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Living on the margins: Climate change impacts and adaptation by remote communities living in the Pacific Islands, the Himalaya and desert Australia

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ABSTRACT

The latest IPCC assessment reports (2021, 2022 and 2023) confirm the devastating impacts of climate change are being felt with increasing frequency and intensity, with these impacts causing profound changes in the livelihoods of remote communities. People who are heavily dependent on agriculture, fisheries and forestry are particularly impacted, with risks and vulnerabilities increasing. These communities are already adapting their livelihoods, yet they often face constrained access to critical information, social safety nets, knowledge and skills, and technology, for effective adaptation to climate change. More importantly, they are typically outside the mainstream decision making and socio-economic structures that provide vital support during times of crisis. This article synthesizes analysis of the climate change impacts on, and adaptation by, remote communities living in very different environments – the tropical islands of the South Pacific, the mountains of the Himalaya in Nepal, and the deserts of central Australia. The authors' analysis informs discussion about the limitations and strengths of local adaptation by remote communities and what strategies can support them build resilience.

1. Introduction

Communities living in remote locations, sometimes thousands of kilometers from major cities, are typically resourceful and self-reliant, supporting their livelihoods through local means and knowledge acquired and shared over many generations. Yet, too often remote communities are on the periphery of national debates about development priorities, marginalized because they are too few, often voiceless, too remote and too expensive to service (Mesikämnen 2016). Being largely self-reliant requires remote communities to be cautious, deliberate and flexible with their livelihoods. However, as a global community we are learning that our past experiences and accepted wisdom may not be a useful guide about how we should live in the future. The catastrophic impacts of climate change and the sudden consequences of a global pandemic illustrate how quickly livelihoods – in developed cities and remote villages – can collapse (IPCC, 2022).

During stable periods, being surrounded by a healthy natural environment has generally led to prosperous and sustainable

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livelihoods for remote communities (Salafsky & Wollenberg 2000), yet the intensifying impacts of climate change are showing clear signs of eroding both the natural ecosystem and the livelihoods its supports. The inextricable link between the natural environment and livelihoods is now fragile and exacerbating the vulnerability of both. That is, when both the natural environment and livelihoods are co-dependent and stressed, decline and risk of collapse without recovery emerges as a threatening possibility (Scherr 2000). Receiving vital support from central governments and national institutions (i.e. the mainstream), such as medical treatment and supplies, particularly during the immediate aftershock of severe weather events or other hazards (e.g. extreme droughts), is critical for supporting the rebuilding of livelihoods, however the impacts of the global pandemic of COVID-19 have shown how quickly the national focus can turn elsewhere when domestic economies are threatened.

This article is timely as there is an unprecedented level of investment being made to address climate change – both mitigation and adaptation. For example, the World Bank invested more than US\$30 billion in 2022 (fiscal year) to support countries tackle climate change, an increase in funding of 19% from the previous year. Of this funding, nearly US\$13 billion was for adaptation and building resilience (World Bank 2022). Also, the Green Carbon Fund (<https://www.greenclimate.fund/>) has recently launched its second phase to build on its initial US\$10 billion to empower ‘climate action’ in developing countries. This article also coincides with the IPCC’s release of its Synthesis Report from the sixth reporting period in March 2023, galvanizing global attention on the critical need to make strategic investments and accelerate change to address climate change (IPCC 2023). We also argue that a more equitable distribution of effort and funding is needed so remote communities are supported to adapt and build their resilience in ways that enhance the natural environment.

This article draws on our experiences of remote communities in diverse environments – the tropical islands of the South Pacific, the mountains of the Himalaya in Nepal, and the desert region of central Australia – to discuss the impacts of, and adaptation to, climate change by remote communities. It also discusses the limits of self-reliance for remote communities who depend heavily on the surrounding natural ecosystems, when livelihoods and the local natural environment are increasingly stressed. We review international literature, critique international agreements and national strategies, and combine our personal knowledge of each case study region (residents and long-term interdisciplinary researchers) to provide an analysis of the extent of current efforts that are supporting remote communities to adapt and build resilient livelihoods at the local level (Jerneck & Olsson 2008; Knickel et al. 2018). In this article we argue the need for a more balanced and inclusive dialogue that moves beyond the mainstream always needing to ‘rescue’ marginalized communities. Careful analysis of the capacity and needs of remote communities and strategic investment could build their resilience and enhance their surrounding environment, rather than perpetuate the view that they will always be vulnerable.

2. The environment and livelihood connection

The impacts of climate change are experienced in a myriad of ways, directly and indirectly – throughout the economy, natural environment and broadly across society (Weerasekara et al. 2021). Geographical diversity and socio-economic inequity mean that the impacts are felt unevenly, and actual adaptation is variable, both locally and globally (Berrang-Ford et al. 2021). The increasing intensity of extreme weather events (e.g. cyclonic storms, heavy or erratic rainfall, devastating wildfires) and extended periods of environmental stress (e.g. extended droughts and heatwaves) are complex and difficult to predict (Pecl et al. 2017). Yet there is growing consensus that the damaging impacts of climate change are escalating (COP26 2021¹; IPCC, 2021; IPCC, 2022; IPCC 2023), causing the decline in ecological integrity that leads to a reinforcing cycle of decline when the next shock or stress occurs (McNutt 2013).

A decline in the health of natural environment directly erodes the health of dependent local communities which is part of the global concern highlighted by the FAO State of Food and Agriculture (2021, p.xv) which estimated that ‘... already 3 billion people cannot afford a healthy diet’. For example, in the South Pacific, seafood provides 50–90% of animal protein in rural communities (Hanich et al. 2018), yet already these marine fisheries are showing signs of decline. In the Himalaya, as rainfall becomes more erratic, there are growing fears that vital food crops will fail (Duncan et al. 2013). In the desert region of central Australia, the loss of wildlife and spread of pest animals and weeds (NESP 2020), restricts opportunities for pursuing many cultural activities and harvest of important food for Indigenous peoples. The extricable link between people and their surrounding environment magnifies their vulnerability when the environment is severely degraded (Salafsky & Wollenberg 2000; Scherr 2000; Thomas & Twyman 2005). Conversely, it also offers an opportunity to build their adaptive capacity (Hill et al. 2020).

There are well-established links between environmental stress and the direct and indirect impacts on human health (McMichael et al. 2006; Rocque et al. 2021). Severe weather events and prolonged stress can lead to injury or death, temporary or permanent disability, and long-term sickness. Damage to food production and supplies, and decline of freshwater supplies, loss of biodiversity and ecosystem services, unsafe housing and unhygienic water and sewerage systems can erode the foundations of healthy communities. In combination, these factors can lead to rapid spread of disease, causing people to withdraw from education and employment, and household and socio-cultural activities. A recent estimate suggests that climate change impacts on human health will cost about US \$2–4 billion per year by 2030 (WHO 2021²), with adverse effects to human health most likely to be experienced in low-income countries (Haines et al. 2006). In Nepal, climate induced disasters cause about 650 deaths and an economic loss of US\$22 million (1.5–2% GDP) per year (MoFE 2021). In Fiji, nearly one quarter of the population is already living below the poverty line, yet this proportion increases to 43% of the rural population where there is weak public health capability – to prepare and respond to crises (Fiji

¹ The 26th UN Climate Change Conference of the Parties (COP) hosted by the United Kingdom, see <https://ukcop26.org/>.

² World Health Organisation – Climate Change and Health, see <https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health>.

Health 2018). In Australia, increasing temperatures have already been a threat killing more people than all other disasters combined (Climate Council 2015), with more severe impacts on desert Indigenous communities who have poorly insulated housing (Quilty et al. 2022).

The numerous pressures on natural landscapes stemming from beyond local communities (e.g. loss of native vegetation due to land clearing for large-scale development or overgrazing by widespread feral animals), erodes the protective capacity and resilience of the natural environment and, therefore, undermines its ability to sustain biodiversity and food security of local communities. We have developed a conceptual framework that includes two dimensions, the first is that prosperous livelihoods are inextricably linked to a healthy environment, particularly for those living outside the mainstream (Estoque et al. 2022), with both positive and negative interactions flowing to both dimensions. The impacts of climate change are stressing both dimensions (i.e. livelihoods and environment) both individually, and in combination – compounding and amplifying the stress for resource-dependent communities. Of particular concern to remote communities is that local agriculture is more heavily exposed and affected by the extreme impacts of climate change, compared to other sectors (FAO 2021).

The second and interlinked dimension of our conceptual framework is that remote communities – geographically, socio-economically and politically, are often located outside the mainstream (i.e. on the ‘margins’), so are poorly connected to expertise, information and services commonly enjoyed by the mainstream (Brown 2011). Crises and disruptions to their livelihoods largely requires local responses and recovery, whether reactive and short-term or more informed and strategic (Berrang-Ford et al. 2021). However, responses to save property and communal infrastructure is inadequate to address the risks and vulnerabilities of remote and marginal communities unless it addresses pre-existing socio-economic disadvantages and vulnerabilities (Maru et al. 2014; Gentle et al. 2018). The history of economic development (e.g. harvesting and introduction of new species) and governance (e.g. change in land tenure and resource management rights leading to a loss of traditional knowledge) has been a powerful influence on the current vulnerability, or adaptive capacity, of remote communities and has led to the perceived ‘remoteness’ from the mainstream.

The close connection goes beyond the natural environment being a source of food and shelter, but also includes a deep cultural attachment for Indigenous peoples – with the land for desert Australian and Himalayan communities, and to the sea in the Pacific Islands region, being at the core of their culture and traditional ecological knowledge (Weir et al. 2017). Damage to the natural environment translates into damage to the traditional culture and a threat to their livelihoods (Hanich et al. 2018). The compounding effects of climate change can erode the natural environment and livelihoods beyond the adaptive capacity of both, leading to a loss of biodiversity and, in extreme situations, forced relocation of communities (e.g. communities in seven countries across the South Pacific have relocated, Bower & Weerasinghe 2021) [see Fig. 1, below].

2.1. Pacific island livelihoods

Communities in close proximity to market hubs with access to transport, and links to major centres have led to livelihoods based on a blend of market-oriented and subsistence practices, with many families now relying on the sale of harvested food crops to purchase necessities of clothes, fuel and transport. Additional expenses, such as the cost of education and medical care, can then lead to families taking out loans and repaying if, or when, harvests are large enough. This becomes a risky business model when harvests are smaller than expected, or prices for farm produce in the markets are depressed – storm damage can severely disrupt the seasonal cycle of farming and take many years for families to recover agronomically and financially. Multiple crises – simultaneously or in short succession, such as storm damage (e.g. due to tropical cyclones Pam in 2015 and Winston in 2016, the volcanic eruption in the Tongan archipelago in 2022) and economic disruption (e.g. collapse of tourism sector due to COVID-19 restrictions), can devastate the

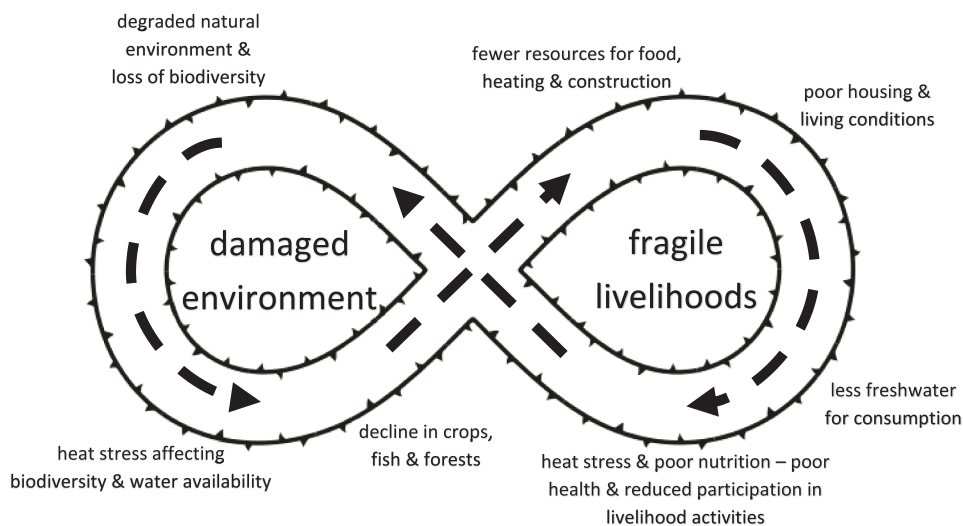


Fig. 1. Connection of pressure and stress between the two dimensions of ‘environment’ and ‘livelihoods’ (source: authors).

livelihoods of families for many years.

Recent experience has also highlighted the vulnerability of rapid urbanization, with major cities and large towns poorly equipped to cope with the influx of people, particularly as many urban centres in the South Pacific have a dire shortage of adequate housing, stretched social services, adhoc employment opportunities, and are commonly in low-lying coastal locations – at high risk of flooding and storm damage (Barnett & Campbell 2010; Kiddle et al. 2017). Despite the limitations with urbanization, the social turbulence after economic shocks (e.g. collapse of tourism sector) and environmental crises (e.g. cyclonic storms) typically leads to a surge of people moving to towns and cities, with many never to return and settle back with their rural communities (Locke 2009; Jones 2012).

2.2. Himalayan livelihoods

The Himalaya region is home to the world's highest peaks, unique cultures, and a rich reserve of biodiversity and natural resources. The Himalayan livelihood is historically based on subsistence agriculture which includes a strong nexus between farming, forests, livestock and weather patterns (Merrey et al. 2018). Subsistence farming is declining and livelihoods changing with increased access to communication, roads and markets. There is also the trend of internal and external migration for alternate employment, mostly by men, which is causing a decline in agricultural production and more women heading households. While migration is helping to reduce risk by contributing to financial resilience through remittances and reduced reliance on land-based livelihoods, such change is also increasing the workload of women and altering community relationships and resource use in rural areas (KC and Race, 2020).

The impacts of climate change in the Himalaya include more frequent hazards such as floods, landslides, heatwaves and cold waves, windstorms, hailstorms, droughts and forest fires (MoFE 2021). These events have resulted in human casualties, loss and damage of private and public property, crop failure and decreased food and livelihood security, increased water scarcity, loss of biodiversity and increased prevalence of human diseases (Gentle & Maraseni 2012; MoFE 2019; MoFE 2021). Pre-existing conditions, such as the limited access to information, services and resources, restricted access to and control over natural resources (e.g. forests, land and water), as well as the declining affordability of basic services (e.g. drinking water, irrigation equipment, health care, financial credit and insurance) remain key factors of vulnerability (Gentle et al. 2014; IPCC, 2022; Surminski et al. 2016).

2.3. Desert Australian livelihoods

Desert Australia typically features sparsely populated communities which are home to a high proportion of Indigenous people. The vast 'desert' region has an arid climate that supports a grassland and desert ecology³ (70 % of the area of the Australian mainland is arid or semi-arid) and includes highly dispersed remote Indigenous communities and small mining communities serviced by a central town. The service towns usually have a transient population mostly working in the service sector (e.g. government agencies, hospitals), tourism and limited primary education institutions (McGregor & James 2011). Australian inland communities and towns are already experiencing the direct and indirect impacts of high summer temperatures (Bardsley & Wiseman 2012; Race et al. 2016a). These communities are vulnerable to climate change and associated health impacts due to their geographic isolation, decline in infrastructure when exposed to extreme weather, limited economic resources, limited transport, and existing health burdens (Race et al. 2016b; Hall & Crosby, 2020). Energy poverty is another salient issue in remote communities, where many energy-intensive adaptive measures (e.g. cooling air conditioners) are unaffordable or unavailable for remote residents (Havas et al. 2015).

Climate projections indicate an increase in frequency and severity of hot weather events for this region (BoM & CSIRO 2020). The most direct impacts of climate change for people in desert Australia is from heat stress (Race et al. 2017; Quilty et al. 2022) as it affects both general livability and working conditions. Hotter environments will further strain working conditions and lead to a decline in workforce productivity (Zander et al. 2015). Most remote organisations already face a high staff turnover (Wakerman et al. 2019), so recruiting replacement staff and retaining them will become more difficult as living conditions become arduous and more of the resident population and seasonal workers (e.g. servicing the horticultural and pastoral industries, mining industry, health care and service sectors) decide to work in more livable locations (Fitts et al. 2020; Pendrey et al. 2021).

3. Discussion: Strategies to build capacity and strength in remote communities

Remote communities have always sustained their livelihoods due to their intricate knowledge of the local environment – what it can produce, how it regenerates, when to harvest. The effects of colonization, industrialization and modernization have altered and disrupted traditional practices, yet their underlying knowledge and ingenuity has enabled them to remain resilient through hazardous times. Despite living sustainably within the capacity of their local environment for millennia, the nature and rate of change occurring to the livelihoods of remote communities appears to be beyond their adaptive capacity to respond and recover – there are signs that the change exceeds their level of resilience. For example, many of the current adaptations appear reactive or short-term, expensive and providing limited protection (e.g. purchasing bottled water and imported foods, constructing seawalls as a barrier to inundation by seawater during storms, relying on electrical appliances powered from conventional sources).

Also, recent measures to control the COVID-19 pandemic disrupted global and national supply chains, harming '... food security and nutrition of billions of people, particularly in low-income countries and among the poorest.' (FAO 2021, p.xvi). This situation

³ Australian Climate Zones (bom.gov.au).

illustrates that some local adaptation strategies (e.g. purchasing imported foods when crops fail) can actually just increase their vulnerability when shocks and stresses are compounded. Analysis of responses to the 2015 earthquakes and COVID-19 in Nepal revealed that the local institutions were the first to reach remote communities and were key to saving lives and property and provided immediate responses using their local knowledge, trusted social capital and mobilisation of local resources (Gentle et al. 2020). Similarly, in Australia Indigenous organisations provided vital leadership in ensuring travel restrictions were imposed in a timely manner and remote desert communities were protected from the spread of COVID-19 (Fitts et al. 2020). However, there is a need to more fully recognise the strengths and experiences within local communities, and further enable the role of local institutions to work with remote communities at the time of crisis as well as for anticipatory adaptation (Foran et al. 2019; Rijal et al. 2021).

There has always been an occasional crisis or shock that affected remote communities, as anywhere, and historically remote communities were largely able to recover their livelihoods because of the surrounding community (social capital) and natural environment (natural capital). However, a mix of debilitating development (e.g. higher input and living costs) and governance pressures (e.g. restricted use of customary resources), and the increasingly severe impacts of climate change, have depleted both the social and natural capitals that previously provided the resilience for remote communities. The inextricable link between ‘environment’ and ‘livelihoods’ that has for so long provided a reinforcing strength (Maru et al. 2014), is now creating a heightened vulnerability – with both on the brink of collapse. Yet it need not be this way, as information about the potential adaptive capacity of communities can inform decisions to change both the type of development (e.g. climate-proof, local food production, affordable housing, affordable and renewable energy, educated and empowered local communities) and governance arrangements (e.g. more localized decision-making) (Chaudhury et al. 2016; Jones & Boyd 2011; Stafford Smith & Huigen 2009). Resilience theory indicates that adaptive capacity needs to be strengthened at the local scale (Nordgren et al. 2016), with it argued ‘... that adaptation needs to be facilitated, promoted and achieved in the local context where vulnerability to climate change is perceived and experienced, especially among the poorest populations’ (Jerneck & Olsson 2008, p.179).

4. Conclusion: Having a clear view of those on the ‘margins’

We need a change in paradigm and practice in the ‘mainstream’ so that people choosing to pursue their livelihoods away from bustling capital cities with modern infrastructure and services are not seen as merely ‘marginal’ – geographically and socio-economically. Typically, remote communities are deeply rooted and enriched by living on their customary lands, fulfilling important cultural responsibilities (for their communities and land) and largely practicing traditional resource-dependent livelihoods. Somewhat ironically, they are often popularized in the mainstream media as living quintessential (traditional) livelihoods, yet they are often too quickly forgotten by the mainstream when deciding on the investments in services and support.

There is a need to recognize that living on the margins, in most cases, is a result of socio-economic and political marginalization where remote communities are living with severe impacts and uncertainty. Governments are showing promising signs – recognition of climate change impacts and the severe impacts on livelihoods (‘business as usual’ is no longer a plausible option), yet the translation of policy intent into meaningful capacity building and resilience is hard to detect in remote communities. Budgets and decisions still largely remain centrally controlled, and provision of support services during critical times of shock and stress are slowed by complicated bureaucracy and long pathways (Nagoda 2015) – pathways that are easily dislocated during a crisis. Also, excessive focus on expensive technological ‘fixes’ can distract from strategic investment in the socio-political systems of remote communities. Furthermore, attempts to replicate the strategies from the mainstream (e.g. imported foods, expensive home appliances) may give a false sense of resilience and security, delaying the socio-political transformation needed in remote communities and building their sustained resilience (Wilson et al. 2020).

Collectively, we now have the awareness to change direction and ‘walk’ a different pathway and achieve economic development *and* environmental sustainability that is designed, implemented and managed by local communities – remote, rural and urban. Of course, support from central governments will be vital, but this support needs to be articulated and managed by local communities who have formed their own coordinating entity. If the promise of ‘green’ finance, as declared in the *Paris Agreement* (COP21, 2015⁴), can flow through governments to nurture the ‘grassroots’ of remote communities, we can all reimagine the future – where living remotely need not mean living without, thereby ensuring that living on the margins does not mean having to live in poverty with a degraded environment.

Author contributions.

- Digby Race conceptualized the article and contributed to the analysis and writing.
- Popular Gentle contributed to the analysis and writing.
- Supriya Mathew contributed to the analysis and writing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

⁴ The *Paris Agreement* was adopted at the 21st UN Climate Change Conference of the Parties (COP21), see <https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement>.

Data availability

No data was used for the research described in the article.

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