

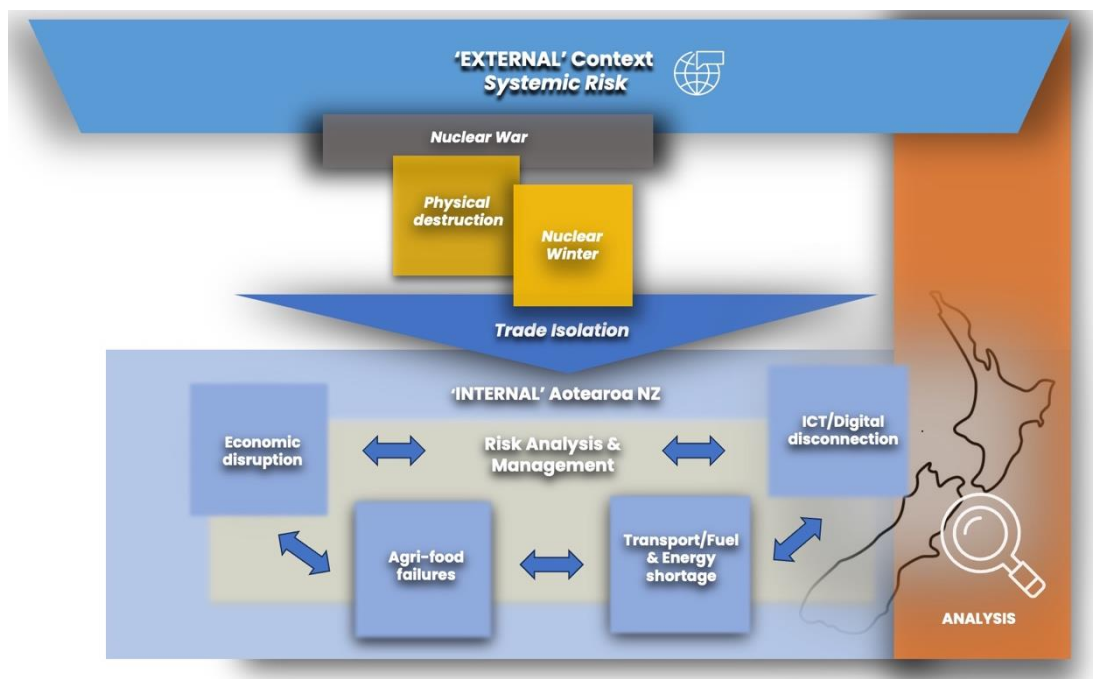
Short Preliminary Report on NZCat Interviews: Vulnerability and Resilience to Northern Hemisphere nuclear war

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Abstract

This short report was prepared in August 2023 based on transcript data from the NZCat Interview Study. A full report was subsequently prepared independently (by another NZCat team member, and convergence of findings provides evidence that interview transcripts were reliably interpreted). The interview study aimed to determine the important impacts and potential mitigation measures for New Zealand if faced with the effects of a Northern Hemisphere nuclear war (or similar global catastrophe). Initial respondents were identified from an earlier survey, and snowballing expanded the interview pool. A total of 18 participants were interviewed across four core sectors, plus resilience and planning experts. Results revealed the precarious position of energy and food supply, transportation, and ICT/digital services in New Zealand. A range of solutions were proposed, including a systematic approach to risk by government and a suite of relevant national strategies and response plans. These could be developed in non-partisan fashion, with a long-term perspective. Key themes underpinning resilience included cooperation, anticipation, community, expertise, information sharing, and the identification and protection of critical infrastructure.

Summary Figure: the complex interdependencies of human and ecological systems impacted by nuclear war would likely cause severe cascading consequences



Introduction

Global catastrophic risks have the potential to cause civilisation collapse, and some may threaten human extinction (Bostrom & Cirkovic, 2008). These risks include nuclear war, extreme pandemics, technological catastrophes, massive volcanic eruptions, asteroid/comet impacts, or solar flares, among others. Such risks threaten immense disruption to global trade (Boyd & Wilson, 2022; Green, 1989). Collectively these risks are not improbable, as suggested by a 2023 forecasting study, with superforecasters, non-domain experts, and the public all ranking nuclear catastrophe as the most likely catastrophic risk (4–10% chance of killing >10% of the global population by 2100) (Karger et al., 2023).

A nuclear war would likely lead to major global trade disruption and could lead to shortages of critical commodities, as well as the need for nations to leverage their own potential for self-sufficiency to cope. Without prior planning or preparation this could be very difficult.

Our NZCat research project aims to identify the important impacts that a Northern Hemisphere nuclear war might have on a remote non-combatant island nation (New Zealand). The interview study described in this paper aimed to elucidate from subject-matter experts the likely important impacts of this scenario on New Zealand and the key ways in which the impact could be mitigated through either preparation or response.

Methods

Ethical approval: This study was conducted with approval from the University of Otago ethics committee [Reference: HD23/006].

We developed a hazard profile for New Zealand based on the scenario of a Northern Hemisphere nuclear war. This was validated at an international and multidisciplinary workshop in February 2023. The workshop revealed that response to the scenario was critically dependent on sufficiently functional sectors for transport, energy, food, and digital/ICT.

Based on the workshop and scenario we deployed a qualitative survey with the aim of compiling a set of impacts and potential pre- and post-catastrophe mitigation measures. We collected 42 responses across these key sectors. One of the survey questions prompted respondents to suggest key knowledge holders that would likely have deeper insight into this risk and the scope and practicalities of successfully managing the risk.

We then conducted an interview study with the aim of devising a policy agenda for managing this risk. Initial contact was made with potential interviewees recommended by survey respondents, with additional interviewees added in snowball fashion with the aim of roughly equal coverage of the four key sectors previously identified, as well as experts in risk assessment, disaster management, and economics. The interviews were semi-structured, conducted by one researcher (BP) with questions developed that were based on information about impact and mitigation approaches that we obtained from the qualitative survey. The aim was to drill deeper into some of these suggestions to understand their logic, possible

feasibility, and potential priority. Interviewees were also given the opportunity to add anything they felt was important content pertaining to resilience of New Zealand to this risk.

To encourage frankness about risk and resilience, particularly for commercially sensitive enterprises, interviewees were assured anonymity, identified only by the general industry and job title, unless they approved their naming in conjunction with particular quotes.

An automated transcription service (Speak.ai) was used to transcribe the interviews verbatim. Two researchers (BP, MB) then read the raw transcripts to familiarise with the data. Lists of scenario impacts and possible mitigation measures were extracted from the transcripts. ChatGPT was used to summarise the raw transcripts into abbreviated easily readable versions. The two researchers each independently extracted themes from the data to supplement the compiled lists of impacts and mitigation options.

Results

A total of 18 individuals were interviewed as listed in Table 1. The results sections below reported the findings of interviews, without being moderated by the researchers. Results are organised by sector. The Discussion section that follows then picks up on key themes running across the results from individual sectors. Some interview participants provided information relevant across multiple sectors, and the summaries of results reflect this.

Table 1: List of interview subjects

Sector/Organisation	Individual's role
Food/Agriculture	
Food and grocery	Senior management role
Farm holding company	Arable Farmer/Managing Director
Government primary industries	Senior scientific role
Agricultural technology	Former Chairman
Public Service	Former senior leader
Energy	
Petroleum Supplier	Asset Advisor
Government	Former senior scientific role
Transport	
Transport Planning Consultancy	Consultant Engineer
Transport Company	Chief Information Officer
ICT/Digital	
Futures & Technology	Consultant
Cloud Provider	Chief Executive
Network Technologies	Business Development Manager
Economy	
Economics	Senior academic
Economic Consultancy	Founding Director
Risk & Disaster Management	

Local Government	Emergency Management Specialist
Foresight and Futures	Consultant
Urban Planning	Academic
Risk Management	Academic

Risk & Disaster Management

Interviewees with experience in risk management, foresight, and planning, identified potential weaknesses of the proposed New Zealand Emergency Management Bill with its focus on individuals rather than organisation functions, as well as insufficient transparency around risk assessment and policy.

There is a paradox of preparedness, with some risks identified but not addressed. Leaders have scarce attention and an immediate focus, which is a barrier to resilience. There is a lack of government foresight work. A proactive framework is lacking and there is no National Risk Strategy. It is not always clear who should lead national responses, and a central response may not always work in extreme catastrophes.

Local regions need more self-sufficiency with fuel and food (eg more centralised transport hubs, proactive strategic planning – not solutions that just ‘sound good’), and the ability of communities to function even in significant disruption (including to communications), this requires investing in critical infrastructure and careful decisions around levels of ‘essential’ service.

There should be more (continuous) national focus on sustainability and resilience and legislation should provide for ‘foreseeable emergencies’, which includes planning for large risks beyond just scaling up smaller response plans.

However, there also needs to be management of expectations, and nurturing trust, social networks, and vertical connections, given the risk of civil unrest or political polarization.

Sufficient resources need to be allocated for legislative review and a national risk assessment and election reform ahead of time could allow for solutions to be possible (overcoming political stasis). There could be more use of the National Security System and private sector.

Critical infrastructure arrangements need to include cloud/digital/telecoms technology, with NZ able to operate a ‘local area network’, as well as coastal shipping, mountain passes, etc.

A Disaster Recovery Authority could oversee post-catastrophe work in conjunction with pre-disaster plans and a long-term recovery strategy. Importantly, the government may lack the funds for full rebuild, and some prioritisation processes are needed.

Collaboration with Australia is important including addressing the complexities of post-catastrophe trade and issues like immigration.

Food & Agriculture

Interview participants thought that even post-catastrophe NZ has the potential to produce lots of food, but a balanced diet and distribution of food are vulnerable. Critical decisions would be needed about production and distribution (substitutions to diversify and replace imported products, reallocation of resources, pivot to easily stored produce – eg butter not milk), and integrity of other systems like digital/mobile communications is critical. Production of many products will have to fall, storage may be an issue. Animal welfare would be a key issue especially if there were no exports and a need to pivot production to domestic market, also half of NZ's grain feed is imported.

Post-crisis the government would likely need to intervene but needs serious expertise and good information. Pre-crisis planning was thought to be needed to identify needs and optimal locations for resources. Respondents proposed a National Resilience Framework that includes GCRs, also a set of 'zero-trade' thinking exercises and analysis of supply chains, as well as a National Food Security Strategy. This strategy would need to calculate NZ's internal food needs, and include both zero-trade, and 'no diesel' scenarios (rapidly scaling biofuel would be difficult – see 'Energy' below), as well as account for yield losses if NPK fertiliser and agrichemicals are not available.

Modern agriculture is highly interconnected and heavily dependent on central pumped water and modern techniques. Key vulnerabilities include digital infrastructure (though less for production), fuel supply and fertiliser supply, as well as parts necessary for maintenance of equipment. Multiple participants cited ~20–40% yield reductions without fertiliser inputs. The preponderance of urban living is also a vulnerability for food supply. There is a lot of automation, but potential to revert. A 'reverse roadmap' could show a way to go 'backward' from advanced agriculture to sustainable mixed farming methods in a catastrophe, in conjunction with an investment plan to build up supplies of manual tools and a coherent plan to pivot production methods.

Localising food distribution would help. NZ could learn from other countries that maintain stockpiles, commodities like selenium, copper, and cobalt are important). Efforts to decrease dependence on imported fertiliser and agrichemicals should be undertaken, as well as analysis of seed storage and animal vaccine supply. Genetic modification for frost resistance could be explored if regulations were changed, as well as collaboration with international experts in crop science.

Labour supply might be an issue. Organisations such as the Food and Grocery Council could coordinate across members. However, a plan is needed, and some regulations might need to be altered or cast aside (eg food labelling, anti-competition legislation).

Utility companies would need to cooperate with the food system. There is some dependency on coal supply. Water supply needs to be guaranteed for horticulture and there is scope for investment in water storage. Anticipatory scenario work is useful, but it's hard to force private companies to engage [though perhaps this is a point the DPMC's critical infrastructure resilience regulation proposals could address]. There should be shared

government-industry responsibility and information sharing, with interdepartmental coordination.

Strategies for continuing trade with Australia are needed and this could include grain for fuel arrangements. NZ can also accelerate deployment of EVs, hydrogen fuel, etc (see below). A standard broadcast communications system might be needed.

Energy

Many interviewees (from the energy sector and other sectors) highlighted NZ's complete dependence on imported oil/gas/petroleum products, relying on refineries in the Northern Hemisphere such as in South Korea. These are in turn dependent on producers such as Saudi Arabia and in a conflict or crisis agreements could be reneged. New Zealand doesn't hold much stored fuel, and storage is expensive. Additionally, there is dependence of fuel supply on data servers that are based in Sydney and LA, and there is a lack of contingency planning for major technological outages.

Biofuel is a possible solution but faces significant barriers such as feedstock availability, competition with food, cost-competitiveness, high-quality requirements, supply issues and past failures (eg Z-energy in Auckland) and government intervention would be needed for this solution to work. However, government intervention in energy and fuel can have unpredictable shifts in market behaviour.

New Zealand lacks the electricity required for a full conversion to EVs at this point (although lobbyists were said to be influential in opposing), although geothermal energy is a possibility. The competitiveness of hydrogen is doubted.

NZ lacks preparation for a large-scale long-term energy/fuel crisis. There is a lack of government skill in these areas and a lack of long-term policies that can survive change in government. There is a lack of political will (especially to face unpredictable risks given the predictable impact of climate change). Yet, a major event would require government intervention and the government may have to force oil companies to cooperate.

There needs to be an oil priority plan (National Fuel Plan) that directly addresses trade-offs such as food vs health. For example, food might be available but hard to access/distribute. There is a need to calculate of how much fuel is needed (and there has been limited planning so far).

Other solutions proposed included more investment in renewable energy and storage, foster resilient and independent locally-based industries, guide strategic direction in the energy sector, advance biofuel production and invest in overcoming the challenges, enhance resilience of the electricity supply system (geothermal/hydro), undertake long-term supply chain planning, establish physical repositories of knowledge to hedge against digital/electrical outage, a trade alliance with Australia for security in catastrophe, planning for food system sustainability if supply chain broken, incorporate resilience as a major factor in economic planning, engage key decisionmakers in GCR strategy discussions (eg Board of Food and Grocery Council), and decouple long-term planning from short-term cycles.

Transport

NZ's supply chain is heavily dependent on road trucking and IT. There is a lack of local shipping capacity (which could be enhanced with more coastal ships). NZ may need to develop more local manufacturing to provide resilience, including electronics/computer manufacturing and/or explore local mineral sources for battery technology. This could include latent capacity for local production in times of need. One approach could be to use NZ KiwiSaver funds to boost local industry. NZ should look to retain its manufacturing and transport talent.

Shifting to more localised supply chains (eg seasonal vegetables, and reduced expectations for 'always available') would help resilience. A transport strategy should stop trying to 'do more with less' and focus instead on minimum resilience requirements. Senior leadership team conversations need to include resilience with a shift to anticipation/planning for a wider class of risks, and personnel that solely focus on resilience.

Given the challenges to ensuring a reliable supply of liquid fuel described above, interviewees felt that transport in NZ needs to become less dependent on oil and more diversified and joined-up with local transportation hubs, electrification, design for ease of access, and 'people-oriented cities' (footpaths, rail, cargo bikes, E-trucks), with less focus on peak-hour throughputs and more focus on resilient mobility with a focus on accessibility and participation. Hydrogen (or hybrid hydrogen-diesel trucks) could be pursued to increase self-reliant transport and to address 'post-oil' needs, with excess electricity used to make hydrogen 'off-peak'. NZ should look to act as a 'self-sufficient hub' with a degree of power generation and data independence (eg a 'Tier 4' data centre in NZ).

Developing this infrastructure might require subsidising electric public and shared transport, including electrifying inter-regional rail and the use of mobility hubs. Community hubs could limit transport needs if they included service centres, libraries, medical facilities and so on. There are important interconnections between transport, mobility, community, democracy, transparency, and trust.

ICT/Digital

A major concern for interviewees was how to ensure communications with the public in a catastrophe, and how to ensure critical systems like payment processing continues. Additionally, maintenance is susceptible, failure of components could take up to a year to replace, even if there is trade. Cyberattacks are a threat. Quick collaboration across all sectors would be needed in a catastrophe.

If cloud computing is down the food, transport, payments, and other industries are impacted. NZ is dependent on major global supplies of ICT/digital including cloud services (eg heavy government preference for AWS/Microsoft, yet external factors could impact these providers). Limited fibre connections to the world (five) are a risk. Starlink is not a solution as not locally controlled. There is lack of redundancy and lack of local expertise.

Two interviewees felt that NZ needs a coordinated National Digital Communications Continuity Plan. Cloud computing should have legal recognition as critical national infrastructure and NZ should invest in its own, including increasing capacity, data location awareness, and security, and using standards like 'infrastructure level 4', NIST, and the RBNZ BSII, as well as conducting 'business resilience mapping' on a national scale. NZ could locate one critical data centre in the North Island and one in the South. These issues could be delegated to MBIE or the Minister for Digital Communications, or a new entity tasked with digital sovereignty not corporate colonisation. Whoever is tasked with this needs to understand and have expert knowledge of GCRs.

It is not enough to provide infrastructure, it needs to be regularly audited (with standard process), tested, eg disconnected from global internet and providers, systematic and continuous evaluation and expert consultation. Critical service dependencies should be understood through scenarios, red-teaming, simulations. Provide fall-back layers such as satellite internet and hold providers accountable for infrastructure resilience (potentially through newly proposed regulatory levers).

Local communications and self-reliance would be useful assets, especially for coordinating distribution. Resilient layers of public Wi-Fi or auto-switching routers could ensure communications. Local fibre and microwave digital solutions with local and independent units of organisation would help. NZ also needs to maintain stocks of spare parts, such as fibre, as well as expertise. There is also need for a low-tech government communications system.

NZ could achieve a degree of technological resilience through a government-led open-source tech stack which it shares with other like-minded countries. Facilitating this could be a National Technology Investment Agency, changing procurement rules, and introducing a National Chief Technology Advisor and Digital Infrastructure Resilience Strategy. Consider continuity of citizen records and a 'local GPT-4'.

Economy & Society

Those with economic expertise felt that the country is unprepared for this kind of catastrophe (and national risk information is not public), NZ faces 'chain reactions', but that society would likely adapt (eg WWII), but there needs to be a serious focus on resilience of payment systems, food, and fuel. The 'initial shock' will be a big problem and lessons might be drawn from Covid-19, the Christchurch earthquakes, and Cyclone Gabrielle. In Covid-19 a centralised response worked well and DPMC needs to plan for a major global catastrophe – there needs to be more awareness across government and in the community.

However, some interviewees criticised an overly centralised response and noted there is need to engage with businesses/public. Multilocation preparedness is needed in case of centralisation failure and regular serious gaming by local leadership in anticipation could help.

If there is failure of ICT (as above) this could result in severe collapse of economic activity. There may not be enough physical cash to support transactions. A cash reserve might be

needed, or offline digital currency. DAOs could help shift funds. IOUs could be a short-term solution but susceptible to fraud/lack of trust. An orderly closure of financial institutions might be needed and should be planned for. Manual recordkeeping could be needed. The impact of a loss of electronic backup could have a decades long impact. The Reserve Bank should analyse the scenario of collapse of payment systems. Cybersecurity work needs to include contingencies should defences fail. If critical economic systems breakdown in year one there could be catastrophic civilisation collapse. Downward counterfactual analysis of past events could help with preparations. Moving towards a circular localised economy could help resilience.

Several interviewees noted the potentially large and unpredictable impact of this scenario and the human emotional response that could impact everything from labour availability to social cohesion, and mis/disinformation. Political leadership would be important, but power politics would be a risk factor. These factors mean that any prior efforts to improve social cohesion (values, strength, connection, trust) and political stability could be important. Cross-party/bipartisan planning would be ideal. So too would be efforts to strengthen real-life communities and create 'a community of community groups'. Workplaces and co-workers in particular may be highly trusted and government could engage with businesses rather than just dictate.

Note that a list of representative quotes supporting these results appears in the Appendix below.

Discussion

The results above reveal a complex picture of NZ's resilience in the face of a major global catastrophe such as a Northern Hemisphere nuclear war. Failure of densely interconnected systems appears inevitable, and mitigation would most likely focus on limiting the harm. There is no single solution, but respondents regarded planning in general to be better than no planning. Respondents suggested a range of national plans, strategies and coordination exercises that might significantly improve resilience after-the-fact.

National Plans, Strategies, and Frameworks recommended by interviewees

- Legal/Regulatory arrangements
 - Statutory basis for National Security Arrangements
 - Clear and appropriate definition of critical infrastructure (that includes essential digital services such as cloud computing or mobile communications, as well as neglected infrastructure such as coastal shipping)
 - Legal provisions to maintain democracy
 - Changing procurement rules to encourage local solutions
- National Risk Assessment
 - Publicly facing National Risk Register
- National Resilience Framework
- National Technology Investment Agency
- National Chief Technology Advisor
- Pre-disaster strategies

- National Risk Strategy
- National Energy Security Strategy
- National Food Security Strategy
- Digital Infrastructure Resilience Strategy
- Long-term Supply Chain Strategy
- Catastrophe response plans:
 - National Fuel Plan
 - Contingency Plan for Major Technological Outage
 - National Digital Communications Continuity Plan
 - Reserve Bank Plan for No Digital Payments
 - Zero-trade Plan
 - Strategy for Re-establishing Trade with Australia
- Long-term recovery strategies
- Plan for physical knowledge repositories

Themes across interviews

Several themes emerged from analysis of all 18 interview transcripts. These included:

- The importance of interconnections across sectors, including the deeply interdependent nature of the sectors of transport, food, energy, ICT/digital and the wider economy and society.
- The need for coordination of anticipatory analysis, strategies, response plans, and cooperation across industry and government. This theme suggests the need for a higher-level entity tasked with such coordination.
- Community-level resilience as a critical asset and backstop in catastrophe. Not everything can be planned centrally, and in a disaster, it may even be impossible to communicate. Local networks and communities need to have a level of self-sufficiency, and this needs investment.
- The importance of information sharing, and a shared mental model across government, industry, and communities. This means sharing more risk information and more engagement and dialogue on these issues.
- The pivotal role that appropriate talent and expertise plays in planning, response, and resilience. NZ should make every effort to nurture and retain this talent and expertise.
- The importance of identifying critical infrastructure and defining this infrastructure so it is captured by regulation that will ensure its resilience. Many critical infrastructures were identified such as ICT/digital technology like cloud computing, and transport infrastructure such as coastal shipping, or fuels.
- The role of legislation in ensuring that the right people and organisations can come together to work on the right problems/plans at the right time, and that these cover the foreseeable emergencies.
- The Lack of long-term planning and the need for planning that is divorced from short-term political cycles and includes a set of strategic/emergency plans (for example covering digital outages, fuel supply, food supply).

- The benefits of a cross-party, non-partisan approach to catastrophic risk and resilience.
- The importance of cooperation between government and the private sector (including the role of resilience specialists, and senior leadership engagement)
- Cooperation with Australia is potentially critical, especially in a no-trade scenario and this could help alleviate issues across food, transport, energy, and ICT/digital. A collaborative approach to GCRs and a trade alliance for catastrophe could be important.
- New Zealand's extreme dependence on liquid fuel and limited transport options, which set many sectors up to fail. There is clear need for diversification of transport options in a people-oriented way.

Conclusion

This interview study of 18 experts across critical sectors re-iterated the complex interdependencies among sectors and the vulnerabilities of New Zealand to global catastrophe. Concrete solutions were suggested, and these include taking a systematic approach to national risk, with a set of critical sector strategies and response plans.

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