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Indigenous Knowledge for Climate Change Assessment and Adaptation

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INDIGENOUS KNOWLEDGE FOR CLIMATE CHANGE ASSESSMENT AND ADAPTATION

Many indigenous peoples and marginalized populations live in environments that are highly exposed to climate change impacts, such as arid zones, small islands, high-altitude regions, and the Arctic. As a result of this heightened exposure and their natural resource-based livelihoods, these societies are already observing and responding to changes exacerbated by climate change. Local and indigenous knowledge is therefore a source of invaluable information for climate change assessment and adaptation. This unique transdisciplinary publication is the result of collaboration between UNESCO's Local and Indigenous Knowledge Systems (LINKS) programme, the United Nations University's Traditional Knowledge Initiative, the Intergovernmental Panel on Climate Change (IPCC), and other organizations. Chapters written by indigenous peoples, scientists and development experts provide insight into how diverse societies observe and adapt to changing environments. A broad range of case studies illustrate how these societies, building upon traditional knowledge handed down through generations, are already developing their own solutions for dealing with a rapidly changing climate and how this might be useful on a global scale. Of interest to policymakers, social and natural scientists, and indigenous peoples and experts, this book provides an indispensable reference for those interested in climate science, policy and adaptation. This publication is the second in the "Local & Indigenous Knowledge" series published by UNESCO.

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This book should be cited as

Nakashima, D., Krupnik, I. and Rubis, J.T. 2018. *Indigenous Knowledge for Climate Change Assessment and Adaptation.* Local & Indigenous Knowledge 2. Cambridge University Press and UNESCO: Cambridge and Paris.

University Printing House, Cambridge CB2 8BS, United Kingdom

One Liberty Plaza, 20th Floor, New York, NY 10006, USA

477 Williamstown Road, Port Melbourne, VIC 3207, Australia

314–321, 3rd Floor, Plot 3, Splendor Forum, Jasola District Centre, New Delhi – 110025, India

79 Anson Road, #06-04/06, Singapore 079906

Cambridge University Press is part of the University of Cambridge.

It furthers the University's mission by disseminating knowledge in the pursuit of education, learning, and research at the highest international levels of excellence.

Published jointly by the United Nations Educational, Scientific and Cultural Organization (UNESCO), 7, Place de Fontenoy, 75007 Paris, France, and Cambridge University Press, University Printing House, Shaftesbury Road, Cambridge CB2 8BS, United Kingdom.

www.cambridge.org
Information on this title: www.cambridge.org/9781107137882
DOI: 10.1017/9781316481066

First published 2018

Printed in the United Kingdom by TJ International Ltd. Padstow Cornwall

A catalogue record for this publication is available from the British Library.

Library of Congress Cataloging-in-Publication Data
Names: Nakashima, Douglas, editor. | Krupnik, Igor, editor. | Rubis, Jennifer T., editor.
Title: Indigenous knowledge for climate change assessment and adaptation / edited by Douglas Nakashima, Igor Krupnik, and Jennifer T. Rubis.
Description: Cambridge, United Kingdom; New York, NY: Cambridge University Press, 2018. | Includes bibliographical references.
Identifiers: LCCN 2017037842 | ISBN 9781107137882 (hardback)
Subjects: LCSH: Indigenous peoples – Ecology – Case studies. | Human beings – Effect of climate on – Case studies. | Traditional ecological knowledge – Case studies. | Climatic changes – Case studies. | BISAC: SCIENCE / Earth Sciences / Meteorology & Climatology.
Classification: LCC G50.I53 2018 | DDC 305.8–dc23
LC record available at https://lccn.loc.gov/2017037842

ISBN Cambridge 978-1-107-13788-2 Hardback
ISBN UNESCO 9789231002762

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SPREP. 2011. *Pacific Islands Framework for Action on Climate Change 2006–2015*, 2nd edn. APIA, Secretariat of the Pacific Regional Environment Programme (SPREP). www.sprep.org/attachments/Publications/PIFACC-ref.pdf

Taylor, J. 2008. *The Other Side. Ways of Being and Place in Vanuatu*. Honolulu: Hawai'i University Press.

Torrence, R. 2002. What makes a disaster? A long-term view of volcanic eruptions and human responses in Papua New Guinea. In Torrence, R. and Grattan, J. (eds.) *Natural Disasters and Culture Change*. London: Routledge, pp. 292–312.

UNEP (United Nations Environment Programme). 2005. Pacific Island villagers first climate change refugees. *UN Environment Builds Bridges Between Vulnerable Peoples in the Arctic and Small Islands*. UNEP Press Release. www.unep.org/Documents.Multilingual/Default.Print.asp?DocumentID=459&ArticleID=5066&I=en

Waddell, E. 1975. How the Enga coped with frost: Responses to climatic perturbations in the Central Highlands of New Guinea. *Human Ecology*, 4(4): 249–73.

Warrick, O. 2011. The adaptive capacity of the Tegua island community, Torres Islands, Vanuatu. *Report for the Department of the Environment*, Australian Government. www.environment.gov.au/climate-change/adaptation/publications/adaptive-capacity-tegua-island-community-torres-islands-torba-province-vanuatu

Weightman, B. 1989. *Agriculture in Vanuatu*. Cheam, UK: The British Friends of Vanuatu.

Wescott, J. 2012. *The Good Lake, the Possible Sea: Ethics and Environment in Northern Vanuatu*. Unpublished PhD dissertation, University of California, San Diego.

Wheatley, J. I. 1992. *A Guide to the Common Trees of Vanuatu. With lists of their Traditional Uses and ni-Vanuatu names*. Port Vila: Vanuatu Department of Forestry.

4

Indigenous Knowledge in the Time of Climate Change (with Reference to Chuuk, Federated States of Micronesia)

Rosita Henry and Christine Pam

In order to understand how social resilience might be achieved in the face of climate change, it is crucial to consider how people employ everyday 'local' and 'indigenous knowledge' to deal *in practice* with uncertainty and risk in their lives. Focusing on responses to climate change discourse in the Pacific, with particular attention to Chuuk, Federated States of Micronesia (FSM), we call for more fine-grained ethnographic studies on how the global discourse of climate change transforms knowledge and practice at the local level.

According to the 2010 FSM Census, the state of Chuuk has a population of 48,651, or approximately 47 per cent of the total population of the Federated States of Micronesia, distributed unevenly over about forty islands. Chuuk Lagoon, which lies at the heart of the state, consists of a barrier reef encircling nineteen small 'high' volcanic islands, including the capital, Weno. Around this heart are numerous coral atolls and 'low' coralline islands.

This diversity of high and low islands poses complex socioenvironmental challenges for the FSM in relation to the country's capacity to respond to extreme climatic events. The state of Chuuk, in particular, provides instructive case material on how the discourse of global warming is being taken up and interpreted at the local level and on the conjuncture between contemporary scientific predictions of climate change and indigenous theories of causation and understandings of climate variability and extreme climatic events. What kinds of knowledge and what sorts of practices might island-based communities employ at the grass roots to deal with the impacts of climate change? We consider this question on the basis of research conducted in Chuuk; in the capital of Weno and on the small low-lying coral island of Moch, in the Mortlocks Region to the south-east of Chuuk Lagoon.

Indigenous Knowledge

There have been numerous scholarly deliberations about the definition of indigenous knowledge, in tandem with debates about 'the validity of the concept of indigeneity' (Dove, 2006: 191). It is beyond the scope of this chapter to review these debates yet again (Agrawal 1995; Ellen et al., 2000; Merlan, 2009). Nevertheless, it is important to consider

the nature and substance of indigenous knowledge, or any category of knowledge for that matter, if one is to understand how such knowledge might be employed in the face of change. In other words, behind this chapter lie deep philosophical questions about the nature of knowledge per se and how or where it might find tangible expression.

'Indigenous knowledge' is a category produced in the context of contemporary representations of identity and indigenous rights politics, but it also has substance. That substance is more than particular traditional technologies and taxonomies, or even particular practices, associated with the natural environment. That substance is knowledge of the relatedness and interdependency among things (human and non-human). As such, indigenous knowledge includes the cosmological understandings, values and principles that *inform* the use of technologies, that *generate* taxonomies and that *find expression* in practices of social obligation and responsibility, including in practices of negative reciprocity.

Thus our interest is not only in knowledge as it manifests itself in social practice, but also in how knowledge categories themselves (local, indigenous, scientific) come to be strategically employed in a global politics of climate change. In order to understand how people might respond to climate change predictions, as well as deal with actual climatic events, it is necessary to explore how global scientific discourse is taken up at the local level, and the transformative effect it has on local knowledge. For example, as Rudiak-Gould notes, among Marshall Islanders 'scientific knowledge of climate change has powerfully influenced local perceptions of environmental change: precisely that which seems to best exemplify "pure" traditional ecological knowledge' (2010: 12).

Systems and Practices

The predominant approach among scientists (including many social scientists) to understanding responses to climate change has been a systems-based one, where social and ecological variables are not analysed in isolation but in terms of their interrelation as part of a system. Thus, emphasis has been placed on concepts of the 'vulnerability', 'adaptation' and 'resilience' of socioecological systems. Such concepts 'do not exist in isolation from the wider political economy' (Adger et al., 2006: 5). It is important to recognize that complex historical, political and economic factors constitute the social dimension of any socioecological system. In the context of the Pacific one must keep in mind the shattering effects of the Second World War and catastrophic anthropogenic factors such as atomic testing in the Marshall Islands, as well as the more recent impacts of globalization, population movement, rapid population growth and other threats.

Adger et al. (2005: 1036) define resilience as

> the capacity of linked social-ecological systems to absorb recurrent disturbances such as hurricanes or floods so as to retain essential structures, processes and feedbacks. Resilience reflects the degree to which a complex adaptive system is capable of self-organization (versus lack of organization or organization forced by external factors) and the degree to which the system can build capacity for learning and adaptation.

They argue that the concept of resilience marks 'a profound shift in traditional perspectives, which attempt to control changes in systems that are assumed to be stable, to a more realistic viewpoint aimed at sustaining and enhancing capacity of social-ecological systems to adapt to uncertainty and surprise' (Adger et al., 2005: 1036).

Yet, what are the human qualities, or characteristics, which define this capacity to adapt? What is the relationship between such adaptive capacity and knowledge systems (whether scientific or indigenous)? In considering vulnerability and resilience it is necessary to take into account the social practices that not only underpin and generate knowledge, but also constitute knowledge systems in and of themselves (knowledge of how to live in the world as social beings).

Although systems-based approaches have generated useful models, they are not able to effectively capture the complexities of people's real-life experiences and responses. Models must be informed by studies of actual practices of contemporary everyday life. While climate change is a global phenomenon, there is great regional and local variability in terms of impact. As noted in the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC):

> Climate models are simplifications of very complex natural systems; they are severely limited in their ability to project changes at small spatial scales, although they are becoming increasingly reliable for identifying general trends. In the face of these concerns, therefore, it would seem that the needs of small island states can best be accommodated by a balanced approach that combines the outputs of downscaled models with analyses from empirical research and observation undertaken in these countries.
>
> (McCarthy et al, 2001: 870)

However, in the Fifth Assessment Report, Nurse et al. (2014: 1626) note that while there has been 'a problem in generating formal climate scenarios at the scale of small islands because they are generally much smaller than the resolution of the global climate models', this has improved with the use of 'the new Representative Concentration Pathway (RCP) scenario General Circulation Models (GCMs) with grid boxes generally between 100 and 200 km^2 in size'.

Nevertheless, because local conditions vary widely on different island types it is difficult to predict climate change impacts. The issue is not just geographical and meteorological variability. The way people deal with any kind of change is dependent on pre-existing local knowledge, as well as on their adoption and interpretation of new knowledge, including science-based theories of climate change. It is also dependent on locally *experienced* historical, social, cultural and political contexts and administrative environments (Torry, 1979). For example, Marshall (1979) provides a case study on how the distribution of aid in the wake of a natural disaster can prove problematic when 'local administrative politics' are not taken into account. He documents the distribution of relief in the Mortlock Islands (22 May–7 July 1976) by the United States government and the Red Cross following cyclone Pamela and shows that more politically powerful island communities received the most aid even though they were the least impacted by the

cyclone. Although Marshall conducted his study over forty years ago, his general point still holds – political and administrative contexts play a significant role in how effectively people are able to respond to climate change impacts. Thus, systems-based research on climate change must be supported by practice-based research at the community level that will provide an understanding of the impact of local political realities on response strategies (see also Barnett and Busse, 2001). As Nurse et al. (2014: 1635) argue 'Recent moves toward participatory approaches that link scientific knowledge with local visions of vulnerability offer an important way forward to understanding island vulnerability in the absence of certainty in model-based scenarios.'

Pacific States and the Discourse of Global Warming

Climate models predict that low-lying atoll states in the Pacific, and elsewhere, are highly vulnerable (Barnett and Adger, 2003; Pittock, 2005; Adger et al., 2014; Nurse et al., 2014). States such as Tokelau, Tuvalu, the Marshall Islands and Kiribati, which are composed entirely of low-lying coral atolls that rarely exceed 3–4 m above present mean sea level, are considered most at risk (Barnett and Adger, 2003). However, states that include high islands, such as the Federated States of Micronesia, also face disastrous consequences because of climate change, including sea-level rise, rise in sea surface temperature and increased intensity and frequency of extreme weather events. On the high islands, human populations are concentrated in the coastal zone, making them vulnerable to sea-level rise which 'will exacerbate storm surge, erosion and other coastal hazards, threaten vital infrastructure, settlements and facilities, and thus compromise the socio-economic well-being of communities and states' (Mimura et al., 2007: 689). One of the key matters of concern is the impact of climate change on water security (Nurse et al., 2014: 1622–3).

Climate science predictions are well accepted in the Pacific, with Pacific Island states responding by developing a regional framework for action on climate change, climate variability and sea-level rise (2000–2004), superseded by the *Pacific Islands Framework for Action on Climate Change 2006–2015*. There has also been wide acceptance of popular media representations among Pacific Islanders of their plight as victims of global warming. For example, Rudiak-Gould (2010) discusses how climate change doomsday prophesies have been taken up in the Marshall Islands. Some states have appropriated a discourse of vulnerability and enlisted the metaphor of 'smallness' in challenges to global debates on climate change (Kempf, 2009). Some states have also strategically employed the media as a means of seeking international recognition and assistance. Connell (2003) expresses concern about this, arguing that the acceptance of 'doomsday' predictions blinds people to immediate, local (including anthropogenic) causes of environmental degradation. Barnett and Adger (2003: 329) suggest that acceptance of the inevitability of imminent disaster and 'lost confidence in atoll-futures' may be more of a problem than the physical impact of climate change itself, in that it may lead to 'changes in domestic resource use and decreased assistance from abroad'.

Figure 4.1 Moch Island, Mortlock Islands, Chuuk, FSM. (A black and white version of this figure will appear in some formats. For the colour version, please refer to the plate section.)

Chuukese Concerns About Climate Change

Because Chuuk and other small island states have long faced more immediate socio-economic problems (including poverty, high unemployment, housing, education and health care), one might expect that climate change issues would be accorded a low priority. Yet, our research on Chuuk reveals that government officers and other Chuukese are deeply concerned about the potential effects of climate change. During our pilot study and the longer-term ethnographic fieldwork that followed, we interviewed people living in the high island capital of Weno as well as members of the Mochese community living predominantly on their home island in the Mortlocks (Figure 4.1). The pilot study was conducted in 2008 and involved in-depth interviews with government officers in Weno, and a field trip to Moch at the invitation of the Mochese research officer at the Chuuk Historic Preservation Office (Henry et al., 2008). Pam's doctoral research was an extension of this study, conducted primarily with the Mochese community living on their home island, but also among the extended community living in Weno. Her research was based on participant observation over a period of eight months between 2009 and 2011, and was especially informed by her involvement with a climate change project initiated by the Moch municipal government.

Because of urbanization processes, many of those we interviewed who were living in Weno originally hailed from outer atoll islands in Chuuk. They conveyed great fears for the future of their home islands, emphasizing that these were in the process of gradually disappearing:

> It's a low flat island … When I go back it looks like it's getting worse because some of the beach I saw before is gone and the island is getting *smaller and smaller* because the waves wash away the sand. It's not like before … Our main food is taro and the waves come into the taro patch and kill off the crops.

> *Little by little* our shore is disappearing and coconut trees are standing in water. It's happening more and more over the years. We heard that pretty soon we'll be all underwater, the whole of the Mortlocks. They say this is the time of evacuation. They say this is the time to evacuate people to higher ground. Right now we are suffering erosion and we are suffering the high tide. In our language we call it *setupul*.

Research participants described their experiences of storm surges and unusually high tides as well as their memories of particularly extreme climatic events such as cyclones (typhoons). In particular, cyclone Pamela, which hit the Mortlock Islands in May 1976, was well remembered. It washed away a quarter of the island of Kuttu, a small coral island (0.2 square miles with a population of about 350), which forms part of the Satawan Atoll. According to Marshall (2004: 65), all the islands in the Mortlocks were badly affected by this cyclone. Namoluk, where he conducted his field research, was completely submerged by waves that swept across the island for fifteen to eighteen hours.

> The saltwater entered the taro swamps and killed all the taro plants, and a high percentage of breadfruit, coconut and banana trees perished outright from the combination of salt, wind and waves. Equally devastating was the substantial damage to the atoll's reefs and reef organisms many of which serve as a regular food source.
>
> (Marshall, 2004: 65)

The cyclone resulted in the formation of a new islet, which was immediately named 'Pamela' by 'local wags' (ibid.).

For people living on Moch, typhoons loom large in the social memory of the community. While discussing the effects of a tidal surge on the island in late 2008, one woman said she was scared when the waves came close to her house because it reminded her of Typhoon Pamela. Others remembered listening to the old people tell stories about the typhoon that hit the island in 1907 (Spennemann, 2007); how they heard the screams of people from the islands of Satawan and Ta as they were swept out through the channel and into the ocean, and how afterwards they found people dead on the reef.

Clearly, storm surges, high tides and cyclones are not new phenomena in this environment, and people in times past developed various cultural responses and strategies to cope with their impact. The dynamic potential for transformation of the seascape is recognized within Micronesian cosmology, as reflected in narrative knowledge of islands disappearing into the sea, or being deposited within the seascape by ancestral beings (Lessa, 1961; Mitchell, 1973; Lessa, 1980; Goodenough, 1986). According to Mitchell (1973: 23) there

is a recurrent motif in these narratives of islands being 'fished up' from under the sea with a hook or a net. Other narratives tell of islands being 'kicked' out of their original place by a culture hero or of being formed from a rock or sand being thrown onto the water or dropped into the ocean (Lessa, 1961: 275).

Yet, the concern today among Chuukese people is that climate change will result in this dynamic world becoming so drastically transformed that it will no longer be habitable. Certainly there was a general consensus among people living on Moch that the high tide and waves were not as they were before. Many men noticed that high tide was getting higher each year and the low tides that exposed the reef happened less often. One man remembered that when he was younger the high tide did not 'go up inland' but that now it was very easy; 'the high tides just wash up inland'. Women also noticed the changes to the tides – that a few years ago the tide was low and you could walk out on the reef, but that now the tide stayed high – and there was agreement that the changes were happening rapidly, that every year the tide was higher and every year it was getting worse.

Additionally, there was agreement within the Mochese community that the land was getting smaller. As one man said, not only was there increasingly more people and more houses on the island, but the land itself was being eroded by the waves. People said that each year they watched the waves take away land, and they were concerned for the loss of significant food and medicinal plants that grow on the shore.

People were worried about the prospect of having to abandon the atoll islands altogether and of having to evacuate to the high islands. While their chief concern was the gradual disappearance of the islands, they were also troubled about the immediate effect of sea-level rise on water resources:

> There is only one deep well on the island that is not brackish, but all the deep wells around the shore have been affected by saltwater. The water in the ground itself is salty and this has killed the taro. All the deep wells around the shore are all half seawater and half fresh. They say, 'Don't drink; you drink fresh water catchment.'

Concerns about saltwater inundation extend to the immediate impact this has on food security on atoll islands, especially given the importance of the freshwater lens for the cultivation of swamp taro, the mainstay of subsistence agriculture for island communities. This was recognized by some as the primary concern for the Mochese community:

> First we have to think about our survival – food. That's what we have to think about first. Ten years from now breadfruit and taro patch and whatever will be dying out, and after that the island is sinking … But first thing is the plants, food.

Chuukese government officers we interviewed in 2008 (including the Chuuk State Historic Preservation Officer, the Disaster Coordinator, Federal Emergency Management Authority and the Executive Director, Environmental Protection Authority) conveyed concern about the condition of the freshwater lenses on the more vulnerable outer islands and their capacity to maintain their current populations. They also expressed apprehension about the limited capacity of Chuuk State to handle the socioeconomic and political consequences of resettlement within the state.

Figure 4.2 Land reclamation on Weno, Chuuk Lagoon, FSM. (A black and white version of this figure will appear in some formats. For the colour version, please refer to the plate section.)

The money is not enough [from the Compact of Free Association with the United States of America]. So when we heard about this climate change, we are worried about these outer islands, because we do not have enough [money] … We need ships, we need planes to evacuate the people.

While people on Moch made it clear they do not want to leave their island, there was talk of evacuation that expressed similar concerns. In particular, one man who identified himself as a teacher of climate change criticized the government for not having a plan for the island communities:

It's good for our mayor and our senators to … find the money to start to move the people to somewhere else, to immigrate to the US, to immigrate to Hawaii, Guam, wherever we accepted to immigrate. I think that's the only way. [But] there is no such thing because as I told you, there is no future plan for thirty years on this island. There is no plan.

The Executive Director of the Environmental Protection Authority noted that the high islands were already densely populated and that the migration of increasing numbers of outer islanders to the capital of Weno was causing competition for land to become acute. Thus, it is not surprising to find land reclamation activity along much of the foreshore of Weno (Figure 4.2), a practice that has caused concern because it is thought to place 'communities and infrastructure in positions of increased risk' (Nurse et al., 2014: 1623).

The social situation of the landless in Chuuk is unenviable. As Hezel writes: 'If land was life for traditional Micronesians, then loss of land was a form of death; in Chuuk, according to one author (Parker, 1985] it was lamented with the cry "I am no longer alive"' (Hezel, 2001: 34–5).

In its 1997 Climate Change National Communication, the FSM National Government acknowledges that 'land ownership is the most valued right in Micronesia; the landless person has much lower status than the landowner' (FSM, 1997). Thus, land is valued not only for its economic use-value but also for the social status and political power that derives from its ownership. Moreover, the concept of personhood, what it means to be *fully human*, is tied to one's association with land, as are the very qualities of a person. For example, the lagoon island of Tonoas is said to be a reposing man and people living in the district around the highest peak of the island, which represents the head of the man, are said to have large heads through scheming and 'planning evil deeds' (Young et al., 1997: 16).

Traditionally, a complex system of social security based on ceremonial exchange networks, kinship practices and complex land tenure systems assured rights to and association with land for most people in this region of small islands. Land is, in principle, inherited matrilineally but patrilineal succession is recognized, with men being able to give land to their sons while they are still alive. Claims can arise from living on land, cultivating it, having ancestors born or buried on it and so on. People can have interest in many plots or trees in different locations. Cultivable land is divided into named tracts owned by different lineages, as are the offshore waters and reefs (Murdock and Goodenough, 1947).

However, such cultural practices may not be able to keep up with and/or sustain the large population shifts that have occurred in Micronesia over the past forty years as, for example, ethnographically documented by Marshall (2004) on the island of Namoluk in the Mortlock Islands. While Nurse et al. (2014: 1625) note that there is currently 'no unequivocal evidence that reveals migration from islands is being driven by anthropogenic climate change', leaders we interviewed on Moch Island considered that migration may well be inevitable and that eventually the whole island may have to be evacuated. Chuukese government officers in Weno expressed concern over the great pressure that migration already exerts on state resources and particularly on infrastructure in the high islands of the lagoon. Outer islanders in the capital were worried about their ability to support their kin should it be necessary to evacuate them from their home islands: 'See, it's a really sad situation. If they come in, the money that we have is not enough to share around. So they have to stay out there and we send them what we can.'

Outer island respondents living in Weno expressed a strong connection to their home island. While they feared that evacuation might eventually be necessary, they stated that it was important to maintain their families on their home islands in order that these places, so significant to their identities, would continue to be cared for and nurtured. As Marshall notes in relation to the people of Namoluk, fewer than 40 per cent of whom live on the island itself, individuals continue to derive their personal identities 'from a collective community identity that is rooted in place: their island home. They carry Namoluk with them when they move – wherever they move' (2004: 134).

This is the case also for the Mochese community, which prioritizes sharing as 'a way of living' and as a means through which to activate a network of relationships that extend well beyond the home island. For example, our research evidences the profusion of energy invested by people within the community, both on Moch and Weno, to sustain their connections through the ongoing sharing of resources. Certainly the boat that travelled between Moch and Weno always had people on-board taking local foods to relatives living in Weno, and likewise the boat from Weno to Moch was loaded with processed foods, and with building materials, fuel, letters from loved ones and parcels from relatives living in the USA. Indeed, while much is written about the 'dependence' of small island communities on support from off-island relatives (Connell, 2010: 122–3; Birk, 2012: 89), it is the intentional activities of sharing – *to and from* the home/island – that establishes identity and a way for belonging.

Providing support for kin on the home islands is not only important in terms of identity but also for more practical reasons. If coral islands are not inhabited, if people do not dwell there, then these places may become even more vulnerable. For example, Rainbird (2004: 171–2) attributes recent coastal transgression in some areas in the Chuuk Lagoon to the fact that, following adoption of a western cash economy, 'coastal lowlands are not being maintained and consequently the sea is reclaiming the space it had enjoyed prior to human intervention' (Rainbird, 2004: 171).

Similarly, a preliminary report to the Conference of the Parties for the Convention on Biological Diversity by the Federated States of Micronesia (FSM, 2001: 17) notes that 'urbanisation removes people from day to day contact with natural resources so that there is no longer a feedback system between people and their environment that could alert people to problems'.

Pam's research reveals an intense relationship between people and a coral landscape, a relationship that is realized through practices that maintain the home island as a successfully and intensely inhabited place – as a place worthy of attachment and belonging. These practices of engagement with coral included attending to taro pits and seawalls, weeding the main path, spreading clean white coral around buildings and keeping socialized areas open and free from overgrowth and debris (see also Besnier, 2009).

Knowledge for Orienting to Climate Change

In 2001, a Chuukese task force appointed to report on the impact of 'unusual sea-level rise and its adverse effects' recommended that in order to adapt to global climate change it is important to:

> Re-orient ourselves with our own traditions and cultural values to be the driving force on how we counter this onslaught of events. Our main problem stems from the loss of our values and the old ways whereas we take great pride in the things that we planted and reap from the ground as opposed to buying and relying entirely on cash (money) economy.
>
> (Billimont et al., 2001)

The IPCC has considered the significance and relevance of indigenous knowledge for dealing with climate change. For example, in its contribution to the Fourth Assessment Report of the IPCC, Working Group II provides case studies on 'Indigenous knowledge for adaptation to climate change' in the report on small islands (Parry et al., 2007). However, Mimura et al. (2007: 712) in the same report note that while the use of traditional knowledge as a means of adaptation to climate change has been advocated in relation to small island states, further research on whether such knowledge can realistically enhance 'adaptive capacity and resilience' is required, given the dire future scenarios predicted:

> With respect to technical measures, countries may wish to pay closer attention to the traditional technologies and skills that have allowed island communities to cope successfully with climate variability in the past. However, as it is uncertain whether the traditional technologies and skills are sufficient to reduce the adverse consequences of climate change, these may need to be combined with modern knowledge and technologies, where appropriate.
>
> (Mimura et al., 2007: 712)

The relevance of indigenous knowledge has been further discussed in the IPCC Fifth Assessment Report, where it is concluded that:

> As in previous IPCC assessments, there is continuing strong support for the incorporation of indigenous knowledge into adaptation planning. However, this is moderated by the recognition that current practices alone may not be adequate to cope with future climate extremes or trend changes. The ability of a small island population to deal with current climate risks may be positively correlated with the ability to adapt to future climate change, but evidence confirming this remains limited.
>
> (Nurse et al., 2014: 1636)

Certainly, climate change scenarios paint a dismal picture for small Pacific Island states. However, one of the problems with such representations is that they serve to erase recognition of 'the agency, resourcefulness and resilience' of Pacific Islanders (Farbotko, 2005). As Barnett and Adger (2003: 333) note, 'the challenge is to understand the adaptation strategies that have been adopted in the past and which may be relevant for the future in these societies'.

In relation to this, Rainbird (2004: 94, 171) presents archaeological evidence of past human transformations of the seascape and of practices of protection and maintenance in Micronesia. Rainbird argues that the first human settlers

> altered the very nature of the landscape, by manipulating the vegetation so as to cause erosion and thereby lay the foundations for the subsistence systems … This approach to the landscape by the initial settlers would be responsible for creating conditions of high sediment transport and the progradation of the shoreline onto the reef flats.
>
> (Rainbird, 2004: 95).

Atoll islands were purposefully cultivated into rich dwelling places. This is evidenced by the central taro patch typical of atoll islands (Figure 4.3), developed, mulched and cared for over centuries (Rainbird, 2004: 163). A workshop in the Mortlock Islands in 2006 documented practical knowledge and cultivation of thirty-two varieties of swamp taro.

Figure 4.3 Healthy taro patch. Moch Island, Chuuk, FSM. (A black and white version of this figure will appear in some formats. For the colour version, please refer to the plate section.)

While different islands are known for having different cultivars, one man on the island of Ta, where there has been damage to taro due to salinity, like on the island of Moch (Figure 4.4), grew up to twenty cultivars. At the workshop, salt-resistant cultivars were proposed as a means of countering the effects of sea-level rise (Levendusky et al., 2006).

In their contribution to the Fifth IPCC report, Adger et al. (2014: 766) review recent anthropological studies. While many studies argue that 'mutual integration and co-production of local and traditional and scientific knowledge increase adaptive capacity and reduce vulnerability' and that local and traditional knowledge 'contributes to mitigating the impact of natural disasters', 'maintaining domestic biodiversity' and 'developing sustainable adaptation and mitigation strategies', other studies point out the limitations of indigenous knowledge for dealing with climate change.

Our research on Moch and in Weno reveals that Mochese people strive to orient themselves to climate change in practical ways by drawing on their own empirical observations, lived experiences and deep connection with their island home. Knowledge is not something fixed, but dynamic and changing. Moreover, it is enacted in terms of place-based practices of engagement with other people and things of the world. Thus we argue for a concept of indigenous knowledge that goes beyond the realm of ideas, to practices of relatedness

Figure 4.4 Saltwater where there was once a taro patch, Moch Island, Chuuk, FSM. (A black and white version of this figure will appear in some formats. For the colour version, please refer to the plate section.)

that foster social security (see also Henry and Jeffery, 2008). In other words, knowledge does not exist in a vacuum, but thrives or withers as part of a wider political economy of principles and practices.

For example, one of the strategies that people often used in the past to deal with extreme climatic events was to invoke the principle of reciprocity by turning to their kinship and exchange networks across the region. According to Rubenstein (2001: 75): 'Micronesian island communities accommodated to climate extremes and natural disasters through the development of social and political linkages between the more vulnerable coral atolls and the neighbouring high islands.' In some parts these linkages became institutionalized in terms of formal ceremonial exchange systems, such as the *sawai* system in the western Carolinian islands (Darcy, 2006). While travel and/or migration were common practices among Micronesians in the past, emigration from the Federated States of Micronesia became a significant social phenomenon after the implementation of the Compact of Free Association in 1986. Thousands of FSM citizens left for Guam, the Commonwealth of the Northern Mariana Islands, Hawaii and the mainland of the United States. The explanation for this was primarily employment and education (Hezel and Lewin, 1996; Marshall, 2004). They did not conceive of themselves as leaving their home islands permanently.

They maintained close social bonds through exchange with their kin so that they could return home if and whenever they wanted:

> Goods flow back and forth between the home islands and the new communities as freely as people. A few years ago, Chuukese would send fish and pounded breadfruit to their relatives on Guam in ice chests that would be returned a few days later, filled with frozen chicken and other treats that could be bought cheaply on Guam. Chuukese on Guam would also send back cartons of secondhand clothes … Goods are exchanged between migrants and their relatives back home just as they would be if all were living on the same island.
>
> (Hezel, 2001: 153).

Thus, keeping exchange paths active might be considered an adaptive strategy in the face of climate change (see also Barnett, 2001). Because kinship relations and exchange networks themselves provide a means of mitigating impacts of climate events, it is important to understand the way these networks of connection operate and the political and economic contexts under which they will be able to continue to flourish. There has been much recent anthropological research conducted on migration, transnationals, diasporas and global flows of people and goods, which is helpful for understanding the kinds of *social capital* that people might employ to cope with climate change. Such social flows are linked to a cultural seascape constructed in terms of movement, so that rather than being perceived as a barrier, the sea is conceptualized as a 'way' or 'pathway' of connection (Hau'ofa, 1994; Rainbird, 2004; Darcy, 2006).

Conclusion

Much socioeconomic modelling has been undertaken to try and estimate and quantify the damage from climate change, and 'climate anthropologists appear to be making strides at relating global warming models to everyday lives' (Brown, 1999), yet little research has been conducted to date on the creative human capacity to respond to and mitigate its effects.

In Chuuk, as elsewhere in Micronesia, strong ties to land, understood to include sea, are a vital aspect of local cosmologies. In the past, people dealt with environmental change by responding resourcefully through their land tenure regimes, economic and political institutions, and exchange networks. Our research with Mochese people reveals that they continue to do so today.

Indigenous knowledge research is crucial in order to understand how people perceive risk and orient themselves towards change (Pam and Henry, 2012). However, such research commands an expanded definition of what constitutes knowledge, a definition that includes cosmologies, or worldviews, and practical modes of social organization, governance and management.

Understanding human resourcefulness and resilience in the face of climate change requires fine-grained ethnographies on the political economy of knowledge. It requires a holistic approach that involves consideration of the dynamic social, political and economic relations that constitute knowledge *in practice*.

Acknowledgements

The pilot study in Chuuk was conducted in association with an Earthwatch project run by James Cook University maritime archaeologist, William Jeffery. We acknowledge the assistance and support of Bill Jeffery and the staff at the Chuuk Historic Preservation Office (HPO) for this initial study. We especially thank Mr Doropio Marar, research officer (HPO), who introduced us to his home island of Moch. We are deeply grateful to the people of Moch for their hospitality and their generous invitation to return for the longer-term ethnographic research project conducted by Christine Pam. We acknowledge the financial support of James Cook University and the Australian Research Council postgraduate scholarship that enabled Christine Pam's doctoral project.

References

Adger, W. N., Hughes, T. P., Folke, C., Carpenter, S. R. and Rockström, J. 2005. Social-ecological resilience to coastal disasters. *Science*, 309: 1036–9.

Adger, W. N., Paavola, J. and Huq, S. 2006. Toward justice in adaptation to climate change. In Adger, W. N., Paavola, J., Huq, S. and Mace, M. J. (eds.) *Fairness in Adaptation to Climate Change*. Cambridge, MA: MIT Press, pp. 1–19.

Adger, W. N., Pulhin, J. M., Barnett, J., et al. 2014. Human security. In Field, C. B., Barros, V. R., Dokken, D. J. et al. (eds.) *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, UK and New York: Cambridge University Press, pp. 755–91.

Agrawal, A. 1995. Dismantling the divide between indigenous and scientific knowledge. *Development and Change*, 26(3): 413–39.

Barnett, J. 2001. Adapting to climate change in Pacific island countries: The problem of uncertainty. *World Development*, 29(6): 977–93.

Barnett, J. and Adger, W. N. 2003. Climate dangers and atoll countries. *Climatic Change*, 61: 321–37.

Barnett, J. and Busse, M. 2001. *Ethnographic Perspectives on Resilience to Climate Variability in Pacific Island Countries. (APN Project Ref: 2001–11). Final activity report*, www.apngcr.org/resources/files/original/be5630282fa16cb2ab1d33822f6dd185.pdf

Besnier, N. 2009. *Gossip and the Everyday Production of Politics*. Honolulu, Hawai: University of Hawai'i Press.

Billimont, B., Penno, I. and Osiena, R. 2001. *'La Nina' Task Force Special Report to Office of the Governor, State of Chuuk, Federated States of Micronesia*. Unpublished manuscript.

Birk, T. 2012. Relocation of reef and atoll island communities as an adaptation to climate change: learning from experience in Solomon Islands. In Hastrup, K. and Olwig, K. F. (eds.) *Climate Change and Human Mobility: Global Challenges to the Social Sciences*. Cambridge, UK: Cambridge University Press.

Brown, K. S. 1999. Taking global warming to the people. *Science*, 283(5407):1440–1.

Connell, J. 2003. Losing ground? Tuvalu, the greenhouse effect and the garbage can. *Asia Pacific Viewpoint*, 44(2): 89–107.

Connell, J. 2010. Pacific Islands in the global economy: Paradoxes of migration and culture. *Singapore Journal of Tropical Geography*, 31: 115–29.

Darcy, P. 2006. *The People of the Sea: Environment, Identity, and History in Oceania*. Honolulu, Hawai: University of Hawai'i Press.

Dove, M. R. 2006. Indigenous people and environmental politics. *Annual Review of Anthropology*, 35: 191–208.

Ellen, R., Parkes, P. and Bicker, A. 2000. *Indigenous Environmental Knowledge and its Transformations: Critical Anthropological Perspectives*. Amsterdam: Harwood Academic Publishers.

Farbotko, C. 2005. Tuvalu and climate change: Constructions of environmental displacement in the Sydney Morning Herald. *Geografiska Annaler*, 87B(4): 279–93.

FSM (Federated States of Micronesia). 1997. *Climate Change National Communication: Federated States of Micronesia*. Pohnpei, FSM, Climate Change Program, http://unfccc.int/resource/docs/natc/micnc1.pdf

FSM. 2001. *Preliminary Report to the Conference of the Parties of the Convention on Biological Diversity, May 2001*. Ponhpei, FSM, Biological Diversity.

Goodenough, W. H. 1986. Sky world and this world: The place of Kachaw in Micronesian cosmology. *American Anthropologist*, 88(3): 551–68.

Hau'ofa, E. 1994. Our Sea of Islands. *The Contemporary Pacific* 6(1): 148–61.

Henry, R. and Jeffery, W. 2008. Waterworld: The heritage dimensions of climate change in the Pacific. *Historic Environment*, 21(1): 12–18.

Henry, R., Jeffery, W. and Pam, C. 2008. *Heritage and Climate Change in Micronesia: A Report on a Pilot Study Conducted on Moch Island, Mortlock Islands, Chuuk, Federated States of Micronesia*. *January, 2008*. Townsville, AU: James Cook University, www.islandvulnerability.org/docs/henryetal.2008.pdf

Hezel, F. X. and Levin, M. J. 1996. New trends in Micronesian migration: FSM migration to Guam and the Marianas. *Micronesian Counselor*, 19, www.micsem.org/pubs/counselor/frames/micmigfr.htm

Hezel, F. X. 2001. *The New Shape of Old Island Cultures: A Half Century of Social Change in Micronesia*. Honolulu, Hawai, University of Hawai'i Press.

Kempf, W. 2009. A sea of environmental refugees? Oceania in an age of climate change. In Hermann, E., Klenke, K. and Dickhardt, M. (eds.) *Form, Macht Differenz: Motive und Felder ethnologischen Forschens,* Göttingen: Universitätsverlag Göttingen.

Lessa, W. A. 1961. *Tales from Ulithi Atoll: A Comparative Study in Oceanic Folklore*. Berkeley, CA: University of California Press.

Lessa, W. A. 1980. *More Tales from Ulithi Atoll: A Content Analysis*. Berkeley, CA: University of California Press.

Levendusky, A., Englberger, L., Teelander, R. et al. 2006. *Documentation of Mortlockese Giant Swamp Taro Cultivars and Other Local Foods on Ta, Moch, and Satowan, May 2006*. Kolonia, Pohnpei: Island Food Community of Pohnpei.

Marshall, M. 1979. Natural and unnatural disaster in the Mortlock Islands of Micronesia. *Human Organization*, 38(3): 265–72.

Marshall, M. 2004. *Namoluk Beyond the Reef: The Transformation of a Micronesian Community*. Boulder, CO: Westview Press.

McCarthy, J. J., Canziani, O. F., Leary, N. A., Dokken, D. J. and White, K. S. (eds.) 2001. *Climate Change 2001: Impacts, Adaptation & Vulnerability, Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press.

Merlan, F. 2009. Indigeneity: Global and local. *Current Anthropology*, 50(3): 303–33.

Mimura, N., Nurse, L., McClean, R. F. et al. 2007. Small islands. In Parry, M. L., Canziani, O. F., Palutikof, J. P., van der Linden, P. J. and Hanson, C. E. (eds.) *Climate Change 2007: Impacts, Adaptation and Vulnerability*. *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press, pp. 687–716.

Mitchell, R. E. 1973. The folktales of Micronesia. *Asian Folklore Studies*, 32: 1–276.

Murdock, G. P. and Goodenough, W. H. 1947. Social organization of Truk. *Southwestern Journal of Anthropology*, 3(4): 331–43.

Nurse, L. A., McLean, R. F., Agard, J. et al. 2014. Small islands. In Barros, V. R., Field, C. B., Dokken, D. J. et al. (eds.) *Climate Change 2014: Impacts, Adaptation, and Vulnerability*. *Part*

B: Regional Aspects. *Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change,* Cambridge, UK and New York: Cambridge University Press, pp. 1613–1654.

Pam, C. and Henry, R. 2012. Risky places: Climate change discourse and the transformation of place on Moch (Federated States of Micronesia). *Shima*, 6(1): 30–47.

Parry, M. L., Canzani, O. F., Palutikof, J. P., van der Linden, P. J. and Hanson, C. E. 2007. Indigenous knowledge for adaptation to climate change. In Parry, M. L., Canziani, O. F., Palutikof, J. P., van der Linden. P. J., and Hanson, C. E. (eds.) *Climate Change 2007: Impacts, Adaptation and Vulnerability*. *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press, pp. 843–68.

Pittock, B. A. 2005. *Climate Change: Turning up the Heat*. Collingwood, Victoria: CSIRO.

Rainbird, P. 2004. *The Archaeology of Micronesia*. Cambridge: Cambridge University Press.

Rubenstein, D. 2001. Climate change and relations between local communities and larger political structures in the Federated States of Micronesia. In Barnett, J. and Busse, M. (eds.) *Ethnographic Perspectives on Resilience to Climate Variability in Pacific Island Countries*. *(APN Project Ref: 2001–11) Final activity report*, pp. 75–6.

Rudiak-Gould, P. 2010. *The Fallen Palm: Climate Change and Culture Change in the Marshall Islands*. Saarbrücken: VDM Verlag Dr. Müller.

Rudiak-Gould, P. 2011. Climate change and anthropology: The importance of reception studies. *Anthropology Today*, 27(2): 9–12.

Spennemann, D. 2007. *Melimel: The Good Friday Typhoon of 1907 and its Aftermath in the Mortlocks, Caroline Islands*. Albury, NSW: HeritageFutures International.

Torry, W. I. 1979. Anthropological studies in hazardous environments: past trends and new horizons. *Current Anthropology*, 20(3): 517–40.

Young, J. A., Rosenberger, N. R. and Harding, J. R. 1997. *Truk Ethnography*. *Micronesian Resources Study*. San Francisco, CA: National Park Service.