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The need for modelling resilience in food distribution and trade relations in post-nuclear war recovery

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With a rise in global tensions among nuclear-armed states, preventative measures against nuclear war have once again attracted attention. However, recovery measures in a post-nuclear exchange remain heavily neglected. A nuclear winter poses an existential threat to global civilisation. For example, associated climatic effects would devastate global agriculture in the Northern Latitudes. In the event of a large nuclear exchange, infrastructure would be crippled, ranging from healthcare, industrial agriculture, and supply chains, with ensuing famine increasing our vulnerability to epidemics and other unforeseen aftershocks. We posit that in an Abrupt-Sunlight-Reduction-Scenario (ASRS) caused by a large nuclear exchange, societies vulnerable to isolation, starvation, and resource scarcity would have low resilience against environmental threats and would risk local extinction without adequate support. Understanding vulnerabilities in post-nuclear trade networks could inform efforts to mitigate collapse risks and enable recovery across such scenarios. We also posit that key trading chokepoints and infrastructure would likely be targeted as countervalue in a limited exchange. This would severely disrupt global trade and supply chains for food, essential medicine, fossil fuel, and fertilisers, resulting in widespread famine and potentially billions of deaths.

The precise mechanisms and vulnerabilities in post-nuclear trade and supply chains are poorly understood. Current food and commodity prices are heavily dependent on the price of fossil fuels. Large fluctuations in price compounded by infrastructure destruction will impact every part of the post-catastrophic aid delivery process. Existing research is scarce and assumes either complete cessation of trade or full trade conditions, which are both unrealistic (e.g. Jägermeyr et al., 2020, Xia et al., 2022). In reality, there would likely be an initial shock to trade networks, followed by partial resumption over time as infrastructures are repaired and negotiations begin. The trajectory of this trade disruption, food price, and recovery will be critical in determining the extent of the nuclear winter famine and loss of lives.

At present, the existing humanitarian Trade and Supply Chain (TSC) is not only affected by price fluctuations, but also by local infrastructural and institutional collapse. Today's humanitarian TSC is a mature industry, where permanent logistics clusters and rapid deployment of temporary distribution centres are common practice. Yet, Schiffing et al (2020) suggest that coordination among key players in crises suffered from both disorganisation and internal competition due to unaligned motivations, leading to inefficiency, and avoidable loss of lives. Previous systematic

literature reviews have suggested improvements through supplier hedging and improving inventory metrics. Particularly, there are suggestions for a paradigm shift in ecological resilience thinking and Complex Adaptive System (CAS) modelling in both the commercial and humanitarian supply chain space. Such a shift might help harmonise and prioritise recovery even in smaller humanitarian logistical challenges than nuclear recovery. Furthermore, the 'cold-chains' required for vaccines and medicine are susceptible to disruptions to the energy supply; local sourcing that alleviates chaotic logistical responses will also become more challenging. Careful investigation into post-catastrophe trade disruption is therefore much needed, with these results then informing further work on preparedness and policies that mitigate nuclear winter risks.