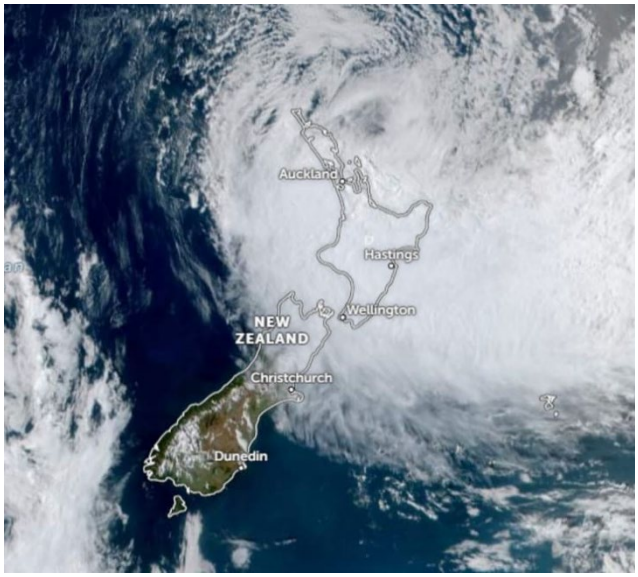
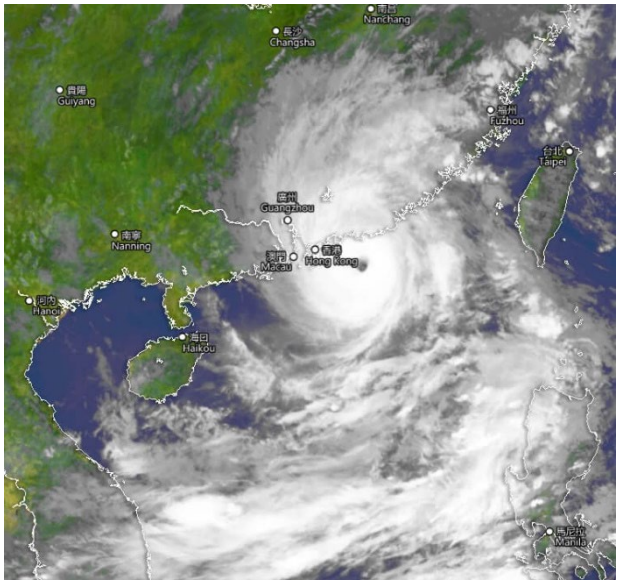
Weathering the Storms:

Examining Extreme Weather Impacts and Responses in China and Aotearoa New Zealand

中国和新西兰与气候相关的极端天气事件的影响和应对措施





A short report completed by the Winds of Change North Asia 2023 Group 4:

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Cover images

Left – Cyclone Gabrielle hitting Aotearoa New Zealand (Radio New Zealand, 2023). Retrieved from https://www.rnz.co.nz/news/national/484182/cyclone-gabrielle-the-science-behind-its-power

Right - Typhoon Sura Approaches Hong Kong and Guangdong (Archyde, 2023). Retrieved from https://www.archyde.com/typhoon-sura-approaches-hong-kong-and-guangdong-updates-precautions-and-impact/

Acknowledgements

We would like to thank the Centres for Asia Pacific Excellence (CAPEs) for providing us with the opportunity to come together for this project. We are very grateful for the guidance and support from our mentors, Raaniera Te Whata and Wiebke Finkler, and Winds of Change Project Manager Natalie Reeve, as well as all other programme mentors, staff, and participants for making this such a positive experience that we will cherish moving into our careers.

Contents

Introduction

Our short report identifies two case studies of similar-scale extreme weather events in Aotearoa New Zealand and China: Cyclone Gabrielle 2023 and Typhoon Sura and Davy 2012.

We identify and briefly explain the impacts, responses, and recovery process of these events, and conclude with some lessons and key takeaways so we can be more resilient in the wake of future climate-related weather events.

Our anticipated audience for this report is people who want to take part in the response to climate change and other stakeholders who want to know more about preparation/adaptation for climate-related weather events.

About Cyclone Gabrielle: Aotearoa

Cyclone Gabrielle was a severe tropical cyclone that devastated parts of the North Island of Aotearoa New Zealand earlier this year. Originating off the northeast coast of Australia in early February, the cyclone tracked south and struck Aotearoa between February 12 and 16 2023.

It has been referred to as the worst weather event of this century as it caused widespread devastation, leading to extensive damage, and requiring the evacuation of numerous residents (Gisborne District Council, 2023a). One of the most significant consequences was the heavy rainfall, which triggered severe flooding in many areas.

Te Tairāwhiti Gisborne and Te Matau-a-Māui Hawke's Bay were dubbed “the epicentre of devastation” as they experienced flash flooding, road slips, power cuts, evacuations, and loss of lives and livelihoods. One major concern was the amount of forestry slash which washed down rivers in flash floods, most notably in the Esk Valley, which exacerbated the damage.

The aftermath of the cyclone prompted a coordinated response from local authorities and relief organisations to aid in recovery efforts. It is estimated to have caused 1,720 injuries and 11 deaths, with an economic cost estimated to be up to $14.5 billion.

An international research team has also identified that weather records suggest climate change is responsible for between 20% and 30% of the rain that fell in Gisborne and the Hawkes Bay.

This was not the first extreme weather event that had hit the East Coast of the North Island in the past few years. The region has been subject to several big storm events that have caused impacts to the region; however, Cyclone Gabrielle was the biggest to date and is New Zealand's most damaging climate-related weather event.

Impacts of Cyclone Gabrielle: Aotearoa

On the East Coast, there were impacts to –

1. ***Infrastructure:*** *Roading**,** Power**,** Drinking water supply**,** Wastewater*

Roads were impacted by multiple large slips and silt build-up. During the event, two power substations in Hawkes Bay were flooded, and a lot of the lines network was damaged. This cut off power and internet to tens of thousands of households, with connections to some rural areas taking extended periods to be reconnected.

In Gisborne, the cyclone caused extensive damage to the water supply pipe into the city, breaking it in ten places. It took 45 days to repair. Such infrastructure is critical for protecting public health, providing drinking water and treating waste.

2. ***Food Security: H***orticulture, viticulture, agriculture, Disruption of productivity and supply chains, Increased food prices across Aotearoa

Hawkes Bay, Aotearoa's largest growing region for stone and soft fruits, lost around 25% of its harvest for the year. The crops that were rain or wind damaged may have a harvest again in the next year or so. Then there are crops that have been totally wiped out, and the supply won't come back for years – if ever. The area is also known for viticulture, which also experiences severe damage and loss of crops.

In Gisborne, the surrounding area is largely farming, with damages estimated at around $80 million, with large amounts of stock drowning in the flooding.

The impacts of this loss of food productivity and disruption of supply chains were felt elsewhere too, as food prices across Aotearoa's supermarkets were driven up.

3. ***People and Communities:*** *Loss of life, Loss of housing and possessions, Strain on public services, Communities banded together*

This event placed huge pressure on communities. As well as loss of life, many other people were trapped on their rooftops or cars and needed rescue by helicopter or boat during the event. Houses and buildings were flooded, and people's possessions were lost.

In Gisborne township, more than 170 homes are either red or yellow-stickered which has made the Gisborne housing crisis even worse. One positive thing was to see communities banded together in the aftermath to provide each other shelter and necessities and start the recovery process.

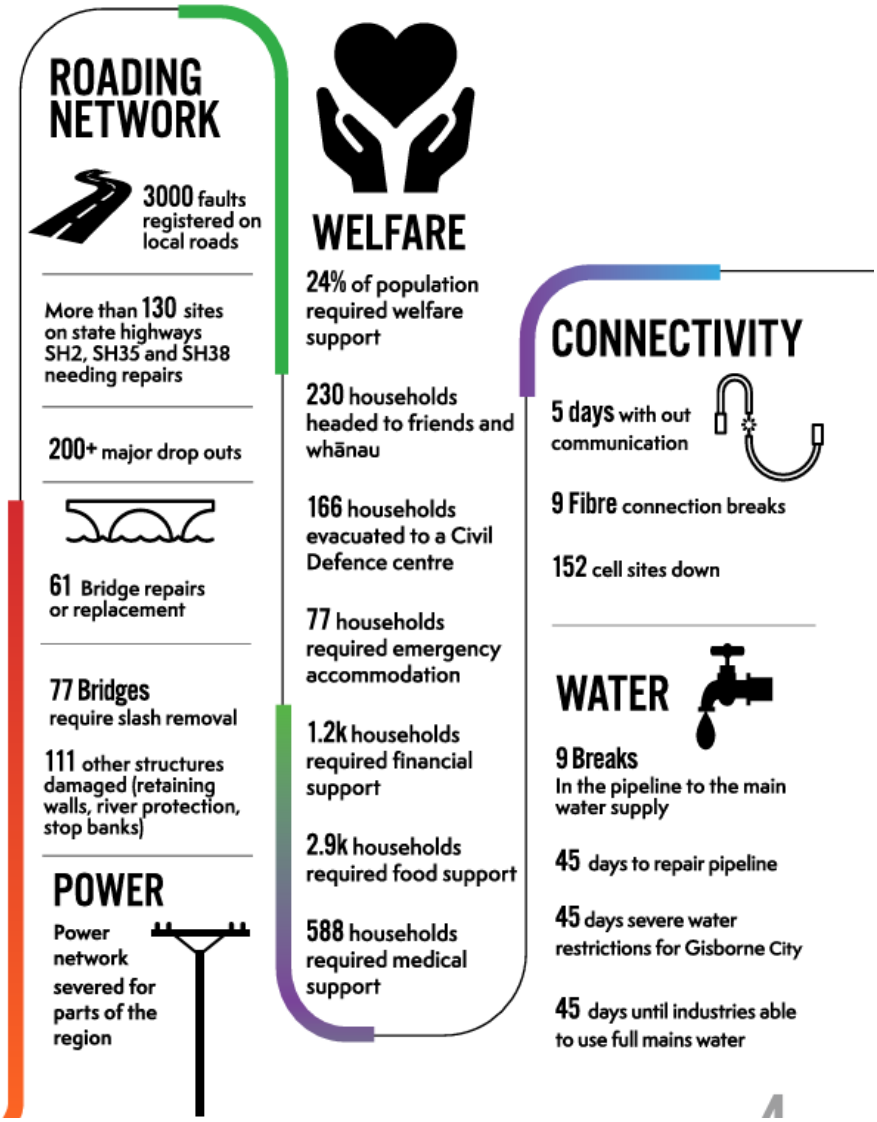

Figure 1 - *Pictogram Explaining the Impacts Experienced in Te Tairāwhiti Gisborne During Cyclone Gabrielle* (Gisborne District Council, 2023b).

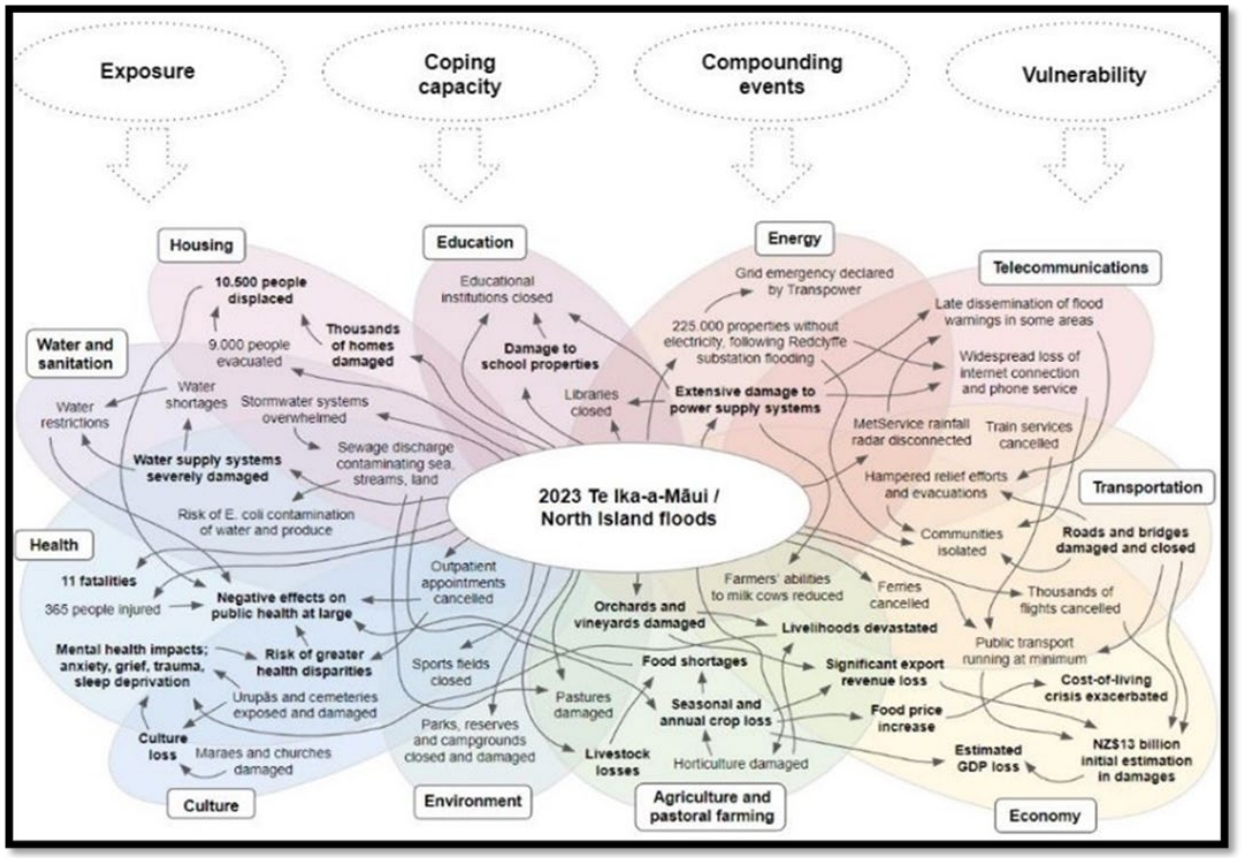

Figure 2 - *Impact pathways among sectors affected by the 2023 North Island floods* (Harrington, Dean & Awatere et al., 2023, p. 23).

The above figures show impacts in the Gisborne District (Figure 1) and on the different sectors of society across the wider East Coast regions (Figure 2).

In Figure 2 the long-term impacts are accentuated in bold, and the study's authors highlight factors like how much a sector is exposed, how easily it is affected, how well it can handle problems, and how different events compound as factors that shape how much damage and loss Cyclone Gabrielle caused (Harrington, Dean & Awatere et al., 2023). This is important to consider, remembering that the East Coast experienced many extreme weather events in the few years leading up to Cyclone, and is essential to think about when planning any type of recovery.

Typhoon Sura and Davy: China

In 2012, No.9 Typhoon Sura and No.10 Typhoon Davy debuted in the western Pacific on the same day. At the beginning of August, two typhoons landed hand in hand on the eastern coast of China, forming a rare "north-south attack" trend, which affected a wide range from Fujian to Liaoning. Davy became the strongest typhoon landing north of the Yangtze River in China since 1949.

From 8 am on 2nd August to 6 pm on 5th August 2012, under the influence of the double typhoons, the cumulative rainfall of 100 mm or more was recorded in the north-central part of Fujian, the eastern part of Zhejiang, the southern part of Jiangxi, the north-central part of Shandong, the north-eastern part of Hebei, the southern part of Liaoning, the eastern part of Jilin, etc.

The rainfall on the northern coast of Fujian, the junction of Fujian and Jiangxi, the southern coast of Zhejiang, and the northeastern part of Shandong, Qinhuangdao in Hebei, and the southern part of Liaoning was 200-350 mm.

TABLE 1 - TRAFFIC DISRUPTION CAUSED BY SURA AND DAVY

Affected Province (City)	Traffic Disruption		
	Roads	**Railways**	**Flights**
Hubei	56 roads in 14 counties were interrupted by the rainstorm		
Fujian		Multiple high-speed trains obstructed.	9 flights cancelled
Shanghai			More than 70 flights were delayed; 7 flights were canceled.
Zhejiang		More than 30 high-speed trains in Wenzhou and 21 high-speed trains in Ningbo were suspended.	10 flights cancelled
Hebei	Traffic interruption on some roads in Qinhuangdao.	More than 70 trains on the Beijing-Harbin Line were suspended, with nearly 100 trains delayed and 70000 passengers obstructed.	

Liaoning	236 national and provincial trunk roads and rural roads interrupted	All trains on 4th August at Dalian Railway Station shut down.	
Jiangsu	Emergency control for relevant sections of the highways.		Flights from Southern Airlines to Guangzhou and Shenzhen Airlines to Shenzhen were canceled.
Shandong		Multiple trains were delayed.	29 flights cancelled at Qingdao International Airport

The characteristics of Sura are strong intensity, slow-moving speed, strong local rain combined with southwest monsoon, long-term, and wide-ranging influence. Monsoon provided it with continuous water vapor and energy. However, Sura's moving speed was very slow. The average moving speed of Sura from the 28th to the 31st was less than 10km/h. Because it was born in a weak environment in steering flow, and Davy hindered its westward movement, its moving speed was slow.

The scale of Davy was much smaller. The movement speed of Davy showed the characteristics of slow before and fast after. After the generation of Davy, it had been circling and moving less from the 28th to the 30th and began to accelerate from the 31st. In addition, Davy was a typhoon generated at a high latitude, entering the Yellow Sea westward and landing in China.

Critical infrastructure such as communications, roads, railways, and water conservancy were severely damaged. The twin typhoons affected various modes of transportation in many provinces in China, including roads, railways, and flights, which can be detailed in Table 1.

Responses to extreme weather events

Although the time constraints of this project cannot cover all the responses that went into each event (some of which are still ongoing), Table 2 below covers some of the key aspects.

TABLE 2 - RESPONSE OF AOTEAROA TO CYCLONE GABRIELLE 2023, AND OF CHINA TO TYPHOON SURA AND DAVY, 2012

Aotearoa New Zealand	China
The government declared a National State of Emergency, with Civil Defence activation following immediately after. Cyclone Gabrielle resulted in a State of National Emergency being declared on 14 February 2023. The National declaration was extended three times and then lifted for Tairāwhiti on the 14 March 2023 (Gisborne District Council, 2023a). Thousands of people took shelter in Civil Defence Centres across the East Coast.	Relevant responsible persons were asked to go deep into the front line and take the lead so that the command, responsibility, and measures were in place.
There was a lack of communication in isolated areas, and even now there is a struggle to communicate between people who have been impacted on the ground and the government leading the response.	The maritime department assisted the local government in doing a good job in the return of ships to port, the transfer and resettlement of offshore operators, and conducted a comprehensive inspection of anchorage ships and port facilities.
Following the event, the Government is providing $240 million in finance and will underwrite loans up to $10m as part of the ongoing rebuild. The	Highway engineering construction departments paid more attention to the defense work of construction personnel, equipment, and facilities.

Government has also announced an official inquiry into the response to the event, noting that with climate change such events will become more common.	
A report has also been presented to the government around the devastation caused by tonnes of forestry slash and silt during Cyclone Gabrielle on the East Coast. Gisborne council has already prosecuted five forestry companies for slash damage in storms.	Professional rescue forces have been scientifically deployed, rationally dispatched, and actively responded, while ensuring their safety.

Recovery from extreme weather events: Cyclone Gabrielle

Gisborne District Council's "Road to Recovery" website offers succinct information about the impacts of Cyclone Gabriele on the region, including their Recovery Plan. This includes recovery to the built environment (e.g., roads, infrastructure), the natural environment (e.g., silt removal, managed retreat), economic environment (e.g., forestry, agriculture), and the social environment (e.g. community, culture, housing).

This recovery plan focuses on being community-led, placing whānau, hapū, iwi and the community at the center of engagement and ensuring that communities lead conversations that determine how they wish to live their lives.

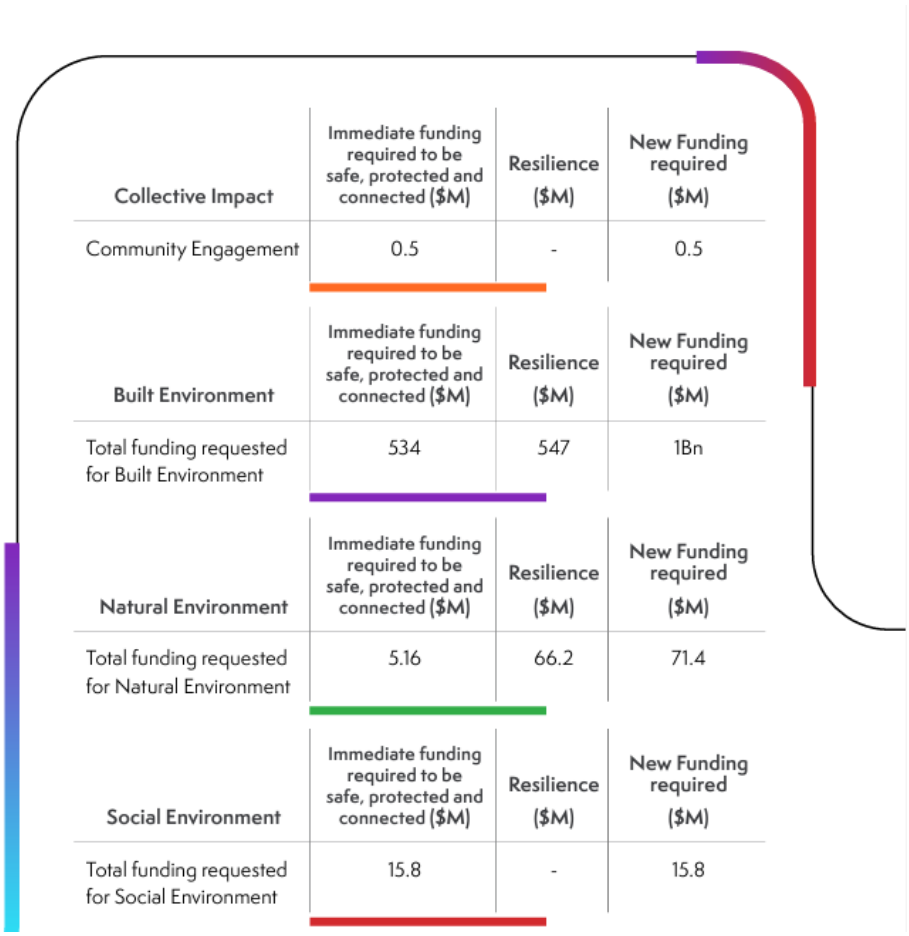

Figure 3 - *Pictogram explaining the recovery costs needed in Te Tairāwhiti Gisborne following Cyclone Gabrielle* (Gisborne District Council, 2023b).

Conclusion

By examining what occurred and how the government and emergency services reacted, we can identify the vulnerabilities in the systems designed to protect people during emergencies. This, in turn, allows us to navigate our adaptation to the climate crisis better.

China and Aotearoa have similarities and differences in their impacts and responses. China is more densely populated, while many communities in Aotearoa live near exposed coastlines.

One significant aspect to highlight in the case of Cyclone Gabrielle is the problem of deforestation, especially in the Gisborne and Hawkes Bay areas. The main lesson learned from this situation is the

significance of replanting enduring forests and carefully choosing suitable tree species for specific locations and timing (McCarthy, 2023). Research on this could be likely to come up during the recovery process.

Although this point is specific to Aotearoa, one similarity and lesson to learn between both China and Aotearoa is the importance of community-led recovery processes. We believe the process Gisborne District Council is undertaking could be an important lesson for China, as it is aiming to make communities more resilient in the wake of inevitable, and compounding, climate-related extreme weather events.

Climate change will mean more of these events are expected in the future, so it is very important to examine their impacts and the effectiveness of responses to them, so we can be better prepared.

We would like to end with “Ka mua, ka muri" which is a whakatauki that means "walking backwards into the future" - the idea we should look to the past to inform the future. This is why examining the impacts of climate-related weather events is important to inform the recovery and resilience of our countries moving forward.

References

Harrington, Dean & Awatere et al. (2023). The Role of Climate Change in Extreme Rainfall Associated with Cyclone Gabrielle over Aotearoa New Zealand’s East Coast.

Gisborne District Council. (2023a). Te Whakarauoranga o Te Tairāwhiti: Tairāwhiti regional recovery. Retrieved from https://www.gdc.govt.nz/services/tairawhiti-road-to-recovery/tairawhiti-regional-recovery

Gisborne District Council. (2023b). Report: Our road to recovery – Tairāwhiti. Retrieved from https://www.gdc.govt.nz/__data/assets/pdf_file/0020/52364/Recovery-Plan.pdf

McCarthy, D. (17 May 2023). Cyclone Gabrielle weather damage: Lessons from Cyclone Bola go unheeded. *New Zealand Herald.* Retrieved from https://www.nzherald.co.nz/nz/cyclone-gabrielle-weather-damage-lessons-from-cyclone-bola-go-unheeded/55CYBJVUF5BSDOKYR4KRNRFCEQ/

Appendix 1 – Symposium Presentation Slides

Weathering the Storms: Examining Extreme Weather Impacts and Responses in China and Aotearoa New Zealand
中国和新西兰与气候相关的极端天气事件的影响和应对措施

Nov 2023

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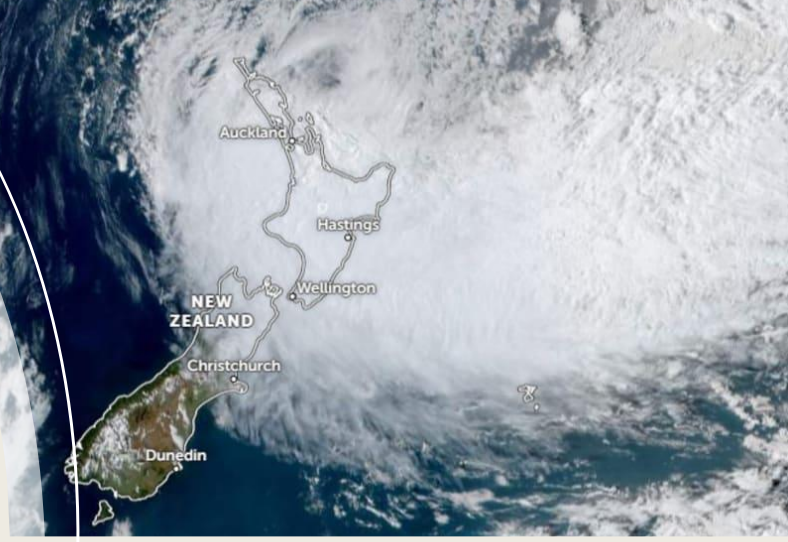
North Asia Centre of Asia-Pacific Excellence

A Winds of Change Programme Case Study on Cyclone Gabrielle 2023 and Typhoon Sura and Davy 2012

Cyclone Gabrielle: Aotearoa

- February 2023
- Heavy rainfall, high winds, flash flooding, road slips
- Power cuts, evacuations
- Worst weather event of this century, claiming the lives of 11 people
- Climate change played a role



Impacts: Infrastructure

- Roading
- Power
- Drinking water supply
- Wastewater

Impacts: Food Security

- Horticulture, viticulture, agriculture
- Disruption of productivity and supply chains
- Increased food prices across Aotearoa

Impacts: People and Communities

- Loss of life
- Loss of housing and possessions
- Strain on public services
- Communities banded together

ROADING NETWORK

3000 faults registered on local roads

More than **130** sites on state highways SH2, SH35 and SH38 needing repairs

200+ major drop outs

61 Bridge repairs or replacement

77 Bridges require slash removal

111 other structures damaged (retaining walls, river protection, stop banks)

POWER

Power network severed for parts of the region

WELFARE

24% of population required welfare support

230 households headed to friends and whānau

166 households evacuated to a Civil Defence centre

77 households required emergency accommodation

1.2k households required financial support

2.9k households required food support

588 households required medical support

CONNECTIVITY

5 days with out communication

9 Fibre connection breaks

152 cell sites down

WATER

9 Breaks
In the pipeline to the main water supply

45 days to repair pipeline

45 days severe water restrictions for Gisborne City

45 days until industries able to use full mains water

Collective Impact	Immediate funding required to be safe, protected and connected ($M)	Resilience ($M)	New Funding required ($M)
Community Engagement	0.5	-	0.5

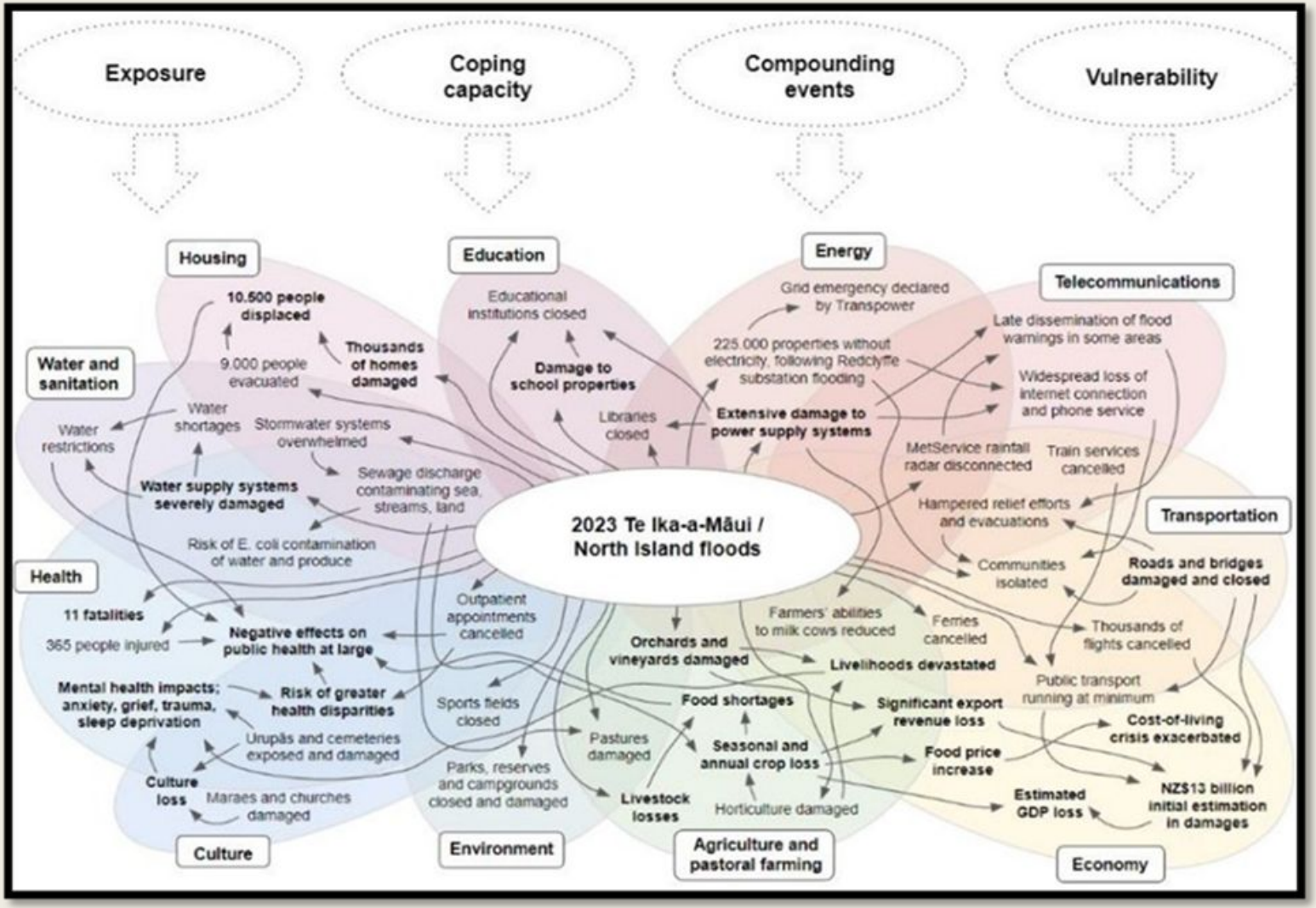
Built Environment	Immediate funding required to be safe, protected and connected ($M)	Resilience ($M)	New Funding required ($M)
Total funding requested for Built Environment	534	547	1Bn

Natural Environment	Immediate funding required to be safe, protected and connected ($M)	Resilience ($M)	New Funding required ($M)
Total funding requested for Natural Environment	5.16	66.2	71.4

Social Environment	Immediate funding required to be safe, protected and connected ($M)	Resilience ($M)	New Funding required ($M)
Total funding requested for Social Environment	15.8	-	15.8

Response: Aotearoa

- National state of emergency
- Civil defence shelters, defence force and charities
- Lack of communication in isolated areas
- Government inquiry into slash


Exposure
Coping capacity
Compounding events
Vulnerability
Housing
Education
Energy
Telecommunications
Water and sanitation
Transportation
Health
Culture
Environment
Agriculture and pastoral farming
Economy
2023 Te Ika-a-Māui / North Island floods
10,500 people displaced
9,000 people evacuated
Thousands of homes damaged
Water shortages
Water restrictions
Stormwater systems overwhelmed
Water supply systems severely damaged
Sewage discharge contaminating sea, streams, land
Risk of E. coli contamination of water and produce
Educational institutions closed
Damage to school properties
Libraries closed
Grid emergency declared by Transpower
225,000 properties without electricity, following Redclyffe substation flooding
Extensive damage to power supply systems
Late dissemination of flood warnings in some areas
Widespread loss of internet connection and phone service
MetService raintall radar disconnected
Train services cancelled
Hampered relief efforts and evacuations
Communities isolated
Roads and bridges damaged and closed
Thousands of flights cancelled
Public transport running at minimum
Ferries cancelled
Farmers' abilities to milk cows reduced
11 fatalities
365 people injured
Negative effects on public health at large
Outpatient appointments cancelled
Mental health impacts; anxiety, grief, trauma, sleep deprivation
Risk of greater health disparities
Urupās and cemeteries exposed and damaged
Culture loss
Marae and churches damaged
Sports fields closed
Parks, reserves and campgrounds closed and damaged
Pastures damaged
Livestock losses
Orchards and vineyards damaged
Livelihoods devastated
Food shortages
Seasonal and annual crop loss
Horticulture damaged
Significant export revenue loss
Food price increase
Cost-of-living crisis exacerbated
Estimated GDP loss
NZ$13 billion initial estimation in damages

Typhoon Sura and Davy: China

- Typhoons hit on the same day
- Rare “north-south” attack on the East Coast of China
- Strong local rain combined with southwest monsoon
- Communications, roads, railways and water conservancy were severely damaged

Traffic disruption caused by Sura and Davy

Affected Province (City)	Traffic Disruption		
	Roads	**Railways**	**Flights**
Hubei	56 roads in 14 counties were interrupted by rainstorm		
Fujian		Multiple high-speed trains obstructed.	9 flights cancelled
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Liaoning	236 national and provincial trunk roads and rural roads interrupted	All trains on 4th August at Dalian Railway Station shut down.	
Jiangsu	Emergency control for relevant sections of the highways.		Flights from Southern Airlines to Guangzhou and Shenzhen Airlines to Shenzhen cancelled.
Shandong		Multiple trains delayed.	29 flights cancelled at Qingdao International Airport

Response: China

- Key individuals took charge on the front line.
- Maritime department aided ship return, operator relocation, and facility inspection.
- Highway construction prioritized personnel, equipment defense.
- Professional rescue teams deployed with safety in mind.

Conclusion

- Climate change will mean more of these events
- China and Aotearoa New Zealand have similarities and differences
- A lot to learn from impacts and responses