7

Managing Climate Change

Introduction

This chapter deals with climate change and its impact on Micronesia's food security, health, territorial integrity and adaptation policies. Effective management of the impacts of climate change may be possible if future scenarios are modelled properly. To this end, the low-lying islands in the Mortlocks will be used as a case study since they are already suffering the consequences of rising sea levels due to climate change. Their experience will be extrapolated to the other low-lying islands¹ in the states of Yap and Pohnpei and the coastal areas of Kosrae. Traditional environmental knowledge is being used to counter the impact of climate change, but is also an example of the persistence, strength and ongoing relevance of Micronesian ways of organising and interacting with their environments.

Micronesians derive their livelihood from the oceanic environment. The ocean occupies a larger space than their land. In that respect, the land must be integrated with the ocean in terms of managing resources to create balance in nature. For example, specific types of agricultural production must be in sync with the seasons of the year. *Lerak* is the season when food is in abundance. Breadfruits are harvested and stored away in *mar* pits. Catching fish is also easier, and they are salted and dried in the sun for the lean *lefang* season. Taro production is left to allow the taros to grow. When the *lerak* season ends, people survive on what they stored during

1 For descriptions of low-lying islands in the FSM, see Alkire, *An Introduction to the Peoples and Cultures of Micronesia*, pp. 44–48; Marshall, 'The Structure of Solidarity', pp. 12–20. For the names of low-lying islands in Yap and Chuuk, see D'Arcy, *The People of the Sea*, pp. 151–152.

the *lerak* season, supplemented by taro farming. The rhythm of nature shapes the islanders' environmental conservation practices. It also dictates the type of social activities undertaken on each island and inter-island events. The reliance on integrated social and environmental practices adopted by islanders prior to colonisation has endured to the present day. The Mortlockese are part of this social endurance.

The Mortlock Islands

The Mortlock Islands are situated in the southern part of Chuuk State and are all low-lying atolls. The distance between Weno, the capital of Chuuk, to the southern tip of the Mortlocks is roughly 273 kilometres (170 miles). It takes around 12 hours by cargo ship to reach the southern end. The Mortlocks are divided into three subregions, the Upper, Middle and Lower Mortlocks. The Upper Mortlocks are near the port town of Weno and consist of three islands, Nama, Losap and Pis. Namoluk, Ettal, Kuttu and Moch islands make up the Middle Mortlocks. The islands of Satawan, Ta, Lekinioch and Oneop comprise the Lower Mortlocks subregion. They range from less than 1.6 kilometres (1 mile) to 8 kilometres (5 miles) in circumference.²

Their elevation is around 3–4 metres above sea level.³ Because of their vulnerability to sea level rise, they will be among the first to be submerged if climate change-induced sea level rise scenarios eventuate. Relocation will be the last option, but many islanders have stated that it is not an option for them at all. For example, during my field interviews, many interviewees described being unable to foresee living in a different environment, even if it was on another island, where their life would be subject to someone else's dictates. They prefer to remain on their islands and die rather than subject themselves to an alien space somewhere beyond the horizon.⁴

2 Marshall, 'The Structure of Solidarity', p. 14. Marshall's description of the Namoluk Isles reveals similar features to other islands in the Mortlocks.

3 Henry, Jeffery and Pam, *Heritage and Climate Change in Micronesia*, p. 7.

4 Many elders from Lukunor islands said they would rather remain on the island and die (Notes from interviews during fieldwork in 2011–2013).

Identity and Natural Disasters

The FSM is located on the southern edge of a typhoon belt, with typhoons regularly causing severe damage to the environment and threatening human life. Two patterns of typhoon are common in the FSM. The first one usually originates in the southern part of the Mortlocks region and slowly intensifies as it moves westward towards Yap and the Philippines. The other pattern is usually generated in central Yap and moves northward towards Guam and Japan.⁵ However, regardless of their origins, typhoons have often inflicted colossal and unforgiving injuries to humans and the environment in the Pacific. They have also left significant scars on Micronesian history.⁶ However, natural disasters have taught Micronesians to be resilient and enhanced their adaptation skills. The recent looming threat to Micronesia is climate change. Recent studies have indicated that climate change is increasing the frequency and intensity of typhoons and tropical depressions.⁷ Sea level rise is also presenting new sets of challenges for Micronesians. Adapting to climate change as resiliently as possible is urgent since the prospect of Micronesians continuing without their islands—a source of their identity—is questionable.

Like other Micronesians, the Mortlockese are natural conservationists; they have a deep understanding of their fragile environment, having made the islands their home for many centuries. They understand that their environment demands constant care to conserve the islands' natural resources. For them, conservation means having a holistic understanding of human behaviour towards the physical environment, an intricate knowledge of the weather system, and an ability to utilise the best available practices compatible with the survivability of Micronesians. Adaptation to climate change has once again required Micronesians to resort to their traditional knowledge of conservation. Current government policies at the national level are supporting local strategies to form the frontline of climate change defences.⁸

5 Alkire, *An Introduction to the Peoples and Cultures of Micronesia*, pp. 6–7; D'Arcy, *The People of the Sea*, p. 15.

6 Dirk H. R. Spennemann, *Melimele: The Good Friday Typhoon of 1907 and its Aftermath in the Mortlocks, Caroline Islands*, Albury, NSW, 2007, pp. 15–18.

7 Joahannes Berden (manager of the Weather Station in Chuuk), Interview, 21 June 2013; Local fishermen such as Tonio Muritock, Lewis Estep and Kauten Kandy, pers. comm. on different occasions in Palikir, Pohnpei; Weno, Chuuk; and Lukunor Island, 2001, 2008, 2013. All stated that it has been getting difficult to predict the seasons due to the changes in weather patterns.

8 *Nationwide Climate Change Policy 2009*, pp. 1–7.

Historically, the Mortlockese divided their atoll islands into common zones, from the ocean side to the middle of the lagoon or vice versa. The zones differ slightly from those on the volcanic islands and standalone islands due to differences in topography.⁹ An outline of the different zones is provided in Table 1.

Table 1: Common zones in the Mortlock Islands

Name of zones	Environment	Activity
<i>Lematau</i>	The deep ocean near the horizon	Deep water fishing/trawling
<i>On mong</i>	Behind the crashing waves	Underwater spearfishing
<i>Likin ounou</i>	The exposed reef system	Shellfish finding
<i>Fan ounou</i>	Where the waves crash	Pole and net fishing
<i>On alang</i>	Shellfish area	Shellfish and sea crab gathering
<i>Fan Net</i>	Beach at the ocean side	Gathering plants for medicines and picnicking
<i>Ilik</i>	Inland breadfruit trees	Breadfruit farms
<i>Lenunu</i>	Where tall coconuts grow	Build gardens
<i>Lepwel</i>	Taro farms	Taro farming
<i>Imor</i>	The edges of taro farms	Coconut planting and gardening
<i>Leal</i>	The lagoon side road system	Inter-village road system
<i>Roro</i>	The foreshore	Small-scale gardening
<i>Leppei</i>	The beach	Leisure activities
<i>Lemoshiset</i>	Swimming zone for children	Spearfishing
<i>Lein imwmwimw</i>	The sea grass zone	Line fishing
<i>Wenen</i>	The exposed lagoon side	Path for canoe transportation
<i>Lepweshepwesh</i>	Swimming zone for adults	Spearfishing
<i>Mesenpal</i>	The sloping part of the lagoon	Underwater spearfishing
<i>Lelol</i>	The first deep part of the lagoon floor	Bottom line fishing and turtle hunting
<i>Lekung</i>	Invisible depth of the lagoon	Deep bottom line fishing
<i>Lenomw</i>	The centre of the lagoon	Big fish trapping

Note: These zones are used as part of cultural maintenance. They can also be used to monitor climate change impact on the total environment in the low-lying islands.

9 This was taught to me on the atoll where I grew up. I learned from my uncles about the zones, their relationship within the ecosystems and the importance of knowing the zones. For fishing zones in the low-lying islands in Pohnpei, see Lieber, *More Than a Living*, pp. 51–59. For Yap, see Alkire, *Lamotrek Atoll*, pp. 19–22. For Yap Island, see Samuel T. Price, 'The Transformation of Yap: Causes and Consequences of Socio-Economic Change in Micronesia', PhD thesis, Washington State University, Ann Arbor, Michigan, 1975, pp. 54, 57–60. For a general outline of the Pacific Islands, see D'Arcy, *The People of the Sea*, pp. 21–23.

The purpose of these zones is for cultural maintenance, conservation and communication. The zones are vital for everyday communication between the residents of each island because they pinpoint space, events and time; that is, zones specify where people are during the day in terms of work and leisure activities. For example, a person may be working at the *lepwel* (taro farms) or fishing in the *lenomw* (lagoon centre) and remain there until the sun reaches the height of *lenunu* (tall coconut trees). Communication with the ancestral gods is an important part of island life as it provides vital information to resolve problems or predict likely future events. As Victor Puas, former mayor of Lekinioch Municipality alluded, 'environmental zones are like our traditional library as they provide useful information about nature and our relationship with it'.¹⁰

Moreover, the zones are crucial environmental references to those who have specialised skills, for example, for *sou safei* (traditional doctors), *sou set* (fishermen) or *sou fal waa* (canoe builders) to locate the resources that their professions require. For example, *sou safei* only need to locate specific zones to collect the ingredients for medical remedies, or to train students as to what particular fauna or flora grow in each zone to treat specific ailments. Island priests also rely on the zones to determine which ancestral gods to pray to or direct their *waitawa*¹¹ to when the need arises.

Islanders have developed deep knowledge of the zones and an understanding of the interdependency between the species in the food chain hierarchy. Changes in any of the zones may be a warning sign of a threat to certain species, which would affect the food chain system or the entire environment the islanders depend on. It would therefore require the islanders to react quickly and implement remedies to curtail such a threat. The zones provide information regarding the habitual behaviour of species, allowing the indigenous population to locate them easily.¹² Likewise, knowledge of the 30 stages of the moon, such as *sikauru* or *wereian anu* (visible to ghosts), *eling* (visible to human) and *meseling*

10 Victor Puas, pers. comm., 2 July 2013, Palikir, Pohnpei. See Segal, *Kosrae*, pp. 212–215, 218–220; Andrew L. Debuze, *Cultural Change in Horticultural Practices on the High Island of Kosrae - Micronesia*, University of Oregon, 1996, pp. 58–59.

11 This is according to the *oral history* of Lekinioch Island. *Waitawa* means channelling to communicate with the ancestors. See Peter, 'Chuukese Travellers', p. 264.

12 My personal experience. For zones in the volcanic islands such as Yap, see Falanruw, 'Food Production and Ecosystem Management in Yap', pp. 5–22. For zones in low-lying atolls, see Duane, *Clan and Copra*, pp. 28–33. For specific fauna and flora, see Marshall, 'The Structure of Solidarity', pp. 16–19.

(all can see),¹³ are also crucial to the ecosystem as they influence the behaviour of species. For example, during a full moon in the Mortlocks, land crabs migrate en masse to the beach to lay their eggs. The islanders only need to go to the beach and wait for them at midnight when the high tide is in to collect the crabs for food.

Certain schools of fish such as *momishik* (island sardines) and *kish* (squirrel fish) are caught only at certain times during *lefang* and *lerak*. Moreover, *souset* have developed a sophisticated regime in calculating when and how to harvest the fish. Religious rituals in the form of *ngorongor* (chants) are also part of fishing activities to lure other types of fish like *angerap* (bonitos or skip jack) close to the beach for *lalo* (encircled traps made from coconut fronds) or *maaii* (fish weirs). *Ngorongor* are chanted before, during and after the fishing activities to pay respect to the ancestral gods. Each clan has a specific system of *ngorongor*, which is passed down through the generations for the purposes of continuing the clan's history and safeguarding its reputation.¹⁴

The impact of climate change on these zones has been affecting the livelihood of islanders over the years, with the effects becoming more pronounced over the past few decades. For example, saltwater incursion on land due to ocean surges is changing the dynamic of both the fauna and flora ecosystems. Islanders are devising ways to adapt to this threat by studying the new life dynamics in the zones. Only time will tell as to whether they will find new solutions to maintain the health of the environment, hopefully by collaborating with climate change experts from the international community.

Climate Change Background

Climate change is a complex phenomenon with numerous different causes and associated impacts varying from country to country and region to region.¹⁵ It is a worldwide phenomenon affecting all of humankind. It is no

13 Kamilo Likichimus (master canoe builder and oral historian from Lukunor Island), Interview, Weno, Chuuk, 20 June 2013. See also Uman, Saladier and Chipen, *Uruon Chuuk*, pp. 359–361.

14 Being a member of an *ainang* is permanent and demands your total loyalty. Emotional attachment to one's *ainang* is strong as it is tied to one's personal identity and history.

15 Christopher B. Field, Vicente Barros, Abdrabo Mohamed A. K. et al., *IPCC: Intergovernmental Panel on Climate Change. WGII AR5 Phase I Report Launch. Climate Change 2014: Impacts, Adaptation, and Vulnerability Summary for Policymakers*, 31 March 2014, pp. 4–9; Climate Institute, *Sea Level Rise: Risk and Resilience in Coastal Cities*, www.climate.org/topics/sea-level.

longer defensible to blame natural processes as the main cause of climate change. Increasingly, scientists from across the world have identified anthropogenic activities as a significant accelerator of climate change.¹⁶ A rise in sea levels is one of the consequences of climate change and has already affected islands and coastal regions around the globe.¹⁷

Since data collection on climates began in 1880, the temperature of the earth's surface has increased, especially from the 1970s onwards. For example, satellite images indicate that the ice sheets in Greenland and Antarctica are melting faster than predicted, with an especially noticeable acceleration from April 2002 to February 2009.¹⁸ Such acceleration has been largely caused by the increasing amount of greenhouse gases collectively produced by industrialised economies.¹⁹

It is a slow process, but the steadily increasing volume of water in the ocean caused by ice melting is causing sea levels to rise. This has significant consequences for the low-lying islands of the Mortlocks, which are only 3–4 metres above sea level. Climate change is also affecting the dynamics of the Pacific Ocean in terms of the El Niño²⁰ and La Niña²¹ weather patterns and marine life due to the increased level of acidification.²² It is hoped that the advanced economies will reduce their greenhouse gas emissions sufficiently to keep the temperature rise below 2°C so as to slow the impact of climate change on low-lying islands in the Pacific and elsewhere.

A study conducted in the FSM, the Marshall Islands and Palau over a 50-year period (1951–2010) provided convincing evidence that weather and environmental changes have occurred throughout most of the Micronesian region. For example, these islands have experienced

16 Field et al., *IPCC*, pp. 4–9.

17 Field et al., *IPCC*, pp. 4–9.

18 Fletcher and Richmond, *Climate Management and Adaptive Strategies*, p. 6.

19 Gillian Cambers and Paul Diamond, *Sandwatch: Adapting to Climate Change and Educating for Sustainable Development* (revised and expanded edition), United Nations, Educational, Scientific and Cultural Organization, France, 2011, p. 15.

20 D'Arcy, *The People of the Sea*, pp. 16–18.

21 D'Arcy, *The People of the Sea*, p. 17; Francis X. Hezel, 'High Water in the Low Atolls', *Micronesian Counselor*, No. 76, 2009, p. 2, www.micsem.org.

22 Radio Australia (Melbourne), 'Fish Losing Survival Instinct Due to Climate Change: Study Research on PNG Reefs Says Fish Behavior Becoming Riskier', *Pacific Islands Report*, 15 April 2014.

a significant to moderate rise in temperatures and a decrease in rainfall over the 50-year period.²³ The study is one of many confirming that the temperature of the earth's surface is rising, which is causing droughts and sea levels to rise.

The increase in the earth's temperature is impacting the atolls, as seen in the unusual sea surges witnessed by Micronesians in 2007 and 2008.²⁴ Sea surges have occurred before with varying degrees of intensity, for example, in the 1970s²⁵ to 1990s, but these were nowhere near as devastating as the events in 2007 and 2008. The 2007 and 2008 surges affected 50–75 per cent of the land used for food production.²⁶

The first National Communication to the United Nations Framework Convention on Climate Change (UNFCCC) in 1999 noted the increase in:

the frequency, duration and intensity of El Niño droughts, and the need to enhance capacity to address El Niño and La Niña events. Accelerated sea level rise was identified as a concern over the longer-term...[other] concerns were noted as being [the] coral reef ecosystems, coastal zones, waste management ... agriculture and water supply.²⁷

23 Maria Ngemaes, Johannes Berdon et al., 'NOAA: Republic of Palau, The Federated States of Micronesia and Republic of the Marshall Islands', Paper presented in Noumea, 3–4 July 2013; Johannes Berdon (director of Chuuk Weather Station), Interview, Weno Island, 4 April 2015.

24 Hezel, 'High Water in the Low Atolls', pp. 2–3; Fletcher and Richmond, *Climate Management and Adaptive Strategies*, pp. 8–9; Gaynor Dumat-ol Daleno, 'High Seas Flood Tiny Lakinioch, Chuuk', *Pacific Daily News*, Guam, 3 May 2007; Kauten Kandy (local fisherman), Interview, Likie, Pohnpei, 28 June 2013; Paulis Chol (local fisherman), Interview, Sokeh, Pohnpei, June 2012. Kauten and Paulis were among the many from Lakinioch who witnessed firsthand the sea surge and its impact on 5 March 2007.

25 I personally witnessed the sea surge in 1971 (which was not caused by a typhoon). It destroyed almost half of the taro farms in my village, Rewow. Other surges occurred afterward, but on a small scale and only affected the shoreline. Unfortunately, there are no documents about these events.

26 Susumu and Kostka, *Federated States of Micronesia Food Security Assessment Report*, p. 22; Fletcher and Richmond, *Climate Management and Adaptive Strategies*, p. 9.

27 Mulalap, 'Islands in the Stream', pp. 382–383, 386.

Figure 14: *Puron sat* (sea surge) on Lukunor Atoll in 2007.

Source: Photograph taken by Kanrina Puas.

Figure 15: *Puron sat* (sea surge) in Kosrae 2007.

Source: Photograph courtesy of Abraham Simpson.

Territorial Integrity and Climate Change

Micronesia's territorial integrity and sovereignty are defined by its constitution and in compliance with international laws. Article 1, Section 1 of the FSM's Constitution states:

The waters connecting the islands of the [Micronesian] archipelago are internal waters regardless of dimensions, and jurisdiction extends to a marine space of 200 miles measured outward from appropriate baselines, the seabed, subsoil, water column, insular or continental shelves, airspace over land and water, and any other territory or waters belonging to Micronesia by historic right, custom, or legal title.²⁸

Yet, the FSM's islands and surrounding waters are being slowly affected by climate change. Both citizens and climate change experts have noted the effects of climate change in Micronesia.²⁹ The legal implications of submerged islands in regard to territorial sovereignty have still not been seriously considered.

Like colonisation, climate change can be considered a result of foreign state actors, particularly the industrialised nations of Japan, China, India, Brazil and the US. Their industries have high rates of fossil fuel consumption and are largely dependent on these resources. One of the consequences of this is the trapping of heat in the atmosphere, resulting in melting ice caps and ice sheets at the poles and, in turn, sea level rise.³⁰ The resulting damage has already affected many Micronesian communities, and they have started to adapt to this new phenomenon as best as they can. However, new studies need to be conducted to further Micronesians' understanding of climate change in order for them to meet the challenges of adaptation effectively.

28 *The Constitution of the Federated States of Micronesia*, Article 1, Section 1.

29 This is my personal observation following interactions with the local people on Kosrae in 2012. I also interviewed people from the various low-lying islands in the FSM. See also Henry, Jeffery and Pam, *Heritage and Climate Change in Micronesia*, pp. 7–9, 37–38; Hezel, 'High Water in the Low Atolls', pp. 1–3; Fletcher and Richmond, *Climate Management and Adaptive Strategies*, pp. 8–10.

30 R. Warrick and J. Oerlemans, 'Sea Level Rise', in *Climate Change: The IPCC Scientific Assessment*, edited by J. T. Houghton, G. J. Jenkins and J. J. Ephraums, Cambridge University Press, Cambridge, 1990, pp. 263–267.

The FSM Government has adopted a policy that articulates survivability as an uncompromising priority. In its official policy statement, the national government stated that its role is ‘to mitigate climate change especially at the international level, and adaptation at the national and (local) levels to reduce FSM’s vulnerability to climate change’s adverse impacts’.³¹ In this context, the FSM reaffirms its right to exist as a nation under international law, particularly in view of the debate on sovereignty as a result of possible reconfiguration of island territories if some islands become totally submerged in the future.³²

For the FSM Government, mitigation means, among other things, the promotion of a ‘post Kyoto carbon dioxide emission reduction that will maintain temperature rise as advocated by the “Tuvalu Deal”’³³ at the Copenhagen climate summit. For adaptation purposes, the national government has required all development activities to take into account new recommendations for project design³⁴ in compliance with its Strategic Development Plan, use ecosystem-based approaches to encourage and strengthen the application of (local) knowledge and conservation practices, and implement strategies as soon as possible to improve food production.³⁵

The Impact of Climate Change in the Mortlocks

The Mortlockese have already anticipated changing their agricultural practices and fishing techniques to adapt to the effects of climate change.³⁶ The islands are very small in land size and completely flat. One can stand

31 *Nationwide Climate Change Policy 2009*, p. 1.

32 *Nationwide Climate Change Policy 2009*, pp. 1–2.

33 The Tuvalu Deal refers to maintaining a less than 1.5°C rise in world temperature to ensure the survivability of the low-lying islands in the Pacific (*Nationwide Climate Change Policy 2009*, pp. 1–2; Masao Nakayama, ‘Statement before the Committee of Religious NGOs and the United Nations. The Last Push Before Copenhagen: Defining Positions Strategies and Goals on Climate Change’, New York, 10 November 2009).

34 Fletcher and Richmond, *Climate Management and Adaptive Strategies*, p. 17; Henry, Jeffery and Pam, *Heritage and Climate Change in Micronesia*, pp. 38–39.

35 Hezel, ‘High Water in the Low Atolls’, pp. 18–19, www.micsem.org/pubs/counselor/pdf/mc76.pdf; Susumu and Kostka, *Federated States of Micronesia Food Security Assessment Report*, pp. 5, 27.

36 Gibson Susumu and Mark Kostka, *Food Security Vulnerability Assessment Report*, Palikir, Pohnpei, 2012, p. v.

on the beach and survey the islands from one end to the opposite end.³⁷ There are no forests, only dense bushes and a few gigantic breadfruit trees and coconut trees. *Nu* (coconuts), *fash* (pandanus tectorius), *rakish* (sea oak tree) and a variety of waterfront bushes usually surround the beach areas and the shorelines, especially on the ocean side. Further inland, islanders' houses are built with their usual surrounding household gardens. Swampy taro patches, breadfruit trees, coconut trees and thick bushes are located in the interior of the islands.³⁸

The Mortlocks do not have massive agricultural lands suitable for large-scale rice cultivation or cattle rearing (both of which produce methane), thus their greenhouse gas emissions are negligible. Deforestation is not applicable in the Mortlockese context given the lack of forests. Moreover, the FSM as a whole does not have large-scale factories or heavy coal-burning industries, and cars are largely confined to district capitals. What the islanders are aware of is that the emissions from the aforementioned activities are caused by the lifestyle and activities of the 'West' and the emerging economic powers from the developing world, and that this affects their traditional economic and ecological systems via accelerating the process of climate change.³⁹ The combined impact of the economic practices of the outside world on the earth's climate is forcing the Mortlockese to find effective adaptation strategies to grow traditional crops in the face of intensified droughts and sea level rise.⁴⁰

Climate change is one of the biggest threats currently facing the FSM. It poses severe risks to health, agriculture, water and food security, and political relations. It is destroying coastlines, corals, coastal fisheries, taro patches and breadfruit trees. If there is no significant reduction in greenhouse gases in the next 15 years, 'climate models predict that low lying islands in the Pacific may become uninhabitable within the next 50 years'⁴¹ or towards the turn of the century. This includes the Mortlocks and the low-lying islands in Yap and Pohnpei.

37 Gonzaga Puas, 'How Could the Agricultural Sector Become More Conducive towards Climate Change Mitigation and Adaptation?', Paper presented to CliMates International Student Organisation, Paris, France, April 2012, p. 5.

38 Puas, 'How Could the Agricultural Sector', p. 5.

39 Mulalap, 'Islands in the Stream', pp. 382–383, 386.

40 Local adaptation strategies are being utilised, including assistance from the national government (*Nationwide Climate Change Policy 2009*, pp. 1–3).

41 Barry Pittock, cited in Henry, Jeffery and Pam, *Heritage and Climate Change in Micronesia*, p. 7.

Seawalls

In the late 1960s, seawalls were considered to be the best approach to fight shoreline erosion in the Mortlocks.⁴² However, many local elders were against their erection. They opposed the construction because seawalls required the clearing of native trees and bushes on the shorelines, which naturally prevent coastal erosion.⁴³ Many seawalls fell apart within a few months due to changing near-shore currents, as predicted by the local elders. In response, government officials claimed that the seawalls were not installed properly. A new engineering approach was recommended and the seawalls again erected. After the completion of the so-called 'well engineered seawalls', local people started to complain again about resulting changes in the seascape around the shorelines. For example, the usual habitats of certain schools of fish were interrupted, causing their migration to different parts of the islands. This caused tension between clans as certain fish belong to particular clans by tradition, and the seawalls forced fish into different shoreline zones owned by other clans.⁴⁴ This is a sensitive cultural issue, with the tension between clans caused by both the effects of climate change and attempts to mitigate these effects. This needs to be resolved to bring the communities back together.

The result of this erosion has been the shifting of some beach sand to different parts of the shorelines. It has also confirmed the elders' suspicion about the seawalls. It was not until the late 1970s when Typhoon Pamela hit the Mortlock Islands that the folly of the seawalls was extensively revealed to the public.⁴⁵ The typhoon completely destroyed the seawalls, and saltwater soon found its way into the taro patches, devastating people's livelihoods.

42 Seawalls were built based on a model erected at the channel by the Japanese. Unfortunately, they were not successful in preventing shoreline erosion.

43 This is according to Ring Puas and Alfonis Buluay, who were present at the debate on seawall erection in 1972–1973 during a *sotang* (village meeting) in Relong village. See also Marshall, *Namoluk beyond the Reef*, p. 68.

44 I watched village elders debate the issue during the early 1970s. It became apparent in later years that the seawalls were politically motivated, and so many called seawalls the 'political wall'. Today, seawalls are still required due to clearing of vegetation near the coast, but they must be carefully designed according to the topographical features of the coastline.

45 Typhoon Pamela destroyed many seawalls in the Mortlocks (Marshall, *Namoluk beyond the Reef*, p. 68).

Figure 16: Old-style seawall constructed in the 1970s on the island of Lukunor.

Note: This seawall, like many others in the Mortlocks, fell apart shortly after its construction due to various environmental factors that were not accounted for due to the elders' lack of involvement in the project.

Source: Photograph courtesy of Inos Walter (2012).

Many local people suspected that the erection of the seawalls was politically motivated.⁴⁶ It was alleged that the seawall project was part of several municipality capital improvement projects used to disguise corruption. The process of allocating funds was controlled by powerful political figures, with funds channelled to relatives at the local level. The construction of seawalls was not properly planned and lacked input from professional engineers.⁴⁷ The overall result was that the funds earmarked for these walls were used for political reasons, rather than to properly safeguard the shorelines.⁴⁸

46 I observed this public reaction and discussed it with Haglegam during my fieldwork interviews. Haglegam, Interview.

47 Saltwater was mixed with cement, gravel and sand. When the concrete dried, it took only a few days to crack and fall into the water. A similar experience occurred in the Solomon Islands according to Terry Brown, 'Small Island States and Global Warming', *Anglican Communion News Service*, Niagra, Canada, 5 June 2014.

48 Haglegam, Interview; Congress of the FSM, *Public Law No. 3-12*, First Regular Session, 1983.

Today, the debate over seawall construction is still dividing island communities.⁴⁹ In my interview with Marion Henry, a traditional leader from the island of Oneop and national secretary of the FSM Department of Resources and Development, he stated that:

seawalls contradicted traditional wisdom because they interrupt the natural flow of ocean currents around the islands which deposit sand on different shores and thereby increase beach erosion rather than preventing it.⁵⁰

He argued that native bushes and trees should have been left alone.

More people are becoming receptive to such traditional wisdom. However, others dispute this view and believe seawalls are still necessary, but that their design must be compatible with the topographical configuration of the islands.⁵¹ In Kosrae, for example, a new design of seawall has been implemented with some success. The seawall was built on a beach, with solid concrete blocks lined in a pattern that hugs the natural configuration of the local foreshore area. In my discussion with some of the locals, they said the seawall has prevented beach erosion and withstood big tides and strong storms.⁵² To this end, it should be up to each island to adopt specific designs that suit their local areas, with the support of the national government.

Seawall technology is a modern form of defence that could assist the islanders in their fight against the effects of climate change. However, collaborative approaches using local and outside experts are required for the purpose of implementing the appropriate solutions to suit local requirements.⁵³

49 Elders and officers of Lukunor Municipality, Interview, Pohnpei, 26 January 2014. This is an ongoing debate.

50 Marion Henry (secretary of Resources and Development), Interview, Kolonia, Pohnpei, 18 July 2013 (he is also a local *samol* from the Island of Oneop); Haglelgam, Interview; Congress of the FSM, *Public Law No. 3-12*, First Regular Session, 1983; Marshall, *Namoluk beyond the Reef*, p. 68.

51 Personal observation of seawall in Kosrae, 22 June 2013.

52 Personal observation of seawall in Kosrae, 22 June 2013.

53 *Nationwide Climate Change Policy 2009*, p. 2.

Figure 17: New seawall design in Kosrae to prevent beach erosion.

Source: Photograph taken by author on 23 June 2012.

Traditional Foods

The main food staples in the Mortlocks and the low-lying islands in Yap and Pohnpei are taro, breadfruit, coconut, banana and resources obtained from the sea. Farming activities involve land clearing and planting of traditional crops such as taro, breadfruit, coconuts, papayas and pandanus for consumption. Taro is available year round, while breadfruit is in abundance during the summer months, usually from May to September. Preservation of food such as *mar* (preserved breadfruit) is still observed but is practised using new methods.⁵⁴

Resources from the sea are also in abundance and harvested year round. Meat sources are coconut and land crabs, pigs, dogs and chicken. Imported food products such as rice, flour, canned goods, sugar and salt are also

⁵⁴ *Mar* (preserved breadfruit) are now stored in big iron cooking pots called *kama* above the ground and kept in the outdoor cooking house. It is now more accessible and can be eaten anytime of the year rather than waiting for the lean months when it has to be dug up from the ground. See D'Arcy, *The People of the Sea*, p. 155.

consumed alongside a traditional diet. Mortlockese employed in the port towns also send foreign food products to their families.⁵⁵ Traditional food crops are constantly under threat from the impacts of climate change. The low-lying islanders are improvising their traditional practices to limit the intrusion of saltwater onto agricultural land along with new methods of preserving food.

Vulnerability to Climate Change

While advanced economies abroad accelerate the process of climate change, the Mortlockese are constantly studying ways to adapt to the changes in their environment. The national government has required:

all development activities ... to take into account projected climatic changes ... in compliance with its strategic development plan ... use ecosystem based approaches, encourage and strengthen the application of [local] knowledge on conservation practices, and implement strategies to improve food production.⁵⁶

The Nationwide Climate Change Policy has yet to be translated into specific defence strategies.

National legislation⁵⁷ was adopted in February 2013 to further reinforce the policy. Its purpose is to provide a Nationwide Integrated Disaster and Climate Change Policy, with relevant departments such as the Department of Resources and Development, Office of Environment and Emergency Management, and Department of Transportation obligated to implement the policy. It requires that:

every year ... the President of the Federated States of Micronesia shall submit a report to Congress on the progress of the implementation of the Climate Change Policy, and recommend additional legislation where applicable and necessary.⁵⁸

55 It is an established custom that relatives send assistance to those in trouble during natural disasters. See Marshall, *Namoluk beyond the Reef*, pp. 26–27; Spennemann, *Melimele*, p. 6; Lessa, ‘The Social Effects of Typhoon Ophelia (1960) on Ulithi’, p. 369.

56 *Nationwide Climate Change Policy*, 2009, p. 2.

57 Congress of the FSM, *Public Law No. 18-34*, Second Regular Session 2013, Palikir, Pohnpei.

58 Congress of the FSM, *Public Law No. 18-34*, Second Regular Session 2013, Palikir, Pohnpei.

This illustrates the seriousness of the FSM Government's resolve to tackle climate change by creating a legal framework for the nation to actively measure its adaptation strategies. As the policy states:

in order for the FSM to successfully achieve its objectives the policy requires ... [the] support of all levels of governments in the FSM, the civil societies, the private sector, [local] communities and traditional leaders.⁵⁹

The FSM is also seeking assistance and support regionally and internationally to ensure that its adaptation goals are systematically implemented to increase the likelihood of achieving positive outcomes. Geologists Charles Fletcher and Bruce Richmond suggested that adaptation within the FSM may be facilitated by a two-step approach of 'forming international partnerships to aid adaptation efforts, and continuing the development of internal policies focused on building resilient and sustainable communities'.⁶⁰ International partnerships will adhere to local needs based on discussions from both sides but within a domestic policy framework, which will lead to appropriate decisions being made, for example, planting more pandanus, sea oaks and mangroves around island shores as has been done in other Pacific Islands. Advanced technology seawalls should also be part of the adaptation strategies adopted, where appropriate. Although there are new concepts for creating floating and artificial islands and barrier reefs, many are too costly for the government to fund. Perhaps they will become a reality if the potential resources from the nation's EEZ are able to be exploited.

Observations of Ecosystem Alterations due to Sea Level Rise

Mortlockese fish behaviourists have deep knowledge of the sea environment. Since the 1990s, they have noticed changes in the behaviour of certain kinds of fish.⁶¹ They no longer reside in specific habitat zones due to changes in the weather patterns that have affected water temperatures. Fish with a low tolerance of temperature variation

59 *Nationwide Climate Change Policy 2009*, p. 4.

60 Fletcher and Richmond, *Climate Management and Adaptive Strategies*, pp. 11–12; *The Nationwide Climate Change Policy 2009*, p. 2.

61 Interviews with many fishermen from the Mortlock Islands during my fieldwork.

such as *angarap* (bonitos), *momoshik* (island mackerels) and *sarikai me til* (anchovies) are now hard to locate. Their migratory habits have become difficult to predict, and islanders have difficulty catching them in schools using *lalo* (coconut fronds to trap the fish) or *maii* (fish weirs).⁶²

During one of my visits to the Mortlocks in the summer of 2001, the fishermen informed me that the low tide no longer exposed the reefs where fish used to congregate in abundance. I used to join the fishermen of my village on the reefs, where I learned about fish behaviour. I can no longer predict their movements based on my past knowledge. The indigenous people are readjusting to the new circumstances in the sea environment.⁶³ For example, they are developing new observation strategies to understand the behaviours now exhibited by the local fish populations. I hope to learn this new adaptive knowledge from my villagers soon. For example, *sarikai* have moved to different depths and zones along the shorelines. *Momoshik* (owned by my father's clan) now appear in different months, making it harder to pinpoint when to catch them in weirs.⁶⁴

In recent years, islands in the Micronesian region have suffered serious damage due to wave surges, saltwater inundation and drought. Traditional methods are being utilised to minimise their impact, particularly saltwater incursion into taro farmland. An example of this is new canals being dug, following the land's topography, to provide an environmentally conscious way to drain the saltwater out of affected taro plots.⁶⁵ Constructing barriers to resist the flow of saltwater into gardens is another example. Just as in the past, Micronesians continue to adapt and seek new methods to prolong their survivability and continuity.

There have been a handful of studies conducted in the Mortlocks on the effects of sea level rise. Most of these studies noted the real vulnerability of beach erosion due to high tides as being an ongoing issue.⁶⁶ The intrusion of saltwater into taro patches is also becoming a major problem. For example, in 2007, the Mortlocks was inundated by saltwater caused

62 Interviews with many fishermen from the Mortlock Islands during my fieldwork.

63 Interviews with many fishermen from the Mortlock Islands during my fieldwork.

64 My personal experience. Elders from *Sofa* and *Soumosh ainang* complained about *momoshik* appearing in different places.

65 When an ocean surge hit Lukunor in 2007–2008, the youth groups dug canals to drain saltwater from the taro patches.

66 Inos Walter (mayor of Lukunor), Interview, February 2011 (he assessed the damage of the sea surge during his time as mayor); Kandy, Interview (he witnessed the event); Chol, Interview (he witnessed the event).

by king tides,⁶⁷ which infiltrated the taro farmland and drinking wells. Other crops such as bananas, papayas, pumpkins and sweet potatoes were destroyed.

On Lakinioch Island, more than half of the island's taro farms were decimated by saltwater incursion in 2007.⁶⁸ It took approximately two years for taro crops to regrow. Youth groups from the island were organised into groups to dig canals to release the saltwater from the taro patches and other affected areas. People survived because of the extended family system, which is relied on during natural disasters as it was in the past. Other relatives from throughout Micronesia and the new diaspora in the US also remit assistance to their families. The quick action by the youth groups prevented further destruction of the taro farms. The islanders continue to observe wave patterns and signs of nature that will alert them to oncoming meteorological events. New adaptive strategies are being monitored, and the islanders must adopt new methodologies for farming to protect their taro farms and other agricultural land against further saltwater intrusion.⁶⁹

Some suggested farming alternatives include hydroponics and vertical farming. Others have recommended the erection of hollow, soil holders built well above the ground.⁷⁰ They can be filled with soil and perhaps enhanced with the use of fertilisers, allowing food crops to be grown and harvested year round.⁷¹ New plant species such as saltwater-resistant taro⁷² have been experimented with to supplement the anticipated reduction in food supply. New varieties of crops that can be rotated throughout the year and harvested in a shorter period are also being explored.

67 Interviews with other witnesses, December 2011; Keim, *Sea Level Rise Disaster in Micronesia*.

68 This was told to me during interviews with many people from Lukunor, including the mayor of Lukunor (who assessed the damage of the sea surge) and Kauten and Paulis who witnessed the event (see fn. 207). See also Mark, *Sea Level Rise Disaster in Micronesia*.

69 Hezel, 'High Water in the Low Atolls', p. 18.

70 Hezel, 'High Water in the Low Atolls', p. 18.

71 Gibson Susumu, Interview, Palikir, Pohnpei, 13 July 2013.

72 The State of Kosrae, and other islands in Chuuk and Yap, are experimenting with saltwater-resistant taros (Gibson Susumu, Interview, Palikir, Pohnpei, 13 July 2013).

Recent Research on Climate Change

Research undertaken on climate change in the Mortlocks confirm what the islanders have already witnessed or experienced. For example, a study conducted by Australian academic Rosita Henry and her team on Moch Island found that many Mortlockese are aware of climate change. When the islanders were questioned about their views on the causes of the rise in sea level, one local person claimed, 'to my own understanding and word by mouth from some people, the iceberg at the North and South Pole start melting and cause this sea level rise'.⁷³

Others linked the concept of global warming to global issues and human activities such as pollution, airplane emissions and greenhouse gases. These responses are not confined to Moch Island but are widespread throughout the Mortlocks. Their awareness of climate change has been heightened by the recent installation of internet networks, by radio announcements, by networks of students in the diaspora and by engagement with officials at the national level.⁷⁴ Indeed, Micronesians are placing responsibility for global warming on the larger economic structures of bigger nations.⁷⁵

Another study conducted by Fletcher and Richmond noted that in 2007 and 2008:

[FSM] communities were flooded by large high tides ... that eroded beaches, damaged roads, intruded in aquifers and ... and inundated communities. Seawater flowed into coastal wetlands and surged up through the water table killing taro, breadfruit, and other food crops. Fresh water [wells] turned brackish and [have not fully recovered]. Crop sites in use for generations were physically and chemically damaged or destroyed on approximately sixty percent of inhabited atoll islets. Again, food and drinking water were in short supply. A nationwide state of emergency was announced on December 30, 2008, and food security was declared the top priority in the nation.⁷⁶

73 Henry, Jeffery and Pam, *Heritage and Climate Change in Micronesia*, p. 21.

74 This is based on my personal observations and interviews with Micronesians at home and abroad.

75 Henry, Jeffery and Pam, *Heritage and Climate Change in Micronesia*, p. 21.

76 Fletcher and Richmond, *Climate Management and Adaptive Strategies*, p. 9.

A study of the same event by Mark Keim⁷⁷ on Lukunor and Oneop islands corroborated Fletcher and Richmond's views. However, Keim (a medical doctor) went further, cautioning authorities to be mindful of the health issues that can arise from climate change due to water and food shortages.

The FSM Government has appointed a team of field observers to collect information to assist in the implementation, monitoring and reporting of observable impacts from storm surges, beach erosion and saltwater inundation in taro patches.⁷⁸ The observers are also charged with educating locals in relation to the newly adopted national government policy. Fundamental to the observers' task is to detail local knowledge of adaptation strategies to be integrated into the Western methods of research studies. For example, during my interview with one of the project coordinators, Gibson Susumu, he commented on how the local people resorted to traditional food items that were typically only eaten during drought.⁷⁹ These strategies need to be recorded as they form the foundation of any first response strategy to be implemented while waiting for further assistance to arrive.

Food Production Strategies

The *Food Security Vulnerability Assessment Report* authored by two FSM agricultural specialists, Gibson Susumu and Mark Kostka, indicated that agricultural production is declining due to poor soil conditions caused by exposure to saltwater. They stated that 'the biggest threat to food security is the impact of climate change. Over forty-five atolls in the FSM continue to be affected by the sea level rise'.⁸⁰ Taro patches are the major problem as local inhabitants are either abandoning them because they have become unproductive or waiting for rain to dilute the saltwater before re-farming the land (which takes considerable time to return to full production).⁸¹

The government has set up a national food security committee, the FSM Food Security Steering Committee, whose role is to enhance coordination and cooperation of food security for the nation and oversee the effective

77 Keim, *Sea Level Rise Disaster in Micronesia*.

78 Susumu, Interview.

79 Susumu, Interview. Drought foods include parts of the coconut and banana trees, shrubs and small land and sea creatures.

80 Susumu and Kostka, *Food Security Vulnerability Assessment Report*, p. v.

81 Susumu and Kostka, *Food Security Vulnerability Assessment Report*, p. v.

implementation of future initiatives.⁸² Again, in my interview with Susumu, he noted that during a trip in 2012 to the low-lying atolls in Chuuk, many people were close to starvation due to the failure of food crops affected by saltwater. He estimated that close to 70 per cent of all the islands he visited in Chuuk alone were affected by food insecurity, and safeguarding effective and consistent food production stood out as the main challenge for the islanders. Many of the low-lying islands in Yap and Pohnpei were experiencing the same difficulty.⁸³

The FSM Government has been working hard on its adaptation policies for food security and environmental management, with the following strategies suggested to sustain food production:

- switch to different cultivars
- improve and conserve soils
- increase water supply by using groundwater and by building reservoirs and rain catchment areas
- improving watershed management to assist in desalination
- improve or develop water management
- alter system operating rules (e.g. pricing policies and legislation)
- improve coastal zones and marine ecosystems
- protect the environment, including via building seawalls and beach nourishment
- research/monitor the coastal ecosystem.⁸⁴

According to Susumu and Mark, new ‘concept projects’ have been put to the national government to consider.⁸⁵ If the government accepts the proposals, they will be shared with both the state and local governments. The concept projects include the following recommendations:

82 Australian Aid, *Food Security: Securing Food Resources in the Federated States of Micronesia* (Pacific Adaptation Strategy Assistance Program (PASAP)), Commonwealth of Australia, 2013, terranova.org.au/repository/paccsap-collection/securing-food-resources-in-the-federated-states-of-micronesia.

83 Susumu and Kostka, *Food Security Vulnerability Assessment Report*, pp. iii–v.

84 Susumu and Kostka, *Food Security Vulnerability Assessment Report*, pp. iii–v.

85 Susumu and Kostka, *Food Security Vulnerability Assessment Report*, pp. iii–v. New concepts of farming (e.g. the saltwater-resistant taro project in Kosrae) were also mentioned by Gibson during my interview with him in Palikir, Pohnpei, 13 July 2013.

- Household food security to create awareness in the community about the importance of food security and the need for people to eat more indigenous food. This will involve the restrengthening of food production systems through the supply of root crops, with vegetables, breadfruit, coconut and fruit trees to be integrated into the agroforestry system.
- Integrated atoll farming system and capacity building. This will involve the planting of traditional food crops, home gardening, establishment of plant nurseries, hydroponics and hands-on technical training.
- Integrated coconut development. This project targets the rehabilitation and replanting of coconut trees.
- Fisheries and aqua culture to carefully assess locations suitable for the production of fish, seaweed, sea cucumber and other sea food resources.
- On the atolls, traditional practices such as restricting fishing activities on the coral reefs for a number of months or even years have been explored. This practice will allow further observation of the reef ecosystem and allow repopulation of fish stocks.
- Building of fishing weirs to farm fish in the lagoon.
- Renewed use of breadfruit ground pits (a hole dug in the ground to store preserved breadfruit for future consumption). Many islanders now use above-ground storage units in the form of large cooking pots to preserve breadfruit and other crops, and these are vulnerable to disasters such as floods and typhoons.
- Reducing family size to lessen food demands as climate change threatens to curtail food production.
- Use of traditional fishing canoes as these are less harmful to the marine environment compared to motorboats that use fuel and pollute the water.⁸⁶

I noted other food production strategies during fieldwork in the islands that can be included in the above list:

- Utilising *peiel* (coconut fibre)⁸⁷ to absorb water and constructing stone walls and pre-dug canals to use the land topography to deviate water flow. This has been done on my island, Lekinioch.⁸⁸

86 Susumu and Kostka, *Food Security Vulnerability Assessment Report*, pp. iii–v; Gibson, Interview.

87 *Peiel* is the fibre enclosing the copra. The fibre is separated from the copra by using a big, sharp stick called *anget*. Piles of the fibre are used to encircle crops to slow the flow of water to the crops.

88 Personal recommendation based on my experience growing up learning the traditional methods of environmental conservation.

- Small family farms for growing coconut trees and land crabs. This will involve locating appropriate inland areas where both species can survive and thrive.⁸⁹
- Barter. This will encourage local people to concentrate on planting traditional crops and reduce the importation of junk food, which is causing all kinds of health problems for the local population.⁹⁰
- Develop marine farms for octopi and clams, as well as the reintroduction of traditional weirs that can be used for both the growing and catching of specific fish species.⁹¹

The rapidly growing body of evidence documenting the adverse impact of global warming on small island states has prompted the FSM Government to undertake an active role in the international arena to call on industrialised nations to cut greenhouse gas emissions.⁹² The FSM has signed international agreements related to climate change including the UNFCCC, Kyoto Protocol, Vienna Convention and Mexico City Pact. It has also signed and ratified other major conventions concerning environmental issues.⁹³

The FSM is also part of a subregional agreement called the Green Micronesia Initiative. This subregional agreement, which is spearheaded by the chief executives of the various regional governments in Micronesia, seeks to increase energy efficiency by 20 per cent, increase energy conservation by 20 per cent and expand renewable energy to 30 per cent of power generation⁹⁴ by 2020.⁹⁵ However, Mr Soram, the national government's spokesperson for climate change, has stated that the FSM is not committed to the COP15 (Copenhagen). It has signed the COP16 (Cancun) agreement but is still in the process of studying the agreement before implementation. As for the COP17 (Durban), the FSM is still

89 Personal recommendation based on my experience growing up learning the traditional methods of environmental conservation.

90 Personal recommendation based on my experience growing up learning the traditional methods of environmental conservation.

91 Personal recommendation based on my experience growing up learning the traditional methods of environmental conservation.

92 *Nationwide Climate Change Policy 2009*, pp. 2–3.

93 Jackson Soram (head of Climate Change Advisory Body to the FSM Government), Interview, 21 January 2011.

94 Office of Statistics, Budget and Economic Management, Overseas Development Assistance and Compact Management, *Millennium Development Goals and Status Report 2010*, p. 74; Benadette H. Carreon, 'Pacific Leaders Launch Green Initiative', *Marianas Variety*, 11 August 2010.

95 Office of Statistics, Budget and Economic Management, Overseas Development Assistance and Compact Management, *Millennium Development Goals and Status Report 2010*, p. 74.

considering some of the issues before committing itself fully.⁹⁶ However, the FSM's participation in international climate change forums cannot solve all its local issues.

Initiating Environmental Strategies

The FSM's environmental strategy began in 1999 during the nation's second economic summit. It called for the establishment of 'a network of effective, community managed, ecologically sustainable agricultural practices, in order ... to safeguard the nations' precious natural heritage'.⁹⁷ This strategy was refined further in different action plans over the first decade of the twenty-first century. These plans include the National Biodiversity Strategic Action Plan (2002), Blueprint for Conserving the Biodiversity of the FSM (2003), state-specific Biodiversity Action Plan (2004), FSM Strategic Development Plan (2004–2023) and National Environment Sector Plan (2009).⁹⁸ The biodiversity reports identified that the biological resources of both the nation and the states are faced with existential biological and anthropogenic threats.⁹⁹ The development plan looks at strategies to optimise economic output in light of future threats and the scaling down of Compact funding.¹⁰⁰ The report on the national environment identifies strategies that can be implemented to protect the nation's environment, on which much of the country's economic output relies.¹⁰¹ The national government is seeking funds to implement the recommendations of these reports. It remains to be seen how long it will take for implementation to occur.

In 1994, the FSM prepared a baseline assessment of its greenhouse emissions. It noted total emissions as expressed in CO₂ equivalents were 246.01 gigagrams per year.¹⁰² Almost all of the emissions (98 per cent) came from the energy sector, with only a small contribution from the

96 Jackson Soram (deputy assistant secretary, Foreign Affairs, International Division), Interview, Nett, Pohnpei, 10 October 2012.

97 Office of Statistics, Budget and Economic Management, Overseas Development Assistance and Compact Management, *Millennium Development Goals and Status Report 2010*, p. 72.

98 Office of Statistics, Budget and Economic Management, Overseas Development Assistance and Compact Management, *Millennium Development Goals and Status Report 2010*, p. 72.

99 *The Blueprint for Conserving the Biodiversity of the Federated States of Micronesia*, 2003, pp. iii–iv.

100 *The Blueprint for Conserving the Biodiversity of the Federated States of Micronesia*, p. 8.

101 *The Blueprint for Conserving the Biodiversity of the Federated States of Micronesia*, pp. 3–5.

102 Office of Statistics, Budget and Economic Management, Overseas Development Assistance and Compact Management, *Millennium Development Goals and Status Report 2010*, p. 74.

agricultural sector. It is important to note that these emission volumes are minute on the global scale. However, as a member of the international community, the FSM is committed to reducing its domestic emissions.

Similarly, industrialised countries need to commit themselves to reducing their own emissions if humanity is going to survive the impacts of climate change. The FSM is a supporter of the 'Tuvalu Deal',¹⁰³ which advocates the reduction of emissions to keep global temperature rise below 1.5°C to curtail sea level rise.¹⁰⁴ Other considerations involve getting the major international 'emitters' to adhere to their suggestion to set aside funds for vulnerable countries in the Pacific and Indian oceans for immediate adaptation projects to safeguard their future.

Saving the Environment

Ensuring a sustainable environment rests on the nation's development goals, which are ultimately geared towards improving adaptation techniques. Development, to the Mortlockese people, may be measured in terms of the application of local knowledge coupled with skill-based imported technology able to be used to enhance islanders' adaptation strategies.¹⁰⁵ For example, the main food supplies for islanders are from the sea and the breadfruits and taros they harvest from their land. Islanders have designed new methods to preserve breadfruits by putting them above ground in large pots instead of preserving them in underground pits to prevent saturation from seawater floods.

Modern technologies such as refrigerators, freezers and ice plants are also used to prolong the storage of fish and other perishable local foodstuffs. Solar panels have been introduced, especially on the low-lying islands, to enable the use of refrigeration technology and connection with the

103 The Tuvalu Deal emerged during the Copenhagen Climate Change Conference, where it was put to the member states attending that Tuvalu will be unable to maintain itself if global temperature rises by more than 2°C. See also Masao Nakayama, 'Statement before the Committee of Religious NGOs and the United Nations'.

104 *Nationwide Climate Change Policy 2009*, p. 1.

105 *Nationwide Climate Change Policy 2009*, p. 2.

international community through the use of computers, radios and televisions.¹⁰⁶ The communication links provided by this technology have enhanced the islanders' understanding of climate change issues.¹⁰⁷

The adaptation policy published by the national government has not yet sufficiently filtered down to the local level to have a comprehensive local impact. Part of the problem is the lack of trainers to educate the local population on policy issues. The Mortlockese are doing the best they can to protect their land while waiting for further research findings and welcoming the knowledge of climate change scientists and international aid. Local communities have implemented programs based on local knowledge, such as the planting of native plants with big roots such as *shia* (mangroves), *fash* (pandanus) and *rakish* (sea oaks) that have the ability to prevent soil and beach erosion. Adaptation remains a matter of life and death to the Mortlockese and has higher priority than large-scale economic development.¹⁰⁸

Development and Climate Change

A 2006 report titled 'Federated States of Micronesia: National Assessment Report' discussed sustainable development strategies. Written by FSM economist and financial expert Fabian Nimea, it indicated that there is not a single comprehensive National Sustainable Development Strategy (NSDS) for the nation. However, there are disparate pieces of information and plans that could and need to be put together to formulate an overall NSDS plan. Any such NSDS should be accompanied by supporting mechanisms for the purpose of implementation and reinforcement.¹⁰⁹ This will include policy development and a legal framework. As Nimea noted, 'sustainable development planning [will] ... better manage the process [of] development, implementation and improvement'.¹¹⁰ However, missing from this report is a specific economic model that the

106 Larry Bruton, 'Successful Renewable Energy Projects in the FSM', Paper presented at the 26th Pacific Islands Environment Conference, 22–25 June 2009, Saipan, CNMI.

107 Stephen J. Winter, 'Water for an Island', The FH Foundation, Long Beach, California, 1995.

108 According to a local source in the atolls, the most important thing in their lives is maintaining local production to sustain their livelihood as they have been doing for many centuries. However, imported goods are shared to supplement local diet. See also Gonzaga Puas and Anelita Puas, 'How Can Development be Linked to Climate Change Adaptation Policies?', CliMates- International Student Organisation, Paris, France, December 2012, pp. 4–5.

109 Nimea, *Federated States of Micronesia: National Assessment Report*, p. iii.

110 Nimea, *Federated States of Micronesia: National Assessment Report*.

Mortlockese can utilise to sustain their livelihood instead of perpetuating outsiders' perceptions of development, which are often unsuitable for an island lifestyle.

Ten key objectives, ranging from establishing a comprehensive system of environmental law and good governance to strengthening the knowledge base of the local people, were key factors in formulating sustainable development strategies 'that will be evolutionary, adaptable, and sustainable for all generations', according to Nimea.¹¹¹ Despite all the suggested frameworks identified in the report, the proposed NSDS fell short of 'linking and integrating them with socio-economic priorities' for the FSM.¹¹²

In 2009, the FSM Government produced its own Nationwide Climate Change Policy that incorporated the objectives of Nimea's report. This policy document identified some major issues that the national government needed to inform its people about, such as the importance of combating the impacts of climate change within the framework of sustainable development. This policy document was compiled using mainly international adaptation instruments and needs input from local inhabitants to ensure the complementary policy of 'act locally, think globally' is enacted. Thus, the overall statement of the policy should be for the FSM Government to participate globally in the mitigation of climate change while promoting adaptation at the domestic level to ensure the survivability of its people into the future.¹¹³

At the international level, the FSM Government is actively involved in lobbying the world's largest economies to be mindful of their practices that are destroying the livelihoods of Micronesians. The FSM is also part of the Small Island Developing States organisation and regional organisations such as the Pacific Forum whose purposes include promoting their collective interests, including the addressing of climate change. At the domestic level, local knowledge should be the main driver while new partnerships are sought with the international scientific community. Partnership means ensuring the preservation of natural heritage and natural resources in all the islands.¹¹⁴ It also means requiring all development activities to take into account 'projected climate change

111 Nimea, *Federated States of Micronesia: National Assessment Report*, pp. iii–iv.

112 Nimea, *Federated States of Micronesia: National Assessment Report*, pp. ii–iv.

113 Nimea, *Federated States of Micronesia: National Assessment Report*, pp. 35–36.

114 Nimea, *Federated States of Micronesia: National Assessment Report*, pp. 35–36.

design and implementation of [the] strategic development plan, such as the use of eco-based approaches, and the implementation of strategies to sustain food production'.¹¹⁵

Self-Reliance

Food security presents one of the main challenges to the FSM Government. The *Food Security Vulnerability Assessment Report* (authored by agriculturalists Susumu and Kostka in 2012) gave a snapshot of what the FSM may look like in the future. The authors characterised the FSM's economy as aid dependent, wherein the FSM relies primarily on money provided by the US under the Compact and from other donor countries like Japan, China and Australia. The authors found that the Compact's funding accounts for about 65 per cent of national government revenue and 75 per cent of state government revenue. The FSM economy remains in negative growth today.¹¹⁶ A shift to local thinking is required to ensure self-sufficiency remains an objective for the nation, especially in the coming years when the effects of climate change are predicted to become more severe.

Additionally, construction methods for public buildings and private dwellings need to incorporate changes in the local environment, such as variations in temperature and topography caused by climate change.¹¹⁷ The best possible design for these buildings is one that uses local knowledge and materials, in addition to weather-resistant imported materials and engineering models from the global community. For example, *shoon fash* (pandanus leaves), *shoon nu* (coconut leaves), *sopon mei* (breadfruit trunks), *sopon nu* (coconut trunks), *shia* (mangrove), *mosor* and *shokis*¹¹⁸ are best suited to the island environment. They can withstand the tropical weather longer than materials imported from China or Japan, for example. Moreover, local products are cheaper than the inflated prices charged for

115 Office of Statistics, Budget and Economic Management, Overseas Development Assistance and Compact Management, *Millennium Development Goals and Status Report 2010*, p. 3.

116 Susumu and Kostka, *Food Security Vulnerability Assessment Report*, p. 3.

117 Islanders also need to observe temperatures caused by climate change to give them ideas about their fishing activities (Walter, Interview).

118 *Shokis* is a very strong tree that is grown in saltwater on the shoreline. Its branches, which can last for many years, are used in traditional house construction, especially for pillars, and for fish traps.

imported materials. Local knowledge should be incorporated into high school or post-secondary trade qualifications to encourage sustainable building practices.

Sustaining the Seas and Agriculture

The fishing industry has been targeted as part of the FSM's self-sufficiency blueprint for survival in the future. The FSM's EEZ is about 2.9 million square kilometres and considered one of the most productive tuna fishing areas in the world. It is estimated that the FSM is capable of sustaining a yield of well over 100,000 tons annually; however, it lacks the capabilities to exploit this potential.¹¹⁹ Its fishing zone benefits outside countries like Japan, Korea and Taiwan who pay a fishing license fee to the FSM Government that is less than 10 per cent of the sale value of the fish caught. Aquaculture has the potential to be a productive industry, and the government is exploring this option. Aquaculture and marine farming trials have commenced in Pohnpei but require skilled workers to maintain them. The National Fishing Corporation is also involved in a joint venture to maximise the EEZ's potential. Already, there has been an increase in the National Fisheries Corporation's profit.¹²⁰

Local agricultural production for domestic consumption is another priority for food security and self-reliance. However, the budget set aside to encourage local people to engage in agricultural programs has been disappointing. For example, Susumu and Kostka noted that in '2004 to 2005 only 1.8 per cent of the national budget (the budget was US\$63 million in total)¹²¹ was set aside for agriculture'.¹²² Many argued that the locals' lack of interest in engaging in agricultural activities stemmed from the following. First, the younger generation considers agriculture to be a 'dirty' business, and so it is not a priority for them. They prefer to engage in white-collar employment where the pay is higher than other local options. Second, agriculture is not widely promoted in the educational curriculum. Third, the younger generation does not see

119 Peter Sitan, pers. comm., Micronesia Australian Friends Association Research Symposium, The Australian National University, 29 April 2014. Peter Sitan is the president and chief executive officer of the National (FSM) Fishing Corporation. The shortcomings in the FSM's capacity to maximise its fishing potential is also discussed by D'Arcy, 'The Lawless Ocean?', pp. 3–5.

120 Sitan, 'The Development of the Tuna Fisheries'.

121 Susumu and Kostka, *Food Security Vulnerability Assessment Report*, p. 5.

122 Susumu and Kostka, *Food Security Vulnerability Assessment Report*, p. 3.

the need to enlarge the scope of agricultural activities as they consider it to be for local consumption only, rather than for commercial sale to attain large profits.¹²³

With the onslaught of climate change, the attitudes of many in the younger generation is that, if the soil cannot be saved from erosion and the impact of sea level rise, what is the point of agriculture if it is a doomed enterprise? Why concentrate on agriculture if many people will likely be leaving their homes in the future due to climate change? There is an urgent need for education about options for climate change mitigation and adaptation for young Micronesians so they do not abandon hope.¹²⁴

Policy Formulation

The mobilisation of government field officers to collect data to provide an overall picture of the impacts of climate change on the nation is ongoing. Evidence suggests that there is a heightened awareness shared by islanders in relation to soil erosion and sea level rise, most notably regarding the intrusion of saltwater onto farmland.¹²⁵ Some islanders have expressed anxiety in relation to the gloomy predictions about their possible relocation, which seems to become more certain as the years go by. There are already people moving to join their relatives on the volcanic islands. However, others, determined to 'keep up the battle' to ensure that future generations will have homelands where the ancestral ways are preserved, have accepted the risks of climate change.¹²⁶

To complement its climate change adaptation policy, the FSM Government produced yet another document in 2010, the 'Millennium Development Goals and Status Report'. This report was in response to the UN's eight Millennium Development Goals, alternatively known as the 'Millennium Declaration', which was supposed to be finalised

123 Susumu, Interview.

124 Marcus Samo (deputy secretary of the FSM Department of Health and Social Affairs and Chuukese Historian), Interview, Palikir, Pohnpei, 21 June 2013.

125 Susumu, Wichap and Silbanuz, *Preliminary Damage Assessment*, pp. 14–16. For further assessment and discussion, see Fletcher and Richmond, *Climate Management and Adaptive Strategies*; Henry, Jeffery and Pam, *Heritage and Climate Change in Micronesia*, pp. 5–15; Hezel, 'High Water in the Low Atolls'.

126 Interviews with Mortlockese people during field research in Pohnpei, 5–12 January 2011.

in 2015.¹²⁷ In 2003, the FSM completed a 20-year Strategic Development Plan that reflected the input of over 400 participants, representing a broad range of perspectives including government, traditional leaders, industry and civil society.¹²⁸ The report identified priorities for the promotion of sustainable development objectives.

The objectives included good governance, coordinated nationwide sustainable economic development with inputs from grassroots organisations and state governments, encouragement of a private sector-led economy, development of technical know-how by merging traditional and outside knowledge, investment in relevant infrastructure to combat the adverse effects of climate change, and implementation of long-term environmental protection and sustainability. The report declared that the link between the Millennium Development Goals and the Strategic Development Plan could be achieved by a coordinated approach between the national and state departments, offices and agencies, the private sector, NGOs and civil society organisations.¹²⁹

While the report identified the areas of development priorities for the nation, it remains to be seen how this will translate into concrete action. Take, for example, goal number seven. Its objective is to 'ensure environmental sustainability to integrate the principles of sustainable development into ... policies and programs; reverse loss of environmental resources by 2015'.¹³⁰ To achieve this objective by 2015 was unrealistic as the FSM Government did not have the capacity to implement it. Perhaps it should be left to each country to set its own implementation deadlines. Alternatively, the FSM should not be obliged to implement a UN goal that is outside its capacity. There are inherent flaws in the FSM Government's policies as it is paying too much attention to dictates from the outside. The report is therefore a symbolic statement that does not reflect the realities of Micronesian modes of production, their environment and their social system.¹³¹ These are the backbone of their identity and continuity.

127 Office of Statistics, Budget and Economic Management, Overseas Development Assistance and Compact Management, *Millennium Development Goals and Status Report 2010*, pp. 8–9.

128 Office of Statistics, Budget and Economic Management, Overseas Development Assistance and Compact Management, *Millennium Development Goals and Status Report 2010*, p. 7.

129 Office of Statistics, Budget and Economic Management, Overseas Development Assistance and Compact Management, *Millennium Development Goals and Status Report 2010*, p. 2.

130 Office of Statistics, Budget and Economic Management, Overseas Development Assistance and Compact Management, *Millennium Development Goals and Status Report 2010*, p. 72.

131 See Rich Harris and Clare Provost, 'The Millennium Development Goals: Big Ideas, Broken Promises?', *The Guardian*, 24 September 2013.

Resiliency and Local Communities

The FSM must continuously explore its economic potential in terms of its own resources to deliver important services to its people.¹³² The national government advocates for the introduction of all development activities that take into account projected climate change design and implementation of its Strategic Development Plan, such as the use of eco-based approaches and strategies to improve local food production, as being fundamental to the nation's adaptation policy.¹³³ Adaptation is therefore about the maintenance and preservation of Micronesian cultures through locally based education and combined efforts with outside agencies as a model of preserving the history of Micronesia, which continues to be threatened by the impact of climate change.

Capacity building and training involves developing a coordinated system of educational and instructional programs in order for the FSM to be able to respond to the impact of climate change issues as they arise. The first priority is to implement local knowledge as a first line of defence.¹³⁴ In order to deliver effective programs, the national government has teamed up with its state counterparts in designing and developing strategies to ensure that people at the grassroots level are aware of new information about climate change. Human resources for the purpose of collection and analysis of data for enhancing adaptation policies are already in place but require more personnel. Of course, many foreign governments and institutions are present in the FSM, but they are there to assist in the implementation of policy practices and community-based climate change projects initiated locally, rather than being the main drivers of the initiatives.¹³⁵

Adaptation and Island Development

The Mortlockese people have adapted to their local environment and utilised local knowledge to provide for their needs for centuries.¹³⁶ When one speaks about development in the Mortlock Islands, the islanders

132 Nimea, *Federated States of Micronesia: National Assessment Report*, pp. 1–10.

133 *Nationwide Climate Change Policy 2009*, p. 2; Susumu, Wichap and Silbanuz, *Preliminary Damage Assessment*, pp. 15–16.

134 *Nationwide Climate Change Policy 2009*, pp. 1–3.

135 *Nationwide Climate Change Policy 2009*, pp. 1–3.

136 *Mortlocks Oral History*; Petersen, *Traditional Micronesian Societies*, pp. 3–5.

often react by asking, ‘development for who?’ Such a reaction reflects the long history of colonialism in the FSM and Mortlockese suspicion of outsiders’ influence in their attempts to reshape the region according to foreign plans or models. The Mortlockese are always aware of their economic circumstances due to the limited modern technology they have. Further, the Mortlockese consider that developing their islands should be done according to how locals envisage their island, and at their own pace.

The interconnection between extended families, which has been in place for many centuries, acts as a safety net for islanders’ ongoing survival. It maintains the fabric of the islands’ social wealth, which feeds into the larger economic system.¹³⁷ Today, this infrastructure continues to be at the heart of the islanders’ continuity. The extended family model has increased its connection globally by virtue of the new diaspora under the Compact. Islanders continue to adapt to an increasingly globalised world to ensure the survival of future Mortlocks generations.¹³⁸

Micronesians understand the benefits that derive from retaining their connections within the diaspora. They also understand the benefits that can be derived from engaging experts from a variety of international channels in designing a unique, locally based economy for the proper conservation of their environment in anticipation of climate change challenges. The education curriculum should also play its part in teaching the younger generation about local knowledge so that they can appreciate their environment and transmit both traditional skills and relevant modern skills from the outside world to the next generation.

Adaptation is a priority not just for the Mortlockese but throughout the FSM and the Pacific Islands. Individual scientists and groups are partnering with community-based groups in the FSM to collaborate on the best options to fight the impacts of climate change. The Nationwide Climate Change Policy’s overall objective is to harness all traditional practices from all low-lying and volcanic islands to form the basis of a Micronesian ‘first line of defence’ against the encroaching sea level rise. Field officers are monitoring environmental changes and educating islanders from low-lying atolls. In Pohnpei, for example, the island of Pakin has recently planted pandanus trees on its shorelines, borrowing

137 *Mortlocks Oral History*; Petersen, *Traditional Micronesian Societies*, pp. 3–5.

138 For discussion on Micronesian global movement, see Marshall, *Namoluk beyond the Reef*, pp. 113–130.

the idea from Mokil and Pingelap islands. Likewise, many islands are circulating new ideas regarding the idea of creating a first line of defence by utilising new engineering projects like the seawall in Kosrae and above-ground farming in Yap. Islanders will continue to adapt as they always have done.

Conclusion

Climate change issues are the responsibility of the three branches of government in the FSM. However, each level of government works within its own jurisdiction, as defined by the nation's constitution. The president, Department of Foreign Affairs, Department of Resources and Development, and Office of the Environment and Emergency Management are working together with their state counterparts and historical preservation offices.

Climate change adaptation ranks as one of the top priorities of the nation, and newly introduced laws have been enacted to support government policies that address this issue. National government officials have been conducting field studies and engaging in discussions with the populations of all the islands, where there is strong support for implementing climate change adaptation strategies.¹³⁹ The FSM's climate change policy is evolving to meet the challenges of its changing environment, although obstacles remain. These include a lack of human resources development, infrastructure building capacity and funding.¹⁴⁰ However, at least the people of the FSM understand that their government is trying as best as it can to link the issues of development with its climate change adaptation policy. In the Mortlocks region, economic development emphasised sustainability practices and discouraged reliance on foreign assistance (except in the use of new technologies) to fight the effects of climate change.

Sea level rise is not only affecting the islands' fragile arable land but is also disturbing fishing activities. Beach erosion and intense sea currents are interrupting the flow of nutrients to feeding grounds. Oral testimonies from fishing communities have indicated that many species of fish are migrating to different parts of the shorelines or lagoon. Schools of fish

139 Susumu, Interview.

140 Susumu, Interview.

such as *sarikai*, *umulo* and *iketor* that were once found in the shallow water have disappeared and it is not clear whether they will return to their original habitats, especially with the changes in the shoreline zones due to climate change.¹⁴¹

From the 1970s to the mid-2000s, the Lower Mortlocks were hit by unusual tides.¹⁴² Locals have observed the increase of saltwater inundation in food crops as a result of king tides. Due to the volume of saltwater, it remains on the farms for many weeks. Lukunor Islanders have had to dig new canals to drain the saltwater. They have even caught fish in the taro swamps, and it was also claimed that they encountered new fish species never before seen by locals.

This is a grim reminder of what the islands will experience in the future without effective adaptation strategies developed in conjunction with the international community. Micronesians' first priority is to maintain self-sufficiency to ensure continuity. The land and the surrounding seas sustain Micronesians' livelihoods. They must be prepared to face this challenge as a priority in order to continue as a people with a distinct history in a unique place where past generations lie buried. The future is unpredictable and challenging, but Micronesians have overcome climate-related obstacles in the past. How Micronesians might best face this uncertain future is the topic of the next chapter.

141 This observation stems from my personal experience growing up on Lukunor, listening to local fishermen discuss issues about fishing.

142 Kandy, Interview; Chol, Interview. My interviews with many Mortlockese confirmed the unusual weather patterns in the Mortlocks.

This text is taken from *The Federated States of Micronesia's Engagement with the Outside World: Control, Self-Preservation and Continuity*, by Gonzaga Puas, published 2021 by ANU Press, The Australian National University, Canberra, Australia.

doi.org/10.22459/FSMEOW.2021.07