impacts, building our resilience.

Monitoring volcanoes is largely a responsibility of national institutions that operate volcano observatories and work with potential authorities, civil protection agencies and communities to manage the risk. The World Organisation of Volcano Observatories lists 80 Volcano Observatories and plays a coordinating role among them. On an international scale, bilateral

and multilateral agreements support scientific investigation on volcanic risk management. The US support developing nations through training, donations and assistance in responding to volcanic emergencies. The International Association of Volcanology and Chemistry of Earth's Interior (IAVCEI) is the main scientific organization of volcanology with more than 1000 members, promoting sharing of scientific knowledge. Developing a global response plan under the auspices of a UN agency and IAVCEI would be a good start to improve governance of this global risk.

7. Artificial Intelligence

Will Artificial Intelligence help us reach greater heights or will it trigger the greatest catastrophe of all: human extinction? AI systems already outperform humans in the tasks they were trained for. However, though a human requires more time to do any of task given to an AI system, humans have a general intelligence. If AI systems develop general intelligence, they will quickly surpass us and we do not know what will happen. The worry of expert thus is on the intentional misuse of AI to cause harm. The spread of fake news on social media through recommendation algorithms and the emergence of Deep fake are examples of threats from AI, especially when misused. AI are algorithms running in the background of programs we are using, able to perform some narrow tasks. But is widely accepted that we will be able to create AI systems capable of performing most tasks as well as a human at some point, this by 2050. With a good chance of super-intelligent AI 30 years after human level AI. Artificial Intelligence promises to do so much good, especially in the medical sphere: it can help beating pandemics, identify illnesses, help in the development of drug, ensuring social distancing with robots used to minimise exposure to disease. AI risk is still emerging today, but could rapidly accelerate, and be exacerbated by geopolitical tensions.

There are many AI policy initiatives from 60 countries, focusing on research and development, and many efforts mention safe and beneficial AI, creating principles and guidelines to develop AI for good. In late 2019, researchers published a Global Landscape of AI Ethics, in which they identified 84 documents containing ethical principles or guidelines for AI, 88% of which were released after 2016. It found eleven overarching ethical values: transparency, justice and fairness, non-maleficence, responsibility, privacy, beneficence, freedom and autonomy, trust, dignity, sustainability and solidarity. Some non-governmental groups like AI Now are tracking problems cropping up with AI: bias, racism, discrimination etc. while other groups emphasize and support AI developed for good, like the UN AI for

Good Global Summit. Legislation is still in early stages, but governments might become increasingly interested in AI development and use.

Another application of AI is autonomous weapons systems that could select and attack a target without someone overseeing the decision-making process. Though fully autonomous weapons do not exist yet, the idea of such weaponry has triggered intense ethical and legal debates around the world as people try to determine the extent to which an algorithm can decide who lives, and who dies.

8. THE NEXT GLOBAL RISKS: black hole, nanotechnology and quantum computing

The amount of energy released during the formation of **black holes** is prodigious, in no more than a few minutes, an amount of energy equivalent to that released by the Sun through-out its 10-billion-year lifetime is expelled in concentrated beams of high energy radiation called gamma-rays. If the Earth is hit by such a powerful beam of radiation, the ozone layer would be destroyed with devastating effects on lifeforms due to UV radiation. All bursts observed thus far have occurred well outside of our galaxy. Consequently, the gamma-ray beam is weak and has little effect, if any, on the Earth's atmosphere. However, though weak, the risk is not totally excluded.

We are hopeful that the **nanotechnology** would lead to great material wealth for the whole of society, but we must also consider the dangers that the technology could imply. The main advantage could be with highly effective medical interventions, for example through the use of nano- or micro-scale autonomous drones delivering targeted interventions within the body. However, such a powerful technology could, however, also enable new sources of global catastrophic risks, with individual's privacy control, highly destructive nano weapons. These implications are very speculative; and it appears likely that they are at least decades away, if they ever materialise. However, it seems prudent to be prepared for unexpectedly rapid progress in nanotechnology.

Quantum computing might also be a great risk, leading to important inequality in access to technology.

9. RECOMMENDATIONS OF THE GLOBAL CHALLENGE FOUNDATION

Given the extremely dangerous nature of global risks and the complex intersections between them as they reinforce each other, given their consequences likely to affect the planet as a

whole in a context of interdependence, the first step is a global consciousness of these risks. governments and people should be aware of the seriousness of such risks and be ready to take actions.

The GCF secondly recommends an enhanced global governance to tackle catastrophic risks. It is critical that our global governance mechanisms and organisations incorporate the increasingly intersectional nature of global catastrophic risks. International cooperation and coordination are crucial to detect, prevent and/or mitigate the effects of catastrophic risks. At this point, the role of the United Nations should be central, and some reforms carried on where necessary with for instance a new commission on Climate Change to solve this issue and ensure a global coordination to reduce greenhouse gas emissions. The UN should be given binding legislative, judicial and enforcement functions to effectively address catastrophic risks, while still reserving most functions to States. Countries and companies should also work towards the development and adoption of new technologies or production models less resource-intensive and/or less polluting to save ecosystems. They should raise their ambition to significantly take action to reduce greenhouse gas emissions to below the 1.5°C target, and move towards a low carbon economy. More integrated approaches between the global governance of ecosystems and trade are required.

Thirdly, scientific research and collaboration between scientists throughout the world are important in best knowing the various risks and determining the best way to tackle or prevent them. Public health entities should be empowered. International scientific organisations should collaborate with UN agencies. We should control the research on potentially dangerous materials, and make sure the usage of such materials as well as Artificial Intelligence is not diverted.

Finally, individuals should be better prepared and involved in preventing or tackling global catastrophic risks. Mitigating the risk of climate change or ecological collapse requires that current generations resist short-term individual benefits with the aim of improving the far future of human civilisation. They should be sensitised on using what new technologies offer for good purposes.

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