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THE ADAPTATION GAP

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3.1 Introduction[1]

The climate change adaptation challenge for Pacific nations is profound. We have not yet fully witnessed the impacts of the anthropogenic emissions burden already in the atmosphere. Whatever we do to reduce emissions now will not affect what is yet to come in the next few decades; it will affect the longer-term prospects which are dependent on nations globally all playing their part to reduce emissions as soon as possible.

We have had a taste of things to come: successive ex-tropical cyclones like Gita; the frequent flooding of major access routes within Auckland, New Zealand's most populous city; prolonged droughts affecting our agricultural way of life and income; rising seas and cyclones affecting Pacific Island life and livelihoods and properties on the west and east coasts of New Zealand. Island communities have relocated as a response to past climate impacts. Increasingly, Pacific communities have widely dispersed diaspora in neighbouring New Zealand and Australia as well as the west coast of North America. This will continue.

The climate changes we face now come on top of many other hazards that challenge the ability of our Pacific region to adapt, including cyclones, coastal flooding, drought, tsunami, earthquakes, habitat loss and volcanic hazards. Climate change compounds these hazards and introduces new sources of impact, like accelerating sea level rise due to the rapid melting of the polar ice sheets. Impacts are not just these familiar and direct impacts. We are increasingly understanding the interdependence between our natural and human systems. Impacts flow across the natural

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1 The authors thank the following with whom we consulted during the preparation of this chapter: the Waiōhine Project Team, Community and Stakeholders; and Anthony Liuvaie Freddie, who provided the Nuie figures. Thank you also to the presenters at the 2018 Second Pacific Climate Change Conference who motivated the stories in this chapter.

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environment, our social systems, our physical assets, challenging the capacity of our human systems to respond, in particular our communities, our financial and governance systems (Lawrence, Blackett, Cradock-Henry and Nistor, 2018).

Our natural instinct is to "protect" ourselves and our families and assets in situ. This is what we have always done. Most of our institutions are geared to this – we are myopic by nature and have an "emergency" response culture. We solve problems as they arise, rather than anticipate what we know is coming to reduce the damage and losses. This predisposition places us in a very vulnerable space. What is to come will stretch our institutions, because the residual risk is increasing – that from which we cannot protect ourselves. This arises because we continue to entrench our exposure in harm's way, creating a legacy of vulnerability that will compound as the climate change impacts continue to change the risk profiles for some time to come.

The emergency culture and current planning law and its practice encourage building back in the same climate change exposed locations, rather than building back better or somewhere else. We assume that the social safety nets that we are used to, will come to our rescue. This assumption is reinforced by governments' recovery packages and our high dependence on insurance or on overseas aid. We demand compensation for past decisions when planning rules are enforced or land uses denied. But the world is changing. We cannot assume that help will be there. Already, we are seeing insurance premium hikes or withdrawal in some places. We need to be much savvier about where we live and work and how we provide network services – roads, underground water services, gas and electricity utilities. The present and future are not like the past. We are operating outside the range of experienced risk which will widen for some time to come, until we can stabilise greenhouse gas emissions. We have an adaptation gap that needs to be filled with some urgency.

We examine these themes to provide a context for thinking about the adaptation gap and how we can address it: what are we adapting to; the call for adaptation action; the risk transfer; and a new way (examples from positive action taking place in the Pacific region: in New Zealand, learning from national policy and community action; in Niue, learning from traditional values and practice; and in Vanuatu and the Solomon Islands, learning from ecosystems).

3.2 What are we adapting to?

Not all climate change impacts are the same. Some are acute and some are chronic. Acute impacts occur as events, like cyclones and intense rainfall events and storm waves on top of king tides, for example. Chronic impacts are less visible until they start to be a nuisance or when they are beyond our coping capacities. This type of climate change impact includes sea level rise and associated groundwater rising, heat and drought. These impacts can compound and have wide cascading impacts for our natural, cultural, social and economic systems. The frequency of the impacts is critical to our ability to respond and in some areas, mainly coastal, will render habitation very difficult well before the more dramatic sea levels projected. Sea level rise is, however, ongoing for centuries and is creeping up on us.

These impacts are all foreseeable and we can reduce their impact by adapting now – where we live and work, how we use the land, how we design our infrastructure, and importantly, how we

respond to the acute climate change impacts and interact with mitigation of emissions. This involves avoiding and reducing the impact of the foreseeable and managing the unavoidable.

Another twist to the problem to which we are adapting, is that many of the impacts will be occurring concurrently within nations and across Pacific nations. Adapting requires a long-term view, especially for investments being made today that have long lifetimes. This means we need to be transitioning now to more adaptive and flexible design, planning and investment of resources and avoiding development of areas highly exposed to the impacts of climate change.

To date, we have been responding to "one-off" events like the aftermath of an ex-tropical cyclone. Increasingly, as heavy rainfall events and coastal inundation become more frequent, we need to be thinking about the flow-on impacts of our current response paradigm. This means thinking of our places of settlement and our natural environment as part of a wider natural and economic system. Impacts on transport infrastructure, for example, influence our value chains by disrupting access to ports and supermarkets and to our telecommunications.[2]

Stormwater and sewerage services that become overwhelmed can lead to public health alerts, and if water supplies become contaminated, whole towns can be affected.[3] Increasingly, fire will become an issue in the east of New Zealand, as it already has in Australia. Competition for water resources becomes critical as drought scenarios play out and irrigation is used as an adaptation. This has already emerged in the Murray-Darling Basin in Australia where governance has been insufficient to manage water sustainably (Bouckaert et al, 2018). The land and water use nexus and the coastal flooding problem have profound and long-lasting effects on people and productive, cultural and natural systems – at Edgecumbe, a coastal town in the Bay of Plenty (New Zealand), when a flood levee failed during a large flood event (Rangitāiki River Scheme Review Panel, 2017); or the Pacific Islands, when more frequent tropical cyclones occur, are other examples where governance becomes a critical issue. This includes how we make decisions as the risk increases, and how we make the transition to new land uses and new ways of living and governing.

For many people, the impacts are beyond imagining and all too uncertain. This means that they focus on the present and think that others can address the impacts. Others know that there is a problem, but cannot act without systems being in place to facilitate solutions, so we make it up as we go along. Some others still deny that climate change is anything other than natural variability at work, while a few accept that there is change, but question its human cause. Adaptation takes foresight and a long-term joined-up commitment across the community and across all levels of government, with an eye on the consequences of our actions today for future generations. Anything less will fail to meet the challenge ahead of us.

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2 For an analysis of cascades, see Judy Lawrence, Paula Blackett, Nicholas Cradock-Henry and Benjamin J Nistor *Climate Change: The cascade effect. Cascading impacts and implications for Aotearoa New Zealand* (Deep South Challenge, Wellington, 2018) at 4-5.

3 See Government Inquiry into Havelock North Drinking Water *Report of the Havelock North Drinking Water Inquiry: Stage 2* (Department of Internal Affairs, Auckland, December 2017).

Pacific nations are on the front line of climate change. Whether it is the impacts on the Great Barrier Reef, communities in Kiribati, Hawkes Bay or the west coast of New Zealand, the consequences are being felt now. The impacts also have wider consequences for how we prioritise actions regionally across Pacific Islands and within our nations to achieve equitable outcomes. The impacts affect funding and overseas aid flows and the nature of those flows. Who should pay and what do we spend our adaptation dollars on? Do we continue to entrench expenditure into "protection" by "holding the line" and the status quo knowing that will fail as a strategy, or do we start to transition ourselves away from "risky places" and "risky economic activities" that make us less sustainable?[4] And at the same time, how do we avoid entrenching current vulnerabilities and capacities?

These are decisions that must be informed by an empowered society in a participatory way with the support of national, regional and local governments, as highlighted by the Intergovernmental Panel on Climate Change (IPCC)'s Special Report on 1.5 degrees Celsius (IPCC, 2018). Transformational change can only happen with such wide societal support.

3.3 The call for adaptation action

Tragically, the call for action is not new. Successive IPCC assessments have strengthened the evidence of the risks. The World Bank reported in 2012:[5]

> … we're on track for a 4°C warmer world marked by extreme heat-waves, declining global food stocks, loss of ecosystems and biodiversity, and life-threatening sea level rise.

The Special Report on 1.5 degrees Celsius (IPCC, 2018) reiterated the urgency for action and in particular highlighted the close relationship between the choices and implementation of adaptation and mitigation options:[6]

> A mix of adaptation and mitigation options to limit global warming to 1.5°C, implemented in a participatory and integrated manner, can enable rapid, systemic transitions in urban and rural areas (high confidence). These are most effective when aligned with economic and sustainable development, and when local and regional governments and decision makers are supported by national governments (medium confidence).

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4 See Intergovernmental Panel on Climate Change "Summary for Policymakers" in Valérie Masson-Delmotte et al (eds) *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* (2018) <https://archive.ipcc.ch/pdf/special-reports/sr15/sr15_spm_final.pdf> [IPCC SR15].

5 World Bank "Climate Change Report Warns of Dramatically Warmer World This Century" (18 November 2012) <https://www.worldbank.org>.

6 IPCC SR15, above n 4, at D3.3.

Furthermore, how we adapt and mitigate has consequences that flow well beyond the immediately observed impacts:[7]

> Adaptation options that also mitigate emissions can provide synergies and cost savings in most sectors and system transitions, such as when land management reduces emissions and disaster risk, or when low carbon buildings are also designed for efficient cooling. Trade-offs between mitigation and adaptation, when limiting global warming to 1.5°C, such as when bioenergy crops, reforestation or afforestation encroach on land needed for agricultural adaptation, can undermine food security, livelihoods, ecosystem functions and services and other aspects of sustainable development (high confidence).

At COP24 in 2018 in Katowice, Poland, the call for action came from Greta Thunberg, the Swedish school-girl who said:[8]

> Until you start focusing on what needs to be done rather than what is politically possible, there is no hope. We can't solve a crisis without treating it as a crisis. We need to keep the fossil fuels in the ground, and we need to focus on equity. And if solutions within the system are so impossible to find, maybe we should change the system itself.

Sage words that apply equally to adaptation.[9] Decisions made today without thinking about tomorrow will not address what is to come, because they will expose future generations to consequences that we know about already.

3.4 A massive risk transfer

We spend an awful lot of time talking about tweaking the current levers for hazard risk management. We have systems of dependency on government disaster relief and on insurance which the New Zealand government underwrites for some classes of damage and loss. Tied to this is the large devolution of powers to local government without the requisite funding needed to address the increasing climate change adaptation gap. We continue along in the belief that someone else will pick up the tab.

Contrary to popular belief, insurance does not reduce risk. It transfers risk from the insured to the insurer. Insurers, unsurprisingly, are shifting their cover away from places exposed to climate change impacts, because they are foreseeable risks.[10] In New Zealand, this places pressure on the Earthquake Commission (EQC) system to deliver at a time when the Natural Disaster Fund is depleted from earthquakes claims. There are limits to this risk transfer.

The transfer of risk has primarily been to local government, which is required to have particular regard to the effects of climate change under the Resource Management Act 1991 (RMA). The

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7 Id, at D3.4.

8 Greta Thunberg "Speech addressed to the COP24 Plenary Session" (Katowice, 12 December 2018).

9 See Glossary at the end of this chapter for a definition of adaptation and its various forms.

10 See Glossary for a definition of risk transfer. See also Chapter 10 in this book.

planning system under the RMA contains a hierarchy of regulatory provisions that should, if administered well, avoid future legacy effects. Addressing existing uses is somewhat more complicated. However, we see ongoing consenting of buildings and infrastructure in low-lying exposed areas around New Zealand off the back of inadequate plans to address the issue. There is a long time-lag between scientific evidence, central government leadership, updating of regional and district plans or land information memoranda (LIMs), consultation on the updates, and then applying them to new consent applications. This is far too long for the urgent change required to address the adaptation gap.

Furthermore, there have been examples where councils have tried to address the land use consequences of rising seas and which have been thwarted. For example, the Kāpiti Coast District Council was challenged in 2013 over its placing of hazard information on LIMs. It is a legal obligation to include information about hazards on LIM reports or in district plans.[11] Doing so enables potential buyers to consider relevant information held by councils about properties. In that case, the form of the information and its quality was questioned successfully.[12] The obligation on councils to place such information on LIMs was not. This highlighted that communities need to better understand councils' legal obligations, and that councils need to communicate the risks better. Plans will continue to be challenged unless that happens.

Successive governments have regarded it as a matter for councils to decide what areas can be built on and for insurers to assess the risks. However, this approach means that different rules are being applied in every council area. This stretches resources, especially of the smaller councils, as development pressures become more intense. In 2015, the Parliamentary Commissioner for the Environment highlighted the risk of rising seas in many towns and cities where there are whole suburbs, such as South Dunedin in Dunedin City, Petone in Hutt City, New Brighton in Christchurch City and Granity on the West Coast, that are particularly vulnerable.[13]

Reflecting the concerns expressed by local government, that there was a lack of clear guidance for addressing the coastal climate change risks highlighted by the Parliamentary Commissioner for the Environment, central government guidance was revised and is now available for councils' decision making on coastal hazards and climate change (Bell et al, 2017). At the same time, guidance was also issued on the implementation of the New Zealand Coastal Policy Statement (NZCPS). The NZCPS is a statutory policy statement which legally directs local government in its coastal hazard functions to take a precautionary approach to coastal hazards. The necessity for engagement with communities on what to do, and how fast, is a centre piece of the guidance along with how to apply sea level information for different types of development and on adaptive pathways planning for addressing changing risk over time.

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11 *Weir v Kapiti Coast District Council* [2013] NZHC 3522 at [68].

12 Id, at [70].

13 Parliamentary Commissioner for the Environment *Preparing New Zealand for rising seas: Certainty and uncertainty* (November 2015) at [5.2], [7.3] and [7.5].

The update of guidance on how to address extreme rainfall and a national policy on other hazard risks have also become urgent. Calls for a stronger alignment of the Building Act 2004 with the RMA and the NZCPS are now urgent to drive consistency across risk timeframes, extreme events and methodologies for identifying "climate change effects".[14] A review of the RMA is currently underway providing an opportunity to address these issues.

There is also a transfer from insurers and local government to banks. This is a timeframe issue since insurance contracts are for one year, whereas bank mortgages are usually for several decades. We are seeing banks continuing to lend to the rural community for large infrastructure investments to manage existing land uses faced by drought conditions – the very locations where drought is likely to get worse. The risk of stranded assets is high within the payback period of those investments. Such areas also face the prospect of increased fire risk which will compound the impacts on rural communities. Perhaps this will change as insurance becomes unavailable or too expensive, government tightens its adverse effects policies and banks' self-interest kicks in:[15]

> Released at the 2018 UNEP FI Conference in Sydney, co-hosted by IAG and NAB, the Joint Statement in Support of a Sustainable Financial System for Australia and New Zealand calls on organisations across the finance sector to support the development of Sustainable Finance Roadmaps for Australia and New Zealand.

A Sustainable Finance Roadmap is "a set of recommendations across policy, regulation and finance practices that helps the finance sector contribute systematically to a more resilient and sustainable economy."[16]

Insurance Council NZ CEO Tim Grafton has shown leadership in his assessment of the importance of adaptation:[17]

> Adaptation and mitigation overlap with building designs that need to be more resilient and energy efficient, as they do when farm businesses seek to be more financially sustainable by substituting to more resilient crops. … If risk is not reduced well, then insurance will become less affordable or even unavailable for some.

In the Pacific, we see foreign aid agencies investing large sums of money to shore up coastal areas and invest in infrastructure that may not last the test of time. This is also occurring in New Zealand

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14 Department of Conservation *Review of the NZCPS 2010 on RMA decision-making: overview and key findings* (June 2017) at [29].

15 United Nations Environment Programme Finance Initiative "Finance Sector Commits to Working Together to Develop Sustainable Finance Roadmaps for Australia & New Zealand" (24 July 2018) <unepfi.org>.

16 Ibid.

17 Tim Grafton "Sustainable insurance in a sustainable world" (18 August 2018) Insurance Business Magazine <insurancebusinessmag.com>.

on the Coromandel coast road, a primary access road for communities and tourists alike. Planning for alternative adaptation options is urgently needed.

Biodiversity is at huge risk from the effects of climate change, such as the frightening decrease in insect life. Scientist Brad Lister comments about the Puerto Rican rainforest:[18]

> The insect population that once provided plentiful food for birds throughout the mountainous national park had collapsed. On the ground, 98% had gone. Up in the leafy canopy, 80% had vanished. The most likely culprit by far is global warming.

Planting forests will certainly help mitigate greenhouse gas emissions and restoring wetlands will attenuate increased heavy rainfall and flood flows. What is often overlooked is how incorporating more nature in our cities can help adaptation. Professor Tim Beatley, populariser of the phrase "biophilic cities", says:[19]

> … the green infrastructure of a city and region—rivers and riparian areas, floodplains and wetlands and large swaths of forested land—all provide essential services, that help cities and urban regions respond to and spring back from climatic and natural events. Cities with large natural wetland systems will be better able to absorb flood waters from hurricanes and storms, for instance.

Ultimately today's failures of governance, legislation and imagination are all massive transfers of risk to our younger generations and generations to come.

3.5 A new way

A new way is urgently needed. First, we need an aware public which can call decision-makers to account over a longer period than our three-year terms of office. Secondly, we need an effective decision framework for adaptation. Support across the political spectrum was given to the Climate Change Response (Zero Carbon) Amendment Act 2019 to provide for a National Climate Change Risk Assessment and National Adaptation Plan, and an independent Climate Change Commission to advise on mitigating climate change, adapting to the effects of climate change and monitoring and reviewing government's progress towards its emissions reduction and adaptation goals.[20]

The public and our officials require the ability to navigate a changing and uncertain future and the ability to mediate difficult conversations with stakeholders and between experts. We need to deploy new tools that can give us confidence in making decisions in the present and to be flexible as the changes evolve. Fundamental to this new way of thinking about change and making decisions that are robust across many different possible future conditions, is attention to the many societal values and objectives. We can learn from others in building a common understanding of the nature of the

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18 Cited in Damian Carrington "Insect Collapse: 'We are destroying our life support systems'" *The Guardian* (online ed, 15 January 2019) <www.theguardian.com>.

19 Timothy Beatley and Peter Newman "Biophilic Cities Are Sustainable, Resilient Cities" (2013) 5 Sustainability 3328 at 3333.

20 Climate Change Response Act 2002, sections 5A-5P, 5ZP-5ZX. See Chapter 8 in this book.

adaptation challenge, working with our elected officials to unblock the inertia in the system. We now illustrate some early attempts to build a more sustainable future from which we can learn.

3.5.1 New Zealand local government and communities

Local Government New Zealand (LGNZ), to which all New Zealand councils belong, has begun to undertake significant work on adaptation, starting with understanding the scale of assets exposed to sea level rise. The three waters (water supply, waste-water and stormwater) infrastructure has been a recent focus, due to pressure for new development on top of aging infrastructure in many areas. Councils manage water services for drinking water, stormwater management and sewage treatment and discharge which include using pipes, reservoirs, pumping stations and treatment facilities. These are all affected by climate change impacts:[21]

> Our analysis reveals that more than $4 billion of three waters infrastructure, roughly $1.0 billion of roading infrastructure and $1.2 billion of buildings and facilities is exposed at a 1.5-metre elevation increment of sea level rise. The total value of all infrastructure types exposed is estimated at approximately $8.0 billion.

However, these costs reflect only replacement costs, associated with sea level rise. They do not include other drivers of coastal flooding or other climate change impacts such as storm events, high tides or land subsidence, which in the near-term may be more significant for coastal communities. From mid-century, however, permanent and ongoing coastal flooding will dominate.[22] The study also does not include costs of other activities, such as temporary or permanent adaptation measures, planning activities and purchasing additional resources to ensure an acceptable level of service. There were gaps in data across councils and for some ports, roads and wastewater treatment plants. As well as councils, there are other major asset owners not included in these costs. The report noted that costs will go far beyond the tangible measures. Potential economic development and growth, community health and safety and social support systems will also entail large costs, some of which will arise from permanent coastal flooding and rising groundwater associated with sea level rise. The costs, therefore, will likely be orders of magnitude more.

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21 Local Government New Zealand *Vulnerable: the quantum of local government infrastructure exposed to sea-level rise* (Local Government New Zealand, 31 January 2019) at 2. See also Local Government New Zealand "Climate Change Project" <www.lgnz.co.nz>.

22 Robert Bell et al *Coastal Hazards and Climate Change: Guidance for Local Government* (Ministry for the Environment, Wellington, 2017) at [6.4.1].

The report by LGNZ provides a starting point from which the community can identify and discuss their appetite for different adaptation options moving forward. Two recent examples follow, using processes for community participation for flood and coastal hazard impacts and options for reducing climate-related risks over long-term planning periods of 50 and 100 years respectively.

Waiōhine River Plan

The Waiōhine River Plan in the Wairarapa (New Zealand) considered climate change impacts within a flood risk management plan and successfully resolved council and community disagreements within the scope and cost of the plan with trigger points enabling decisions to account for changing flood risk profiles and other changes over the planning period. The community disagreement arose when in 2016, the Greater Wellington Regional Council (GWRC) published a draft Floodplain Management Plan setting out the flood plain risk and mitigation options in the Waiōhine River catchment. Concerns were expressed about the information on which the Plan was based that did not draw on local knowledge, the proposed costs, potential restrictions on property interests (land use controls, information on LIMs and building controls), and that local knowledge had not been properly accounted for. This led to a community devised and led process with participation by the GWRC and all other stakeholders, calling on independent experts to align the initial ground elevation light detection and ranging (LIDAR) information with local expert knowledge, including photographs of historic flood events (Waiōhine River Plan, 2020; see Figure 1).

After several months of open community-led engagement and study of updated catchment, rainfall, climate change and flood data, the community, council and experts chose to base their work on the climate impacts associated with the global Representative Concentration Pathway (RCP) RCP6.0 (moderate emissions reductions initially followed by a rise in emissions and population peaking at around 9-10 billion). This scenario generates 16 per cent extra water volume for the Waiōhine – 10 per cent by 2050 and a further six per cent by 2090. The detailed local knowledge of what had been flooded in the past was used to ground truth 24 different model runs. The costs of the options chosen were around 70 per cent lower than the original plan and the science was accepted. Several years on from the public contestation and denial of climate change related to a coastal plan in Kāpiti Coast district, no one in the Waiōhine denied climate change publicly, although some queried its anthropogenic causes. A positive outcome from the process was the community appetite for another community-led process for the Mangatārere River Plan without the acrimony experienced in the Waiōhine catchment. This provides a New Zealand-based example of a collaborative community-led process for designing adaptation options for the effects of climate change on river systems.

Figure 1: semi-braided channel form typical in the reach between the Rail Bridge and Fullers Bend upstream of the State Highway Bridge. Source: Waiōhine River Plan, 2020.

Clifton to Tangoio Coastal Hazards Strategy

In a coastal setting, three Hawkes Bay councils in New Zealand have developed a non-statutory coastal hazards and climate change strategy to 2120 (Clifton to Tangoio Coastal Hazards Strategy 2120, 2018). Coastal erosion and wave overtopping affecting beach settlements have a decades-long history. Numerous reports had not addressed the problem from the communities' perspective. The climate change imperative brought this to a head. Three district councils, the regional council and three iwi groups (Napier City, Hastings District and the Hawkes' Bay Regional Council, He Toa Takatini, Mana Ahuriri Incorporated and Maungaharuru Tangitu Trust Incorporated) came together in a governance arrangement with the affected community to assess the hazards and the implications of sea level rise on the risk exposure, and develop adaptive pathways to 2120. With the help of the research and the consultant community, a strategy was recommended to the councils' Joint Committee. The detailed planning of the implementation phase of the strategy is now underway. This was a ground-breaking process for local government and other councils are taking it up. Nevertheless, challenges remain in getting buy-in from the wider regional community on the question of who pays. The councils have developed a shared funding model for implementation.

Such adaptive planning methods have been used previously in New Zealand (Lawrence et al, 2013) and elsewhere (Haasnoot, Kwakkel, Walker and te Maat, 2013; Bloemen et al, 2018), for example the Hutt River Flood Risk Management plan motivated by use of a serious game – The NZ River Game developed with the assistance of Deltares, The Netherlands, a number of New Zealand councils and the Ministry for the Environment as part of research undertaken at Te Herenga Waka—Victoria University of Wellington (Lawrence and Haasnoot, 2017). These methods stress-test adaptation options for their performance under a range of future conditions over a 100-year period, using several scenarios to reflect the range of uncertainties about the future. Using a range of scenarios rather than one scenario of the future, enables communities to be fully aware of the uncertainties and that scenarios are not what *will* happen in the future, rather they are plausible outcomes that can inform choices. Further research to develop signals and triggers for monitoring different adaptive pathways (Lawrence, Bell and Stroombergen, 2019) is ongoing.

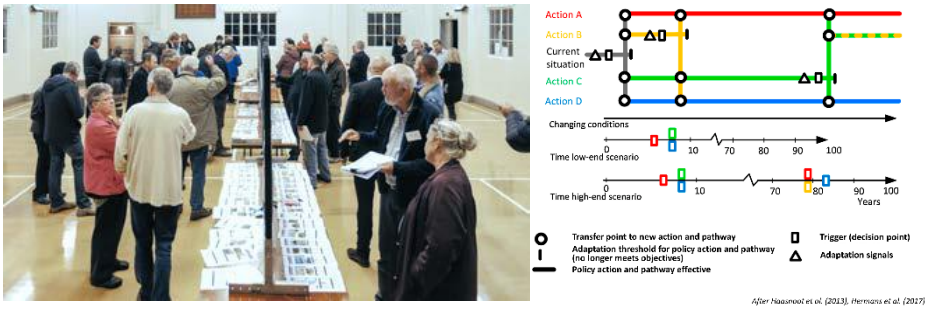

Figure 2: (left) community feedback. Source: Clifton to Tangoio Coastal Hazards Strategy 2120, 2018 at 43; (right) adaptation pathways. Source: after Haasnoot et al, 2013 at 488; and Hermans et al, 2017 at 30.

3.5.2 New Zealand central government addressing adaptation

3.5.2.1 National guidance

The Hawkes' Bay coastal strategy development process was assisted by the revised national Coastal Hazards and Climate Guidance (Bell et al, 2017). Such guidance informs decisions under the statutory NZCPS. The guidance is underpinned by a 10-step decision cycle grouped around five questions – What is happening? What matters most? What can we do about it? How can we implement the strategy? How is it working? Fundamental to the decision process is community engagement and addressing the drivers of climate, social, cultural and economic change, over at least 100 years – the statutory timeframe required of coastal risk management in the NZCPS. Embedded in the guidance is the underlying acknowledgement that decisions in a climate change context have to address dynamic change and uncertainty. Accordingly, guidance is given on the use of new approaches and tools to do this. For example, for coastal hazard assessments, a tiered approach is set out in which a high-level scoping of the problem can be done, and more focused attention given to hotspots. This addresses the resource constraints of many councils. For sea level rise considerations, statistical likelihoods cannot be assigned within the planning timeframe, due to uncertainties around the rate and magnitude of polar ice sheet melting, in which case scenarios can be used to stress-test a range of options for adaptation. Guidance is also given on how the transition from current exposures to how climate change impacts will evolve, can be made. For example, existing developments, changes in land use through intensification and new Greenfield developments can be addressed. To assist in these decisions, guidance is given on applying adaptive pathways planning by identifying options, assessing the options, developing alternative pathways, stress-testing the pathways and designing signals and triggers for monitoring change, so community objectives for the long term can be achieved. Other tools are set out for assessment and planning that can address the changing risk profiles over at least 100 years. For example, a range of economic assessment tools that can be used in situations of uncertainty and change without discounting the damages and losses and wider community benefits for future generations.

3.5.2.2 Climate Change Adaptation Technical Working Group recommendations

To address the growing concern in the community, and especially within local government, in late 2016, the New Zealand government set up a Climate Change Adaptation Technical Working Group (CCATWG) to advise it on adaptation progress to date in New Zealand, and on how New Zealand might adapt going forward. There was growing concern expressed by local government and in the community that local councils where on their own trying to adapt to climate change, especially the rising risk from coastal hazards and sea level rise, and from floods generated from extreme extra-tropical cyclones. The CCATWG reported that adaptation efforts across all sectors and levels of government needed to improve significantly; that there were gaps and lack of integration across legislation which required immediate attention; and that a new framework for adapting to climate change was needed because of the wide scale and scope of the impacts.[23] It also reported that New Zealanders were not sufficiently informed, and agencies not well organised or taking proactive and dynamic action. The elements of an effective adaptation framework were set out as an integrated strategy, to help transition to more effective adaptation across New Zealand. The key elements of the framework are:

- Understanding and assessing the risks;
- Developing a national adaptation plan integrated across national and local government; and
- Independently monitoring and reporting on the plan.

And to reflect the dependencies between these actions, the framework required:

- Accessible information to support decision making;
- Capacity and capability built to adapt;
- Funding the widening "adaptation gap" without creating moral hazard, by anticipating the known consequences and being able to transition before the changes occur; and
- Leadership (including cross-party beyond the three-year electoral cycle) through integrated governance to support long-term adaptation action.

This framework, recommended by the CCATWG, is partially reflected in the Climate Change Response Act 2002 alongside policy development for funding.

The funding remit is especially significant for successful adaptation since it is universally creating a barrier to starting adaptation (Boston and Lawrence, 2018). Understanding the potential costs is important and LGNZ has recently contributed to that (Local Government New Zealand, 2019). However, investments in developments in urban and rural locales are being made now which have the potential to lock-in a legacy of infrastructure, housing and rural activities affected by climate change impacts that will make future adjustments very costly due to the risk transfer to the next generation. Designing new sustainable funding mechanisms that do not create moral hazard and exacerbate

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23 The Climate Change Adaptation Technical Working Group's two reports were: *Adapting to climate change in New Zealand: Stocktake report from the Climate Change Adaptation Technical Working Group* (Ministry for the Environment, December 2017); and *Adapting to climate change in New Zealand: Recommendations from the Climate Change Adaptation Technical Working Group* (Ministry for the Environment, May 2018).

inequities must start now, since institutional change takes time and some communities cannot wait because they are already threatened right now from rising seas, extreme rainfall, drought and fire. A national conversation about who pays and who should pay is the only way to avoid lengthy and ad hoc legal challenges to councils implementing their legal mandates around climate change adaptation. The community needs to be on board with the looming withdrawal of insurance cover and the risk that there will be no one to pick up the tab, leaving stranded communities and assets and potential widespread social and economic disruption. New Zealand does not have a good record in risk reduction and our institutions reinforce post hoc reaction to loss and damages (Boston and Lawrence, 2018). Now is the time to do better at it through anticipatory planning and flexible investments that can adjust in time to avert the worst impacts.

3.5.3 Niue – a new way by learning from traditional values and practices

Niue is already affected by devastating cyclones, exacerbated by a declining population base and a heavy reliance on recovery assistance from its near neighbours. This has affected adaptive capacity in a way that reduces, rather than exacerbates, exposure and ongoing risk to livelihoods and traditional ways of life in a changing climate. A project that sought to provide a contextural understanding of the Niuean environment and its people's response to past climate conditions, demonstrates a more sustainable and affordable adaptation approach than dependency on architectural and building methods imported from elsewhere (Freddie and de Sylva, 2018; Freddie, 2018).

Adaptation to the many cyclones and droughts over the generations has given Niueans an intimate understanding of their island home and how they can sustain themselves on it. However, western influences, modernisation, the importation of material resources and alien building technologies have undermined this self-reliance based on local knowledge, practices and traditional systems. Cyclone Heta in 2004 brought this into sharp focus. The modern centre of Aliluki (established on a highly exposed part of the island in the early 1900s by Christian missionaries), built with modern imported materials like concrete, timber and steel sheet roofing, was completely destroyed with the loss of Niue's only hospital, national museum, public library, hotel and a government-owned apartment complex. This led to a huge demoralising effect on the people and an exodus to New Zealand, which disrupted efforts that were beginning to stabilise population numbers.

Cyclone Heta showed that the range of ad hoc construction projects were exposed and vulnerable to natural weather events, but that in other parts of the island, where traditional architectural and construction practices had been used, similar damage was not sustained. Local communities had historically located themselves in naturally protected areas, using traditional low-built architectural styles which have protected the lives of people in severe cyclones. For example, by taking shelter amongst the many caves on the island or the above ground root networks of the "Ovava" tree, and by locating villages in sheltered parts of the island using vernacular building systems. This established the importance of privileging traditional knowledge, vernacular practices and local capacity in building and community development projects and its significance for nurturing pride and resilience amongst the locals.

A speculative design project was undertaken, focusing on sustainable architectural solutions to reduce the negative effects of climate change on Niue; the resilience of the Niuean people to the

damaging effects of ongoing natural weather events; and socio-economic development of Niue that could help reduce future population drain (Freddie and de Sylva, 2018). It did this by:

- Identifying, improving and building local capacity;
- Improving and diversifying livelihood sources;
- Safeguarding traditions and traditional knowledge;
- Utilising traditional knowledge effectively to improve living environments;
- Developing building technologies to suit local conditions, skills and capacity;
- Adapting modern and proven technologies, methods and systems to local conditions;
- Utilising traditional craft (for instance, weaving, lashing) to improve design and construction; and
- Growing and sourcing building materials locally.

A design for a community and cultural centre was undertaken, that could also serve as an educational facility for skill development, which is vital for community resilience, food sustenance and socio-economic well-being, and to support village based eco-tourism projects, at different scales and with available resources. In the event of an extreme weather event, the building is designed to serve as an evacuation centre. In a severe storm surge, the lower levels of the ground floor might be sacrificed to flood waters while the upper levels and floors provide safe shelter to the people. The multiple hazards affecting Niue were considered for the safety of the site and architectural solutions considered in response to site conditions. For example, the structural qualities of the Ovava tree were used to inform the building forms (Figure 3) and foundation were designed to wrap around and hug the hard limestone terrain and form protective cave-like spaces within the building. Planting heavily with native coastal trees and shrubs to help minimize wave damage from water surges and tsunamis at the island cliff edge was an alternative to the building of large seawalls and engineering projects. These were better suited to local capacity and context when combined with early warning systems.

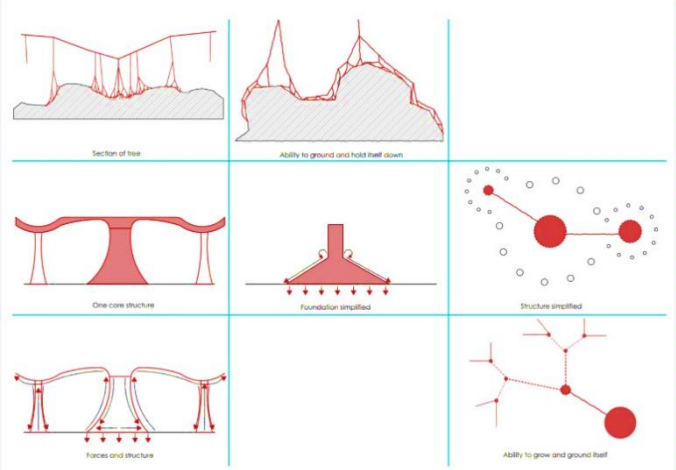

Figure 3: analysis of structural qualities of the Ovava tree. Source: Freddie, 2018.

Inspiration was drawn from:

- The native Ovava tree (Figure 4), which can be sustained through cyclonic weather conditions by its organically interconnected above and below ground structural system;
- Bamboo, as a suitable material for the structure which deflects with cyclonic force, can be grown sustainably; and
- Traditional tying and lashing techniques for securing the forms and shapes that allows the building to flex and move within acceptable limits in cyclonic conditions.

Figure 4: the Ovava tree. Source: Freddie, 2018.

A large central and several secondary structural cores were created (Figure 5) to act like the above ground root networks of the Ovava tree, while raised concrete foundation piles imitate its ground root network. The concrete foundations protect the bamboo and anchor the sub structure to the ground, while forming a circular maze of cave-like protective spaces. This structural system supports the building laterally and vertically when cyclonic forces are applied and form a barrier against tsunami waves that may reach the building. The roof, a diaphragm system inspired by traditional basket weaving techniques, acts like a lattice brace that links and structurally reinforces the whole building to resist lateral loads. Local traditions of thatching and local palm material resources were considered for roof coverings. The proposed building design is adaptable to domestic and public scale buildings and is a structurally safe, sophisticated and aesthetically beautiful response that is suited to the environment, local culture and local capacity.

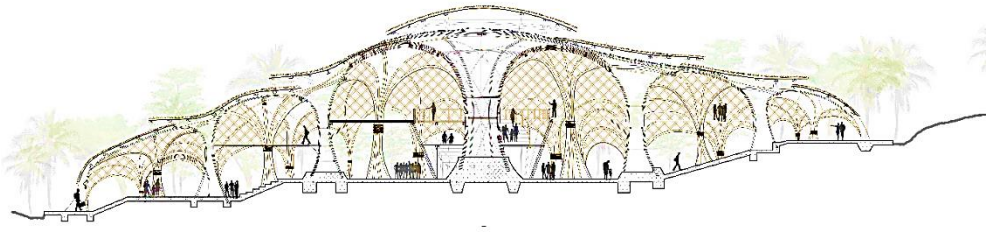

Figure 5: cross section of proposed community and cultural centre. Source: Freddie, 2018.

3.5.4 Vanuatu and the Solomon Islands – learning from ecosystems

Vanuatu and the Solomon Islands both experience urban resilience challenges. Both have rapidly growing urban populations in Honiara and Port Vila respectively (up to eight to nine per cent per annum), many households are largely subsistence-based and ecosystems are pressured by pollution, logging and development. On top of this, climate change is bringing sea level rise, rising air and ocean temperatures and greater rainfall variability that exacerbate existing pressures. Building on nature-based approaches to community resilience, the Pacific Ecosystems-based Adaptation (EbA) to Climate Change Project was set up as a five-year partnership project (2015-2020) between the Pacific Regional Environmental Programme (SPREP) and the governments of Fiji, the Solomon Islands and Vanuatu to demonstrate EbA as a low cost appropriate response to building resilience that can be embedded in policy and planning.[24] Using technical assessments and identification of options that can be used in demonstration activities, the results can be communicated for integration into policy and outreach programmes. Implementation addresses governance arrangements, contractual and funding models, partnerships and on-ground work. Examples include:

- Integrated catchment project for water security and riparian protection which has co-benefits for whole-of-catchment (including coastal areas) watershed protection using a ridge to reef corridor and strategic planting;
- Coastal ecosystem regeneration using strategic planting, traditional knowledge, and long-term funding for amenity, water quality, disaster mitigation and use of local raw materials;
- Intensified urban and peri-urban community gardens and agriculture using sustainable practices;
- Urban forests and agro-forestry encompassing community participation and training in nursery propagation, planting and monitoring; and

24 See Secretariat of the Pacific Regional Environment Programme *Planning for ecosystem-based adaptation in Honiara, Solomon Islands* (Apia, 2018); Secretariat of the Pacific Regional Environment Programme *Planning for ecosystem-based adaptation in Port Vila, Vanuatu* (Apia, 2018); and Secretariat of the Pacific Regional Environment Programme *Planning for ecosystem-based adaptation in Taveuni, Fiji* (Apia, 2018).

- Sustainable integrated housing development encompassing integrated landscape and architecture in appropriate locations integrated with food, energy, water and waste management.

Figure 6: (left) mangrove replanting, Port Vila. Source: photograph courtesy of D Loubser; (right) peri-urban multi-layer bush garden, Port Vila. Source: P Blaschke.

Figure 7: (left) riparian protection, Honiara Botanical Gardens. Source: photograph by B Toki; (right) PEBACC workshop at Honiara. Source: B Toki.

3.6 Conclusions

There are similar themes emerging across the Pacific on climate change impacts and the ability to adapt. Natural hazards are not new. All nations have adapted in the past, but questions remain whether these approaches can cope with the increase in pace and severity of the changes, and to rising seas. It has been shown that strong communities can develop integrated adaptation that addresses a range of hazards, climate change and the changing demographics and external pressures that all nations experience. The spectre of relocation is nigh within and between Pacific nations. We see internal migration within countries and "squatter" settlements emerging on the urban margins dislocated from food production. International migration is constrained by immigration policies. We see increased anxiety in exposed communities in New Zealand as the frequency of storms affects small communities and drought affects rural areas. Climate change is raising moral and equity issues for the richer nations

in the Pacific, including for aid policies versus self-determination. There are also equity issues emerging between different groups in society in all nations in the Pacific – between young and old, men and women, urban and rural, rich and poor (Weir, Dovey and Orcherton, 2017).

Adaptation is universally challenged by governance, institutional and financial constraints and barriers (Boston, 2017; Boston and Lawrence, 2018). While there are several examples of innovative and integrated adaptations, their success and the ability to implement them will be fundamentally challenged by how wide and how fast the adaptation gap will grow and the adaptability of our institutions to make flexible decisions that are robust over time. This in turn relies upon all nations globally making the necessary shifts in development patterns to reduce emissions that can fundamentally move human endeavour to more sustainable lifestyles. In a microcosm, the Pacific represents what is happening globally. More appropriate development pathways that are attuned to nature's limits and work for people are essential.

We learn from New Zealand that our governance and institutional arrangements are far from fit for purpose, and have created inertia that has created a legacy of exposure that is hitting us now and which is shifting a huge burden onto future generations (Lawrence et al, 2013). Current generations are beginning to find that inequitable outcomes are unavoidable, unless we move faster to address their causes. But there is new learning emerging. It has been possible for some communities to come together in new governance arrangements to have those hard conversations about hazards, their threat and options for addressing them over time as the climate conspires. This has happened in New Zealand and in Pacific Island countries alike.

From Nuie, we learn that traditional architectural design, building and siting techniques, and materials for dwellings and community facilities, provided buffers to past climate changes at much less cost than dependency on imported technologies and materials. But can this strategy persist as the impacts of climate change become more intense?

The approach in Vanuatu and the Solomon Islands is providing a deep buffer for the climate changes to come by focusing on capacity development and working with nature in a way that builds multiple benefits.

However, at the heart of these initiatives being successful, is a new brand of leadership derived from the bottom-up which to thrive, requires the wilfully blind and the self-interested to be challenged more forcefully by the community to call our political leadership to account. In the end, our future relies upon it.

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3.8 Glossary[25]

Adaptation: In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process

25 Unless indicated otherwise, references are from IPCC SR15, above n 4.

of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects.

***Incremental adaptation*:** Adaptation that maintains the essence and integrity of a system or process at a given scale. In some cases, incremental adaptation can accrue to result in transformational adaptation.

***Transformational adaptation*:** Adaptation that changes the fundamental attributes of a socio-ecological system in anticipation of climate change and its impacts.

***Adaptation limits*:** The point at which an actor's objectives (or system needs) cannot be secured from intolerable risks through adaptive actions:

- Hard adaptation limit: No adaptive actions are possible to avoid intolerable risks.
- Soft adaptation limit: Options are currently not available to avoid intolerable risks through adaptive action.

Governance: A comprehensive and inclusive concept of the full range of means for deciding, managing, implementing and monitoring policies and measures. Whereas government is defined strictly in terms of the nation-state, the more inclusive concept of governance recognises the contributions of various levels of government (global, international, regional, sub-national and local) and the contributing roles of the private sector, of nongovernmental actors, and of civil society to addressing the many types of issues facing the global community.

Hazard: The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources. Here, the term hazard usually refers to climate-related physical events or trends or their physical impacts.

Likelihood: The chance of a specific outcome occurring, where this might be estimated probabilistically. Likelihood is expressed in this report using a standard terminology (Mastrandrea et al, 2010). See Section 1.6 for the list of likelihood qualifiers used.

Mitigation: A human intervention to reduce emissions or enhance the sinks of greenhouse gases.

Resilience: The capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganising in ways that maintain their essential function, identity and structure while also maintaining the capacity for *adaptation*, learning and *transformation*.

Risk: The potential for adverse consequences where something of value is at stake and where the occurrence and degree of an outcome is uncertain. In the context of the assessment of climate *impacts*, the term risk is often used to refer to the potential for adverse consequences of a climate-related *hazard*, or of *adaptation* or *mitigation* responses to such a hazard, on lives, *livelihoods*, health and *well-being*, *ecosystems* and species, economic, social and cultural assets, services (including *ecosystem services*), and infrastructure. Risk results from the interaction of *vulnerability* (of the

affected system), its *exposure* over time (to the hazard), as well as the (climate-related) hazard and the *likelihood* of its occurrence.

Risk transfer: The practice of formally or informally shifting the risk of financial consequences for particular negative events from one party to another (IPCC, 2014).