Beyond a hazard-centric approach to disaster risk assessment: a Tasmanian scenario-based approach

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Abstract

The Tasmanian Disaster Risk Assessment (TASDRA) 2022 reviews and extends previous risk assessments for the state to identify and better understand disaster risks or sudden stressors that may affect Tasmania. The TASDRA project involved 350 stakeholders across the state in 12 workshops. Participants examined potential disaster risks and identified treatment options to reduce those risks and increase disaster resilience across hazards through considering the systemic nature of risk. This paper includes some practical implications and suggestions to collaboratively examine risk. The sharing of such assessments helps to inform risk assessments across jurisdictions in Australia.

Introduction

The TASDRA project aimed to establish a better understanding of the disaster risks that Tasmania is exposed to and what kinds of disaster events communities must expect. The Tasmanian Government has significant roles to reduce risks and protect communities and needs to work closely with other governments, private sector organisations and communities to reduce risks.

The TASDRA was a partnership project between the State Emergency Service and the University of Tasmania. It involved consultations with subject-matter experts who provided modelling of identified scenarios and workshops where attendees examined plausible worst-case scenarios and potential treatment options.

The project covered:

- identifying ways to prevent a disaster from happening
- 'stress testing' current emergency arrangements for known hazards
- identifying potential disaster risk reduction (DRR) measures.

During the project, participants considered how risk is assessed in accordance with international and Australian practice (Department of Home Affairs 2018; United Nations 2015, 2019). This is an area of current and rapid change.

Changes to assessing risk

In line with international and Australian approaches to reducing risk, risk was viewed as an intersection of hazard, exposure and vulnerability (O'Connell *et al.* 2018, 2020). Traditionally, risk assessment has emphasised the hazard then focused on exposures to that hazard through considering the consequences. Disaster resilience and DRR are about reducing hazards, exposures and vulnerabilities. DRR is about increasing the capability and capacity to reduce exposure to hazards. Figure 1 shows how risk is the combination of hazard, the exposure to that hazard and the extent to which people are vulnerable in the face of that hazard when exposed.

The 2022 assessment extended the 2016 Tasmanian State Natural Disaster Risk Assessment (White *et al.* 2016) to cover additional hazards, exposures and vulnerabilities beyond those previously included, which were 'natural' hazards of bushfire, flood and geological events. Figure 2 shows the types of disasters included in the 2022 assessment including disasters associated with earth systems, geology and extreme weather risks such as tsunami, bushfire, smoke and heatwave, complex severe storms, coastal storm surge with consequent flooding and landslide. Events such as storms may also produce cascading hazards, for example, dam failure and oil spills. The assessment also included disasters associated with biological

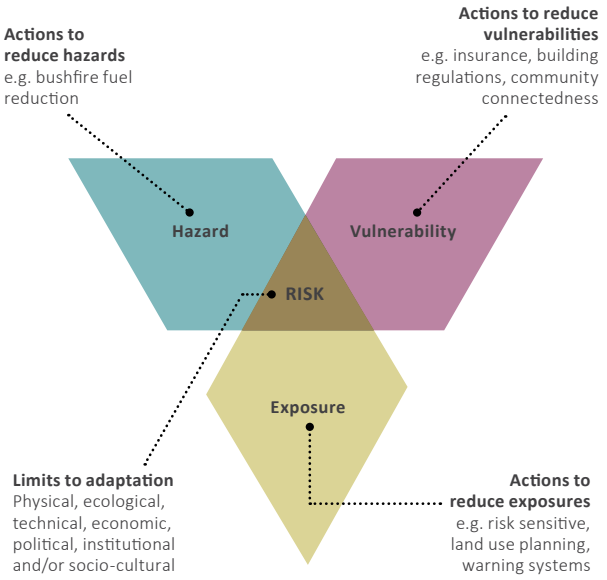

Figure 1: Risk as the intersection of hazard, exposure and vulnerability.

Source: Adapted from www.undrr.org/publication/ecosystem-based-disaster-risk-reduction-implementing-nature-based-solutions-0 p 16.

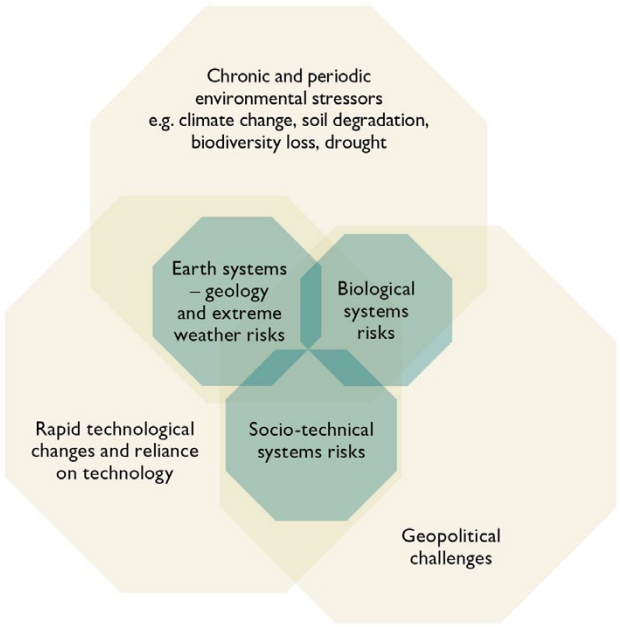

Figure 2: Risks examined in the Tasmanian Disaster Risk Assessment.

systems involving pathogens related to pandemics/epidemics and biosecurity threats, some of which may be caused or exacerbated by other factors.

The assessment also included major accidents or outages or technical systems that underpin modern society such as transport (maritime and road), internet and communications technology (cyber-security) and building safety (structural collapse).

TASDRA is broadly in line with the National Emergency Risk Assessment Guidelines (NERAG) (AIDR 2020). However, NERAG is not specifically designed for society-wide assessments such as TASDRA. Being hazard focused, NERAG does not explicitly address the systemic nature of risk, nor fully explore vulnerabilities. Some aspects raised in the assessment fitted well within existing NERAG categories but others did not, for example, animal welfare does not fit neatly into the existing categories. The NERAG includes the principle that the guidelines should be 'customised' such that the 'framework and process are appropriate to the societal needs, the context and risk profile' (AIDR 2020), so this principle was adopted.

The 5 NERAG categories of consequence helped to structure the assessment and combine the input from stakeholders. However, a few of the labels were adjusted and, in some cases, added to those consequences. Table 1 lists the categories used in what we have called 'NERAG+'. The 2 explicit changes in NERAG+ were the use of 'community and culture' instead of 'social setting' and the term 'core functions' in lieu of 'public administration'. The term 'core functions' was considered inclusive of the essential functions, critical infrastructure and services communities rely on. Some of these are private sector entities. NERAG+ includes 'lifeline' utilities, for example, power, water, telecommunications, transport and supply chains, hospitals and primary healthcare facilities, emergency services, core government services, childcare and educational institutions.

The approach to assessing risk

The TASDRA project involved and collated information from many areas of expertise and perspective. The project centred around a series of scenario workshops to explore risks and measures to reduce those risks. TASDRA is predominantly a qualitative assessment but drew on mapping and other quantitative data where possible.

The scenarios were 'credible but critical' descriptions of specific events at a particular time and location (Norwegian Directorate for Civil Protection 2019). To develop the scenarios, we drew on subject-matter expertise from the relevant hazard management authority or agency (e.g. Bureau of Meteorology, Mineral Resources Tasmania) as well as expertise from the University of Tasmania. The scenarios were 'critical but credible'. Historic events were referenced and made slightly more intense.

Each scenario provided a story to explore the associated exposures and vulnerabilities and consider how to mitigate the event happening and its consequences. The scenarios started with one or more interlinked hazards. The scenario 'stress tested' current arrangements to identify ways to reduce risks and to improve preparedness. While none of the scenarios are likely to happen exactly as described, they provide good examples of probable events.

The scenario assessment workshops involved 25–65 subject-matter experts and stakeholders from:

- relevant Tasmanian Government agencies
- local government
- Australian Government agencies such as the Bureau of Meteorology
- critical Infrastructure and service providers
- private sector and industry groups
- not-for-profit organisations.

Each workshop commenced with a scenario overview followed by work by participants in small groups to map out consequences from their many perspectives. Initially, participants focused on the

Table 1: Categories used in TASDRA based and adapted from NERAG.

Categories	Consequences
People's health, safety and wellbeing	Deaths, injuries or illnesses. People missing, Indirect/long term health/wellbeing consequences.
Community and culture changed from 'social setting'	Community displacement or isolation loss of connectedness; Loss of culturally significant objects, or the interruption of cultural events as a direct consequence of the hazard. Increased stresses in everyday life. Disruption of education and other activities.
Economic	Economic activity and/or asset monetary value loss/economic impact on important industries Indirect economic consequences, for example, due to reputational damage, loss of intellectual assets.
Environment	Loss of ecosystems or species, loss of environmental values of interest. Indirect consequences, for example, soil erosion due to vegetation loss.
Core functions changed from 'public administration'	Decreased capacity of governing bodies and utilities to deliver core functions.

Table 2: Workshops conducted based on hazard-based scenarios.

Scenario	Hazards included
Earth systems - geology and extreme weather	
East Coast Tsunami	Tsunami
'Black January'	Bushfire, heatwave, extended bushfire smoke exposure, with one workshop focusing on bushfire, the other on heatwave and smoke exposure using the same scenario
East Coast Low	Severe storm, flash flooding, riverine flooding, debris flow, landslide, dam failure, coastal storm surge/inundation, rockfall
Biological systems	
Respiratory pandemic Pandemic influenza Novel coronavirus	Pandemic extended from influenza to respiratory generally
Biosecurity incursions	
Foot and mouth disease Avian influenza Mediterranean fruit fly Shellfish biotoxin Didemnum vexillum ('sea vomit')	A range of biosecurity threats covering animal disease, pest incursions in land and marine environments effecting industry and natural values
Socio-technical systems	
Major maritime incident in a port	Transport accident - maritime
Major traffic incident	Mass casualty traffic event, hazardous materials
Building collapse	Structural failure
Statewide cyber outage	Focusing on disruption events

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event impacts for specific locations, sectors of the community, types of individuals or specific types of threats (pandemic and biosecurity). Participants mapped the impacts for a scenario using different colours related to each of the 5 NERAG+ consequence categories. These discussions became the basis of a narrative describing the consequences in the TASDRA reports. This narrative replaces the NERAG's formal risk statements often used in risk assessment. We particularly wanted to explore how risks and consequences linked together, like ripples in a pond, to cause cascading and compounding consequences, including further risks. The narrative approach helped to explore the inter-connected nature of disaster risk. Ripple-effect mapping is an established methodology used in community development and evaluation (see Washburn *et al.* 2020).

Workshop participants discussed what success and failure might look like, reviewed controls already in place and identified potential new measures to reduce risk. Notes from the workshop formed the basis for the core of the TASDRA report that was refined, reviewed through further consultation with others (expert reference group and subject-matter experts). Where possible, research or other evidence to support claims made in workshops was included. Project participants could review the workshop notes and writeups and contribute further to the draft assessments before the full report was finalised.

Developing a 3-dimensional view of risk

By exploring the interconnectedness of cascading and compounding events, their consequences, exposures and related vulnerabilities and capabilities, this assessment developed a 3-dimensional view of risk. This picture helps to understand the risks that can occur in the systems that support, sustain and help communities identify ways to reduce their risks. Table 3 summarises the ways in which the three-dimensional view of risk was developed, connecting the hazard to its consequences and exposures and identifying vulnerabilities including systemic barriers, capabilities and enablers.

Insights

The following insights and practical implications have come from the project and when completing the assessment.

Challenges with NERAG

The main issue with NERAG is that it is hazard-centric. Extracting the hazard assessments in line with NERAG was challenging. For example, the east coast low scenario included 6 cascading hazards. However, often hazards lead to cascading and compounding secondary hazards and consequence. The scenarios discussed in the workshops reflected this. For example, the bushfire scenario explored consequences associated with heatwave and smoke. Participants assessed that an increased number of deaths and injuries would be due to heatwave and smoke hazards rather than the bushfire.

Assessing likelihood and consequences

We assessed likelihood and consequences of both the scenario in its entirety and the specific hazards it covered. For example, the 'Black January' scenario assessment included likelihood and consequence assessments for a significant bushfire event during a heatwave, plus the individual hazards that may occur without the bushfire event, for example, a heatwave without a bushfire. Including smoke as a separate hazard acknowledges bushfire smoke can cause significant risks well away from the fire front that can often be overlooked.

Assessing the scenario and the hazards it included in line with NERAG was an uneasy fit. This is because NERAG does not adequately assess varying levels of exposure and vulnerability. Focusing on hazards and their consequences (or exposures) only provides a 2-dimensional view of risk which is thus more limited. This is an area for future consideration. A 3-dimensional view of risk – that is, one that better considers how systemic vulnerabilities can increase exposures to many hazards. If we can reduce these systemic vulnerabilities then we can reduce risk across many hazards, including those not yet envisaged.

Table 3: Developing a 3-dimensional view of risk.

1. Hazards	2. Consequences and exposures (structured by values)	3. Vulnerabilities (systemic barriers) capabilities and enablers
Explored through scenarios of: · tsunami · bushfire/heatwave/smoke exposure · storm, coastal storm surge, flood, landslide/rockfall, dam failure, oil spill · pandemic · biosecurity · transport/HAZMAT · structural collapse · cyber-threats.	people's health, safety and wellbeing · economic · environment · core functions · community and culture	· placement of communities, infrastructure and assets · access and supply of essential information, goods and services · risk ownership and transfer · working together · community and individual vulnerability and capacities.
Based on evidence/scientific data driven where possible, observations, historical records.	Based on structured categorisation, expert judgement, insights through workshops.	Based on observations, qualitative analysis and systems thinking building on 1 and 2.

As an example, systemic vulnerabilities include land-use planning, more clarity around risk ownership and transfer, governance and community awareness of risk and engagement. This means the TASDRA assessment is in line with emerging international approaches to assessing risk, such as the Global Risk Assessment Framework (UNDRR 2020). Considering systemic vulnerabilities helps to explore complex 'wicked' issues that cause problems in similar ways across hazards and supports a cross-hazard approach to reducing risk and disaster resilience. A 2-dimensional approach reinforces a hazard-by-hazard approach to reducing risk by focusing on hazards and exposures to those hazards, so preventing a cross-hazard approach that disaster resilience requires.

In this respect the paper advances previous understanding by drawing out the 3-dimensional view of risk including hazard, exposure and vulnerability.

Effective stakeholder engagement

No one sector has all the answers to reducing risk and responsibility often lies between organisations and individuals. This meant any assessment needs to have wide stakeholder involvement. Risk assessment workshops were designed to be interesting and encouraged participation. In line with the Tasmanian Disaster Resilience Strategy 2020–2025, understanding and reducing disaster risk is everybody's business and needs to be incorporated into all levels of government, business, and not-for-profit sectors as well as community groups (Tasmanian Government 2019). So to understand, identify and mitigate risk, the process needs to be engaging to be effective. Encouraging workshop participants to be active in the structured groupwork using credible but critical scenarios was a key method to gather rich insights and perspectives.

Participants working in small diverse (i.e. different stakeholder) groups enriched the process and, in some cases, potential issues were resolved at the workshops due to this collaboration.

Being proactive

Proactively managing risk is not only about managing an emergency event and being prepared. In line with the *Sendai Framework for Disaster Risk Reduction 2015-2030* (UNDRR 2015), the scenarios used in the workshops helped participants to imagine potential mitigation measures to avoid hazard events occurring or, at least, reduce the consequences.

Identifying measures to reduce risks across hazards

The scenarios were based on hazards as a starting point. Importantly, mapping out how risks and consequences cascade and compound helped identify systemic vulnerabilities. The interlinked series of scenarios that had a wide range of hazards helped to identify ways to reduce risk relevant to many types of hazards. Many of the issues raised during the workshops were common across the hazards and exposures. These were issues such as land-use planning, supply chain security and cross-agency and sector governance and collaboration. More complex issues were considered and some hard questions were raised. We referred to the Profiling Australia's Vulnerability: the interconnected causes and cascading effects of systemic disaster risk (Department of Home Affairs 2018) to consider vulnerabilities as well as other work to help structure this part of the assessment focusing on systemic vulnerabilities.

Practical implications

TASDRA can inform and enable DRR directly and indirectly, particularly in areas that span multiple hazards. Thinking through a range of scenarios helps to identify vulnerabilities that can help with unanticipated other risks. One of the purposes of TASDRA was to help imagine what disaster scenarios could look like without needing lived experience.

At the state level, TASDRA created a register of proposed measures that can reduce risk, replacing the more formal risk treatment plan that NERAG advocates. This recognises that decision-making about investing in risk reduction generally involves different stakeholders and processes than formal assessments for state-level assessments. The register tracks how measures to reduce risk are being pursued through a range of initiatives, for example, through the implementation of recommendations from the Royal Commission into National Natural Disaster Arrangements (Australian Government 2021) or through existing or new state government programs. For example, Tasmania's SES Storm and Flood Ready program implements state and national recommendations relating to community resilience. TASDRA also supports planned risk assessments on climate change and other risks that may affect Tasmania.

Local government risk assessors can use the TASDRA to review how consequences might apply in their communities. SES Tasmania has a planned project to support councils assess their risks and leverage off the TASDRA assessment, in line with evolving national guidelines. NERAG is currently being reviewed nationally.

A growing collection of documented and shared scenarios from disasters and their consequences can inform risk assessments across jurisdictions as some scenarios are applicable to other parts of Australia. For example, an east coast tsunami would likely impact on coastal Victoria and NSW in similar ways to Tasmania. Effective risk assessment leverages off previous assessments and relies on sharing information.

TASDRA is a resource for service providers to help them consider how they would support their clients to be resilient in the context of other support provided to their clients. This project did not include public information guidance but can assist to develop such material. Guidance should prioritise the needs of community sectors, rather than the 'push' drivers of initiatives such as TASDRA. That is, guidance should be client-community centric and developed in a cohesive manner rather than be the final stage of multiple assessments or other projects.

Existing guidance relates more to the specific hazard and often duplicates information. Emergency management has, traditionally, been planned around hazards and has resulted in duplication and disconnection of issues that are similar across hazards. Information for communities at risk from multiple hazards can lack coherence. TASDRA supports the development of cross-hazard guidance and communications products that explain issues that span hazards. The combined TASDRA scenarios support a

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cross-hazard approach, practical cross-sector engagement and integrated DRR that can better use resources.

Conclusion

Reducing hazards and exposures is important, however, they are only a first step. There are vulnerabilities that drive risk in Tasmania across all or most disaster scenarios, including those not examined through TASDRA 2022. If these individual and systemic vulnerabilities can be reduced, Tasmania will be better placed to deal with and recover from a disaster event. The 5 areas of systemic vulnerability include:

- continuity of supply and access to information and services
- placement and quality of buildings and other assets
- risk ownership and transfer
- governance and collaboration
- individual and community capability.

These themes build the work by the Australian Government and recognises that many of the issues facing Tasmania are similar to other Australian states and territories. Addressing vulnerabilities can significantly reduce disaster risks, however, they are often 'wicked' problems that are complex and difficult to address and generally involve cross-agency and cross-sector collaborative efforts. Addressing these issues involves iterative, adaptive and collaborative learning. It involves multiple streams of decisions and actions coming together and related areas of policy and effort focused on climate change, sustainable development and economic growth as well as community health and wellbeing.

TASDRA 2022 contributes to these streams of decisions by providing a rich and cohesive picture of disaster risk. The use of scenarios and the exploring of associated exposures and consequences uncovers potential measures that build on existing risk controls and measures. By reducing the risks and planning for these events, all parties can reduce risks and take actions to be prepared for disaster events that are yet to be envisioned.

The final TASDRA report contains details that are relevant to groups of users, so it is important to view its content in context. A common, and one of the greatest risks, is to not acknowledge or to oversimplify complexity. Oversimplified assessments usually produce simplistic solutions. Disaster risk is complex and so is its reduction. It involves many parties working cohesively, recognising that reducing risks is an iterative learning process, gradually chipping away at 'wicked' problems that create or sustain disaster risks.

The TASDRA 2022 report is available at www.ses.tas.gov.au/about/risk-management/tasdra-2022/.

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