# Sustained Resilience: the impact of nuclear war on New Zealand and how to mitigate catastrophe

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Efforts to prevent nuclear war should be greatly intensified – but we must also consider what happens if prevention fails. NZ is often cited as somewhere most likely to preserve a thriving society through a nuclear aftermath.

However, our society is a complex adaptive system heavily dependent on trade. Major perturbations triggered by nuclear war could shift the state of NZ society from one of flourishing to one of mere survival. We detail these risks of societal failure and conclude with a set of first steps NZ could take to strengthen its societal systems.

*“I had a dream, which was not all a dream. / The bright sun was extinguish’d, and the stars / Did wander darkling in the eternal space”* (Byron ‘Darkness’)

Byron penned what could be a striking vision of nuclear winter 129 years before the atomic age. Holed up in a Swiss mansion during the ‘year without a summer’ following the eruption of Mt Tambora, he composed ‘Darkness’ (1816) on a day in which ‘the fowls went to roost at noon’.

‘Darkness’ imagines the severe cascading calamities that might ensue if the sun were

obscured, as following nuclear war. We detailed these potential climate impacts and the consequences for NZ food production in a recent blog post, Putin and the Bomb.

However, in his poem Byron envisions the cascading impacts sun-blocking might have on energy supply, communications, resources, ecology, social cohesion, and conflict. In 1987 the NZ Nuclear Impacts Study examined the potential for similar cascading impacts (Green, Cairns, & Wright, 1987). This study involved 300 industry experts, government officials, a public survey, and role plays with citizens. In 35 years, nothing remotely as sophisticated has been done to update the findings for the NZ context.

Contrary to common misconception, radiation is not a major risk to NZ in a Northern Hemisphere nuclear war. It is commonly assumed that far flung Southern Hemisphere islands like NZ may fare comparatively well. For example, existential risk scholar Toby Ord writes in *The Precipice*, "if we consider somewhere like NZ… It is hard to see why they wouldn't make it through with most of their technology (and institutions) intact" (Ord, 2020).

In what follows we question Ord's assumption, reiterate the salience of nuclear war as a global catastrophic risk, its far-reaching impacts on society and industry and what NZ might do to mitigate the threat, including reprising the work of the 1980s with up-to-date understandings.

## Food supply

*"the wildest brutes / Came tame and tremulous; and vipers crawl'd / And twin'd themselves among the multitude, / Hissing, but stingless—they were slain for food"*

A typical human needs around 2,100 kcal of food energy per day to avoid losing weight. NZ produces something in the order of 9,500 kcal/capita/day (Schramski, Woodson, Steck, Munn, & Brown, 2019), and exports the majority of this food. Although modelling of severe nuclear winter reported in a preprint indicates NZ food production could fall 58% (Xia et al., 2021), New Zealanders should, in principle, be able to be fed. However, orderly production and distribution of this supply assumes that people understand there will be enough, that there is sufficient energy to maintain production and distribution, that crop substitutions are appropriate, that essential machinery does not irrevocably break down, that unforeseen cascading socio-ecological impacts do not wreak havoc and that the country is not likely to be overcome by refugees.

## Trade

Covid-19 and the war in Ukraine has taught us that complex interdependent human systems are often fragile – and trade can be vulnerable. Even, when just one ship blocked the Suez Canal, there were global trade disruptions. In a severe nuclear (or volcanic, or asteroid) winter key infrastructure in the Northern Hemisphere may lie in ruin, including ports, airports, fuel stores, fibre optic cables, satellites, factories, and data centres. Food production could collapse in breadbaskets such as the US and Ukraine. This would massively strain a world where two-thirds of countries are currently not food self-sufficient (Schramski et al., 2019). There may be hoarding, reluctance or inability to trade, severe food and fuel shortages, and ongoing conflict.

Research on volcanic eruptions at global 'pinch points' indicates that an unfortunately located eruption could disable world trade (Mani, Tzachor, & Cole, 2021). We must assume

the same following dozens, scores, or even hundreds of nuclear detonations. Remote NZ may be on its own. At the very least Northern Hemisphere markets could be inaccessible and trade networks with Australia, Indonesia, the Philippines, Chile or Peru would need to be strengthened or forged.

## Communications and governance

*“And they did live by watchfires—and the thrones, / The palaces of crowned kings—the huts, / The habitations of all things which dwell, / Were burnt for beacons; cities were consum’d”*

People will panic. This is natural. But actions hinge on information held. The nuclear impact study in NZ found that people were often mistaken, they thought radiation was the most important threat (46%) followed by cold weather (11%) (Green et al., 1987). This is probably not the case in NZ. Authorities must anticipate and provide clear, relevant information about nuclear winter, with two-way dialogue. We need a shared mental model that there should be enough food, but medicines and fuel might need to be rationed. At the beginning of the Covid-19 pandemic, communication in NZ was very successful, but eventually mis/dis-information crept in, the shared mental model was lost and tension arose.

However, in a nuclear aftermath standard communication by NZ authorities might not be possible. There could be widespread international internet and cloud outages, an electromagnetic pulse (EMP) targeted at Australia could potentially disable electronic equipment in NZ (Green et al., 1987), and over time NZ’s telecommunications infrastructure will likely degrade as parts break down and replacements are not available.

## Energy and transport

*“Forests were set on fire—but hour by hour / They fell and faded—and the crackling trunks / Extinguish’d with a crash—and all was black”*

When considering total generic units of energy, NZ superficially appears self-sufficient (IEA 2021). However, NZ exports low-grade coal but imports refined oil; produces hydroelectric power, but this is partly configured to supply to an aluminium smelter; there is geothermal energy but a small electric vehicle fleet; and a single point of failure (one cable) spans the interisland strait. The system may not be resilient to major shocks. Without trade there would be extreme fuel shortages, compounded as the only oil ‘refinery’ has just shut its refining business. Overseas reserves would be useless without the ability to retrieve them. Even if refining were restored, a single key fault could cripple it again without imported parts and international expertise. The effects of an EMP could make the energy situation worse. Critically, energy is needed for food processing and distribution. Milk needs to be transported every day, without electric trucks this requires refined fuel. The energy system will degrade over time and beyond a certain threshold there could be catastrophic cascading effects throughout every other system.

## Conflict and Refugees

*“And War, which for a moment was no more, / Did glut himself again… / …The crowd was famish’d by degrees; but two / Of an enormous city did survive, / And they were enemies”*

Internal conflict may arise if there are concerns about ongoing supply of food or energy, or

if inequality is perceived. People seeking escape from war and famine may try to arrive by force, or bring novel infectious diseases (eg, if bioweapons are released in a Northern Hemisphere conflict). Although NZ is sheltered by a huge natural moat, the country must plan for the possibilities of such challenges. We need to calculate how many can be fed. En masse arrivals may be unlikely in a world without commercial transportation, but NZ's vulnerability might require alliances with other survivors such as Australia, Indonesia, or Chile.

## Ecology and flourishing

*"The rivers, lakes and ocean all stood still, / And nothing stirr'd within their silent depths"*

Ecological systems are complex adaptive systems with many interacting parts. Models of the impact of nuclear winter cannot account for all variables, and we know that ecological systems sometimes exhibit sudden and unpredictable shifts in state. Algal blooms or tropical storms exemplify these processes. It is possible that severe climate impacts of nuclear winter might disrupt global ecology for decades or forever. Human societies are part of this complex adaptive system (Walker & Salt, 2006). We must understand that as human systems degrade accumulating stresses across a range of tightly coupled and interdependent sectors can manifest as cascading failures (Homer-Dixon et al., 2015). As one of the havens most likely to survive comparatively intact after a nuclear war, NZ must avoid tipping into pre-digital, pre-industrial, or pre-agricultural states. Persisting institutions and technological systems will be needed to help 'reboot' a flourishing humanity across the years and decades after a catastrophic nuclear winter.

## A possible solution for NZ?

NZ may have some inbuilt cultural resilience especially in Māori and Pasifika communities. Communitarian efforts via marae and other social networks have successfully distributed food and information in the past, such as during the Covid-19 pandemic and Kaikoura earthquake. NZ's 'social cohesion' score is very high. But we can't take this for granted in an information environment where risks are classified, and misinformation is rife.

Unfortunately, nuclear war matters because it is not improbable. Nuclear safety depends on a system of rational actors, perfect information, and fail proof systems that operate without error in perpetuity. The risk of nuclear war lies in human error, component failures, violent catalysis, irrational leaders, accident, miscalculation, and cyber vulnerabilities (see Nuclear Threat Initiative president Joan Rohlfing's interview from 24 Feb here).

Nuclear winter especially matters because there is still a small possibility that it could lead to human extinction, not directly, but via cascading effects on food, energy, transport, trade, disease, and conflict. Study of these cascading interdependencies is very neglected.

NZ has a chance to both survive and sustain a thriving hub of complexity through nuclear winter. With promising baseline conditions, there is an argument NZ has an obligation to humanity to maximise its chances. This could be achieved by undertaking the following:

- Repeat the 1987 Nuclear Impacts Study in today's context and prioritise intervention according to experts, science and modelling (see Green et al. 1987 for initial policy suggestions).
- Make a detailed local study of food production and distribution under nuclear winter and zero trade/scarce fuel conditions, as well as manage marine stocks to ensure

surplus in times of need.
- Research and prepare communication materials and plans, with redundancies, collaborate with the public and generate a shared mental model.
- Incentivise distributed renewable energy sources, electric vehicle uptake, cycle infrastructure, home insulation, and reduce oil dependence, while maintaining refining capability until zero-oil reached.
- Conduct simulations/walk-throughs of critical functions such as restoring systems after an EMP, or storing, rationing, and distributing food, fuel, medicines.
- Reduce reliance on Northern Hemisphere export markets by diversifying regionally – particularly with Australia, the Pacific and Southeast Asia.
- Study the potential irreplaceable failure points of NZ industry and crowdsource solutions and workarounds, eg, 3D printing.
- Model the co-benefits of resilience measures against nuclear winter on climate targets, inequality, health, the economy.
- Include nuclear war, nuclear winter, and NZ trade isolation in national risk assessments and make public NZ's national risk register (the contents of which are currently classified).
- Establish a Parliamentary Commissioner for Extreme Risks to provide resource, responsibility and political neutrality for assessing and governing nuclear risks and other extreme risks. We have previously made this case (Boyd & Wilson, 2021).
- Research actions NZ might take to increase the chance of rebooting a collapsed global civilization, such as developing local digital manufacturing, renewable energy, and other independent high-tech sectors.

## Conclusions

If nuclear war led the world to a collapsed, even pre-industrial state, all the gains in healthcare, life-expectancy, social institutions, and other domains of human endeavour attained in the last 200 years would be at risk. There is no guarantee they would be quickly recovered, and could even be lost forever.

At present nuclear war and winter impacts are much neglected (the word 'nuclear' did not appear in the 'Summary of Public Consultation' for NZ's National Security Long-term Insights Briefing 2022). Also, when these type of impacts are examined internationally, there seems to be too much focus on just the climate and food impacts, as opposed to issues such as systems interdependencies, governance and communication. There are knowledge gaps about the dynamic cascading effects of nuclear war. It is inconceivable that any present government could successfully manage this kind of situation. We must build better systems that reduce inherent risks of nuclear war eg, better diplomacy and technical safeguards. Better yet, we should greatly intensify efforts to eliminate nuclear weapons. Until that day, we should nurture the changing mindset around climate change and expand this to all catastrophic risks, so we can anticipate them and be better ancestors.

Risk communication is critical. Citizens need to understand risks and have some concept that solutions are possible. This will encourage cooperation and coordination rather than conflict and degradation of social cohesion. No solution to a major risk will succeed without some degree of social cohesion. This is why the problem of mis/dis-information must be solved in parallel with work on catastrophic risks. No risks, nuclear or otherwise, exist in isolation and many of the measures we suggest above have wide-ranging co-benefits.

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