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THE ROLE OF ENERGY SUPPLY IN THE SHAPING OF DEVELOPMENT
PROSPECTS IN SMALL AND ISOLATED PACIFIC ISLAND COMMUNITIES –
PAST, PRESENT AND FUTURE.

A THESIS PRESENTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

IN

DEVELOPMENT STUDIES

AT MASSEY UNIVERSITY, MANAWATU CAMPUS, NEW ZEALAND

PETER SHERWIN COLE

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ABSTRACT

The thesis examines the way that energy supply has influenced directly or indirectly the transformation of society in Niue and Tuvalu from the time before the arrival of palagi (Europeans) to the present day. Of particular interest is the vulnerability that this reliance creates in terms of the risk to people's wellbeing. Most of New Zealand's South Pacific neighbours have to import energy in the form of oil products. In the case of Niue and Tuvalu, over 90% of their energy is imported, largely paid for through aid from overseas donors. Like New Zealand, people in both countries rely on energy to maintain their livelihoods and lifestyles. There is near 100% electrification and vehicle ownership is high and government and commercial enterprises that provide services and employment rely on continuous and affordable energy, the supply of which is highly vulnerable to economic and political pressures beyond their control, a situation not expected to improve. The thesis addresses four questions: how and why this situation has come about, would these two communities be able to adapt to a much reduced or changed energy supply, what steps are being taken to reduce this dependency before a crisis occurs and whether these steps are likely to be effective.

The research used the sustainable livelihoods approach to develop an integrated research methodology including field methods and a novel, systematic form of analysis. Field research methods involved interviews, conversations and observation. The results of the research are set out in narrative form that reviews changes to livelihoods in Niue and Tuvalu over time from the arrival of palagi to the present day. The narrative is followed by an original sustainable livelihoods analysis, the output of which is a series of livelihood profiles including livelihoods asset pentagons that illustrate changes in livelihood assets. A parallel series of "livelihood energy pentagons" were developed to demonstrate the influence of energy on livelihoods. The same method of analysis is used to analyse an "energy-deprived" future scenario, postulated in order to illustrate the impact on livelihoods in Niue and Tuvalu should the supply of oil-based fuels become severely constrained.

The narrative and the analyses show that the role of energy has changed from having an essential role although limited in form, in supporting people's traditional livelihoods to one that enables the full spectrum of services on which contemporary livelihoods rely in Niue and Tuvalu. The analysis of the energy-deprived scenarios underlines this reliance by demonstrating the serious and negative impact on contemporary society should imported fuel supplies be seriously disrupted. Current plans by the two governments to reduce reliance and imported fuel supplies are reviewed and this thesis concludes that while proposed measures go some way to mitigating the impact of a fuel supply disruption, the consequences of such a disruption will still be severe. A recommendation is made that both governments prepare strategic action plans that specifically address fuel supply disruption by emphasising a focus on endogenous rather than exogenous energy sources.

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ACRONYMS

ADB:	Asian Development Bank
ADFD:	Abu Dhabi Fund for Development
AUD:	Australian Dollar
CEDOL:	Commonwealth Education Online
CFL:	Compact fluorescent lamp.
DFID:	Department for International Development (United Kingdom)
EEZ:	Exclusive economic zone
ESDP:	Energy Sector Development Project.
GDP:	Gross Domestic Product
GP:	General Practitioner (medical).
HDI:	Human Development Index
HIES:	Household Income and Expenditure Survey.
IMF:	International Monetary Fund.
Kg:	Kilogramme
LDC:	Least developed country
LMS:	London Missionary Society
LPG:	Liquefied Petroleum Gas
MDG:	Millennium Development Goals
MFAT:	Ministry of Foreign Affairs and Trade (New Zealand).
MOFA:	Ministry of Foreign Affairs (Japan)
NGO:	Non-Governmental Organisation.
NZAID:	New Zealand Agency for International Development.
NZD:	New Zealand Dollar
ODA:	Official Development Assistance
PRA:	Participatory Rural Appraisal.
PV:	Photovoltaic (often referred to as solar generation).
REEEU:	Renewable Energy and Energy Efficiency Unit (unit of TEC).
RRA:	Rapid Rural Appraisal
SAP:	Structural adjustment programmes.
SDG:	Sustainable Development Goals
SOPAC:	Applied Geoscience and Technology Division (SOPAC Division of SPC)
SPC:	Secretariat of the Pacific Community.
TEC:	Tuvalu Electricity Corporation
TKII:	Te Tekakeega II (the (Tuvalu) National Strategy for Sustainable Development.
TMTI:	Tuvalu Maritime Training Institute
UN:	United Nations
UNCTAD:	United Nations Conference on Trade and Development.
UNDP:	United Nations Development Programme
USD:	United States Dollar.
USP:	University of the South Pacific
USPEC:	University of the South Pacific Extension Campus
WCED:	World Commission on Environment and Development
WHO:	World Health Organisation
WST:	Samoan Tala.
\$:	New Zealand Dollar
\$A:	Australian Dollar
\$US:	United States Dollar
€:	Euro
¥:	Yen

ENERGY UNITS AND FACTORS

Energy units used in this thesis:

J:	Joule: unit of energy kJ = 1,000 J MJ = 1,000,000 J GJ = 1,000 MJ
kWh:	kilowatt-hour: unit of energy used in electrical industry (1 kWh = 3.6 MJ). MWh = 1,000 kWh GWh = 1,000 MWh
TOE:	Tonnes of Oil Equivalent (42.6 GJ = 11.83 MWh)
W:	Watt: unit of power kW = 1,000 W MW = 1,000 kW GW = 1,000 MW
Wp:	Watt peak: unit of power used in PV and wind generation sector. kWp = 1,000 Wp.

Energy content factors (calorific values) used for various fuels:

Diesel oil:	45.69 MJ/kg	38.45 MJ/litre
Petrol (gasoline):	46.96 MJ/kg	35.25 MJ/litre
Kerosene:	46.19 MJ/kg	37.26 MJ/litre
LPG:	49.51 MJ/kg	26.54 MJ/litre

Note: all the above are gross calorific values.

Source: New Zealand Energy Data File 2012 (MED, 2012, p. 159).

CHAPTER 1: INTRODUCTION

My reaction on visiting Niue for the first time in 2002 was surprise at the standard of living enjoyed by the residents, not too far removed from the standard of living that we enjoy in New Zealand and certainly ahead of that of the other neighbouring South Pacific countries I had visited. This view is supported by the relatively high gross domestic product (GDP) which at \$16,600¹ per capita for Niue (in 2009) was higher than that of most of Niue's neighbouring island countries (MFAT, 2014d). For example, Samoa with a population of 194,000 (compared with 1,496 in Niue) had a GDP per capita of \$4,420² (MFAT, 2014a). Vehicle ownership is high, housing of a reasonable standard (if one ignores those derelict houses abandoned by families now living overseas), good roads connect the main villages and pumped potable water supplies are connected to most houses. In terms of electricity, virtually all houses are connected to the Niue Power Corporation's power supply and most households have "mod cons" – lighting, electric or LPG cooking appliances, refrigerators, washing machines and televisions. Health services are provided from a local hospital with access to New Zealand hospitals for serious cases and education services are provided from pre-school to seventh form level with scholarships available to the University of the South Pacific and New Zealand universities. Transport to outside of Niue is via a weekly jet aircraft service to Auckland and a monthly shipping service carries all other goods that have to be imported – including virtually all the oil-based fuel necessary for power generation, transport and household use. The fuel imports needed to support this lifestyle account for just under 29% of total imports by value³ (Government of Niue, 2012c).

The extent to which the imported energy supply underpins the way of life in Niue and the vulnerability that this creates became clear when in late 2006, I was asked by the then New Zealand Agency for International Development (NZAID)⁴ to assist in the evaluation of options to replace the diesel generator plant destroyed in a fire at the central power station in Niue in June 2006. The fire badly damaged the power station building and three of the four diesel generators and the power supply to the island was severely disrupted. The hospital, Niue Telecoms, the airport and Niue Broadcasting had local emergency diesel generators so were able to continue in operation but all other public services were halted. Households resorted to wood fires and traditional umu – an earth oven similar in concept to the Maori hangi – and to kerosene lamps and candles for lighting, a lifestyle that brought back memories of life before the 1970s to older Niueans. One element of good fortune was that the recently opened fish processing factory was supplied with electricity from an on-site diesel generator plant so it not only continued in operation but the factory management also made cool-rooms and freezers available for people to store their foodstuffs for the duration of the power supply disruption. A limited power supply was established within a week. From all accounts, the week-long

¹ Unless otherwise noted, all dollar (\$) figures in this thesis are expressed in New Zealand dollars (NZD).

² Converted from WST8,394 at rate of NZD = WST1.90 (MFAT, 2014a).

³ Average for 2009, 2010 and 2011

⁴ NZAID was re-integrated into the Ministry of Foreign Affairs and Trade (MFAT) in 2009 and is now operates as the New Zealand Aid Programme.

crisis was regarded as an adventure with a great level of public spirit and cooperation. Because the crisis was short lived, the impact on day to day life was not serious but it did draw attention to the vital part that electricity supply plays in maintaining the way of life in Niue and if the crisis had continued for several weeks, it is likely that the sense of adventure would have disappeared. Of particular concern would undoubtedly have been water supply as there are no rivers or lakes on Niue and the water supply relies on electric motor driven pumps that draw water from the fresh water lens located under the island. Also, the fish processing factory has since closed and a readily available facility to store perishable foodstuffs no longer exists. The level of vulnerability that the crisis demonstrated increases if one considers a situation where fuel imports are seriously disrupted for several weeks or more as not only would such a situation affect the main electricity supply but also the emergency generators that maintain essential services and the vehicle transport that is an important feature of the Niue way of life.

Visits to other South Pacific islands revealed to me that this vulnerability is not unique to Niue, one other example being Tuvalu, an island nation with a 2012 population of about 10,600 (Tuvalu Central Statistics Department, 2013). Tuvalu has a similar culture and ethnicity to Niue but is physically very different, comprising nine small islands with a total land area of just over 26 square kilometres compared to Niue, a single island with a land area of just over 260 square kilometres. In terms of land resources, therefore, Tuvalu presents a contrast to Niue which becomes even more so when one takes into account the population which is over seven times that of Niue living on one tenth of the land area.

The contrast continues: in 2011, Tuvalu had a GDP per capita of just under \$4,200⁵ (MFAT, 2014c), about one fifth of that of Niue. However, as with Niue, most of the energy needs of Tuvalu are met through fuel imports which account for 16% of total imports (Tuvalu Central Statistics Department, 2008). Although the GDP figures indicate that the standard of living in Tuvalu may not be as high as in Niue, it is probable that a significant reduction in fuel imports would still have a serious impact on people's way of life, particularly given that 98% of household in Tuvalu are connected to a power supply that is mainly supplied from diesel powered plant.

The risk that this vulnerability to an "energy shock" poses was underlined when I observed first-hand the impact of energy supply shortages on rural communities during an energy-related development project in Indonesia that took place between 2005 and 2012. Those communities are far better off in terms of natural resources than Niue and Tuvalu and for that matter, most other South Pacific island countries. The project was located in the Kerinci valley in southern Sumatra, an area blessed with fertile soils and a benign climate, well suited to rice farming and the growing of a wide range of vegetable crops. However, as a consequence

⁵ Based on a figure of USD3,300 and an average rate of exchange for 2011 of NZD = USD0.79 (from <http://www.rbnz.govt.nz/statistics/tables/b1/>)

of the inadequate energy supply infrastructure, particularly electricity, the ability to process vegetable crops for export to other parts of Indonesia or to overseas was severely limited. According to the local government, the ability to process crops – particularly using refrigeration – would not only improve farmers' incomes by enabling increased production but also provide employment opportunities in a food processing industry in an area where many young people had to leave to seek work in other parts of Indonesia. In addition to a lack of electricity inhibiting economic growth, a lack of affordable household cooking fuel became a problem in late 2005 when central government removed the subsidy on kerosene, the fuel of choice for most households. The consequence was that an estimated 80% of village households reverted to woodfuel, typically using open fires or very basic stoves in enclosed cooking areas, thereby exposing cooks – invariably women – to wood smoke with the well documented adverse health impacts (Bloom, Zaidi, & Yeh, 2005, p. 40; DFID, 2002, p. 10) – plus an environmental impact in terms of additional woodcutting in an area already subject to deforestation. This provides an example of “negative” development occurring due to a change in energy supply. Given the current ways of life in Niue and Tuvalu, the fact that both are remote island communities in the South Pacific and not blessed with significant economic resources, this raises the question: how would Niue and Tuvalu survive – let alone develop and prosper – as living communities should the regular supply of imported fuel be even moderately reduced for a period of more than one or two months? This is the question that both motivated and shaped my research.

In the next section of this chapter, I discuss the link between energy and development – referred to as the “energy-development nexus”. This link is a key theme of the thesis and is often poorly understood in terms of how energy interfaces with people's day to day lives. Flowing from this, in the following section, I introduce and discuss the rationale for my research questions. This is followed by an outline of my approach to the research which is based on the sustainable livelihoods approach. In the final section, I set out and discuss the structure of this thesis.

1.1 THE ENERGY-DEVELOPMENT NEXUS

The role that energy supply played in the development of Niue and Tuvalu over the past 40 years was direct, rapid and profound in terms of impact on people's lifestyles. Energy also played an important but largely indirect role in the changes that took place in people's lives from the mid-19th century onwards when, as I describe in Chapters 4 and 5, the traditional lifestyles of Niue and Tuvalu were transformed by the intrusion of whalers, traders, missionaries and labour recruiters. This last group, the labour recruiters, sought people to work in plantations in Queensland and other Pacific Islands and took advantage of what was arguably the most tangible resource of the islands, their young men. This transformation – or perhaps disruption is a better description – was a direct result of industrialisation in northern Europe and North America which created in the industrialised countries a need for raw materials on one hand and markets for manufactured goods on the other (P. K. O'Brien, 1997, p. 76). In spite of remoteness, small size and limited resources, the islands of the South Pacific were not exempt from what was the start of globalisation, defined by Bairoch

and Kozul-Wright as the “process in which the production and financial structures of countries are becoming interlinked by an increasing number of cross-border transactions to create an international division of labor in which national wealth comes, increasingly, to depend on economic agents in other countries” (1996, p. 3). As the end of the 19th century approached, in common with most of the island communities in the South Pacific, Niue and Tuvalu became colonies, not necessarily because of the economic benefits that they brought to the colonising nations but because of the rivalry that existed between those nations – Britain, France, Germany and the United States – all industrialised and seeking strategic advantage in terms of access to raw materials and markets.

This globalisation phenomenon was driven by industrialisation and as I will describe in detail in Chapter 2, energy supply had a critical and symbiotic relationship with industrialisation, a relationship that is continuing today in rapidly industrialising countries such as China. Until the late 18th century, the use of inanimate energy – that is energy from sources other than animals or humans – was limited, the main examples being wind and water mills to grind corn and wind for sailing ships and boats. People used biomass, mainly in the form of wood and sometimes coal where available for cooking and to keep warm. By the late 19th century, in northern Europe and North America, as a consequence of industrialisation, mechanical energy mainly in the form of steam engines had largely displaced human and animal energy in manufacturing, steam railways had largely displaced horse-drawn modes of mass transport for goods and people and steam ships were rapidly displacing sailing ships. Without access to energy resources, industrialisation could not have taken place, while without the need created by industrialisation, it is unlikely that the energy technologies necessary to convert the energy resources into a usable form of mechanical energy would have been developed. Although initially the new energy technologies were developed to facilitate industrial production, eventually the benefits permeated down to household level initially in the form of gas for lighting and cooking and improved water supply and sanitation and increasingly electricity from the early 20th century onwards. However, these benefits did not spread to most of the non-industrialised world until after the Second World War, including those small island communities which lacked the resources – economic and natural – to pay for the energy infrastructure in the first place and then to meet the on-going cost of the fuel imports required. These complex relationships form the focus of the first part of Chapter 2.

Following the Second World War, there was a major shift in attitude on the part of the industrialised world. As I discuss in Chapter 2, development and decolonisation were the priorities, these being driven to a large degree by the United States as a consequence of its rivalry with the Soviet Union (Rist, 1997, p. 76). Economic development that led to an industrialised society was seen as the formula for development along the lines promoted by Rostow in “The take-off into self-sustained growth” (1956). Energy’s role was seen as necessary to support the economic growth through industrialisation in a similar manner to as occurred in 19th century industrialisation in northern Europe and North America. However, development in the form of industrialisation was obviously not feasible for small island countries such as Niue and Tuvalu but as part of

the decolonisation process, economic development plans were put in place by the colonisers, New Zealand and Britain respectively. The nature and success – or otherwise – of these development plans are discussed in Chapters 4 and 5. From the reading of these plans, it is hard to judge the extent to which energy supply was seen as a critical factor. In the case of Niue, pre-independence efforts included the provision of a central power supply funded by the New Zealand Government serving effectively 100% of households. In Tuvalu it was 1984 before a central power supply was introduced on the main atoll of Funafuti while the other islands of Tuvalu, generally referred to as the “Outer Islands”, did not receive central power supplies until the early 2000s (Wade, 2005b, p. vi).

As is discussed in Chapters 4 and 5, access to electricity and other forms of modern energy resulted in increased economic activity and major changes in the way of life. These changes included not only changes at household level – such as improved lighting, clean cooking fuels and refrigeration – but also in improved services including health, education and transport. However, while access to these energy services enables lifestyles that approach to some degree those enjoyed in developed countries, neither Niue nor Tuvalu had or have the industrial or commercial base that justifies these services on strictly economic grounds. As will become apparent from the research questions discussed in the next section, why and how this situation has arisen and what could happen if this situation remains unresolved are the central themes of this thesis

1.2 THE RESEARCH QUESTIONS

The motivation for my research was a concern that the way of life in Niue and Tuvalu has become heavily dependent on imported energy in the form of oil-based fuels. This concern is accentuated by the reality that without official development assistance (ODA), the economies in neither country are strong enough to meet the cost of the imported energy. Furthermore, while with the support of overseas donors, both countries have renewable energy projects underway and planned, these projects appear to be one dimensional in that the main objective is to reduce the amount of imported diesel fuel used to generate electricity by the use of renewable energy technologies and thereby reduce the imported fuel bill. This approach clearly has merit; however, it involves large capital investment in renewable energy technologies and on-going operating and maintenance costs that will stretch both countries in terms of financial and technical capabilities. My concern is that the focus on supply without any attempt to investigate and understand how energy supply interfaces across people’s day to day lives creates a risk that the adopted measures will not meet people’s needs and will not achieve the objective of eliminating the vulnerability from the heavy reliance on imported fuels. There is also a risk that people may believe that the renewable energy projects planned for Niue and Tuvalu provide a solution to all the energy supply problems confronting both communities.

As I discussed above, in spite of isolation and small size, “northern” industrialisation had a profound influence on the development of both island societies. Furthermore, as I will discuss in later chapters, while neither Niue nor Tuvalu can be described as “industrialised”, both share some of the characteristics of an

industrialised society which to a large degree explains the dependency on imported energy. In order to explore the part that energy supply has played in industrialisation and how and why this is relevant to the development of today's societies in Niue and Tuvalu, my four research questions are:

How has energy supply shaped the development of Niue and Tuvalu?

What are the risks to the future development of Niue and Tuvalu from disruption to energy supply?

What measures are being taken by the governments of Niue and Tuvalu and their overseas partners to mitigate the identified risks?"

Are those measures being taken or planned likely to be effective?

1.3 APPROACHES TO THE RESEARCH: SUSTAINABLE LIVELIHOODS AND HUMAN DEVELOPMENT

For my research, I have adopted a sustainable livelihoods approach both as a framework and as a methodology. A sustainable livelihood is defined by Chambers and Conway (1991, p. 6) as:

the capabilities, assets (stores, resources, claims and access) and activities required for a means of living; a livelihood is sustainable which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the short and long term.

The sustainable livelihoods approach, its development and why and how I have used it to design my research methodologies and to analyse results from both field research and secondary sources, is discussed in Chapter 3. In summary, an important characteristic of the approach is that it focuses on people's lives and realities of those lives (Scoones, 2009, p. 172). As such, the sustainable livelihoods approach is well suited to gaining an understanding of people's lives and their priorities. This is particularly the case in complex situations such as exists in Pacific island societies where a foreign industrialised culture overlays indigenous cultures that have been developed over a number of centuries to cope with remoteness, limited natural resources and a climate that can bring both cyclones and drought. In this context, the sustainable livelihoods approach provides a "people-centred" approach that relates energy supply to people's needs and priorities rather than simply addressing as a technical issue (DFID, 2002, p. 24). The people-centred approach is of particular value as energy supply is all-pervasive in that it impacts across livelihoods indirectly as well as directly.

Furthermore, the attention in the sustainable livelihoods approach given to the vulnerability context as represented in the DFID sustainable livelihoods framework (1999b) is useful given that both Niue and Tuvalu rely on an energy supply chain that can be threatened by externalities ranging from cyclones disrupting shipping to political instability in far-off countries which provide the vital oil supply (or the funding for it).

One outcome of a livelihood is lifestyle, a term I will use in this thesis to encapsulate factors such as standard of living, way of life and quality of life, all of which have different meanings but go to make up an individual's day to life. There is a strong linkage between a livelihood – as defined above – and a lifestyle in that an individual's lifestyle will be determined to a large degree by that individual's livelihood. An essential component of a satisfactory lifestyle is "well-being" which includes not only material factors such as income and possessions but also factors such as happiness, self-respect and the ability to participate freely in one's community (Sen, 2008, p. 276). These factors, both material and "non-material" are central to "human development" described by the UNDP in the Human Development Report 1990 as:

a process of enlarging people's choices. In principle, these choices can be infinite and change over time. But at all levels of development, the three essential ones are for people to lead a long and healthy life, to acquire knowledge and to have access to resources needed for a decent standard of living. If these essential choices are not available, many other opportunities remain inaccessible.

(UNDP, 1990, p. 10)

To provide a quantitative measure of human development in general and specifically to compare movement in human development with that of energy consumption, I use the human development index (HDI) from time to time in this thesis. The HDI was developed in 1990 by the United Nations as a response to the reliance on GDP as a means of measuring development, arguing that undue focus on national income and growth "have at times obscured the fact that the primary objective of development is to benefit people" (UNDP, 1990, p. 9). The HDI is based on three parameters – economic development (in the form of GDP per capita), life expectancy and access to education (Crafts, 1997a, 2002; Saga & Najam, 1998). Given the limited input data used, the HDI could be described as a "broad brush" means of measurement, more suited to be a means of comparison between countries and also a means to measure changes in development, development status⁶.

⁶ I note that the calculation of the HDI has been modified from time to time; for example, the HDI figures used in Chapter 2 to compare HDI and energy consumption over time during British industrialisation were calculated by Crafts using the 1994 method (Crafts, 1997a, p. 301).

1.4 ENERGY AND ENERGY TECHNOLOGIES

The focus of this thesis is not intended to be on energy supply and technology. However, inevitably technical issues arise and some discussion is necessary. In this section, I provide some definitions of the terminologies used and where relevant to the situation in Niue and Tuvalu, some brief descriptions of energy technologies.

Given the wide meaning that can be attributed to the term “energy”, a definition is necessary. Unless otherwise stated, the term energy when used in this thesis means inanimate energy, or, as defined above, energy that is not derived from human or animal activity. In this context energy can mean a primary energy source such as oil, the sun or wood, or an energy carrier such as electricity, depending on the context. Before energy either as a primary energy source or as an energy carrier can be used, it needs to be converted into a usable form or energy service, such as lighting, heat (for example, for cooking) or mechanical energy (for example, to propel a motor vehicle) (Arvizu, Bruckner, et al., 2011, p. 38). The conversion process requires an energy technology which can vary in complexity and of which there is a very wide range. Arguably, the simplest example of an energy technology is the open fire when used to cook food. The internal combustion engine is one of the most common examples, including the diesel engine which is used for electricity generation throughout the world and in particular in small island communities such as Niue and Tuvalu.

As will be discussed in some detail in this thesis, renewable energy and the related technologies are subjects of considerable interest in Niue and Tuvalu as these are seen as offering a solution to resolving the concern over both countries’ reliance on imported energy in the form of oil fuels. Renewable energy is “any form of energy from solar, geophysical or biological sources that is replenished by natural processes at a rate that equals or exceeds its rate of use” (Arvizu, Bruckner, et al., 2011, p. 38). Sources of renewable energy in common use include resources such as biomass, solar energy, geothermal heat, hydropower, tide and waves, ocean thermal energy and wind energy. In the case of Niue and Tuvalu, three categories of renewable energy are either in use or under consideration: biomass, solar energy and wind energy and a brief discussion on these the use of these resources and the associated technologies follows. There are no readily available sources of geothermal heat and the lack of rivers rules out hydropower (Wade, 2005a, p. 17; 2005b, p, 29). Ocean technologies are still at the development stage (Lewis et al., 2011, p. 507) and while tidal energy technology is regarded as “mature”, no significant resources are believed to exist in either Niue or Tuvalu.

In the context of Niue and Tuvalu, biomass energy resources include wood, coconut, plants and plant residues and animal wastes (Sims & El Bassam, 2003, p. 2). As I will discuss in Chapter 4 and 5, the main application at present is for cooking, particularly in Tuvalu, using wood and coconut residue, sometimes

referred to as woody biomass. In Tuvalu, there is some use of pig dung as a feedstock in biogas digesters (Alofa Tuvalu, 2014). In this anaerobic digestion process, organic matter is broken down in the absence of oxygen to produce biogas, a mixture of methane (50 to 70%) and carbon dioxide. The biogas is used for cooking, replacing either wood, kerosene or LPG (Chum et al., 2011, p. 240). Other potential biomass applications under consideration in Tuvalu include the use of coconut oil as a diesel fuel, either directly as a “straight vegetable oil” or processed to form biodiesel (Chum et al., 2011, p. 240; Government of Tuvalu & TEC, 2013, p. 5).

The use of solar energy is the main focus of the donor-led energy programmes in both countries. Photovoltaic electricity generation is currently used with further projects planned. Photovoltaic (PV) electricity generation uses the effect of light shining on a semiconductor such as silicon to generate an electric current (Arvizu, Balaya, et al., 2011, p. 351). The current generated has to be converted into a form that can be used in a similar manner to that generated using “conventional” technologies such as diesel generators. The nature of the equipment involved depends on whether the system is “off-grid” – that is, a discrete area ranging from a single dwelling to a number of users and not supplied from any other generation source – or “grid-connected” where the PV generation supplies into a distribution network (or grid) that is also supplied from another source of generation (Arvizu, Balaya, et al., 2011, p. 354). A major drawback of PV generation is that electricity is only produced when there is sunlight and output is much reduced during cloudy weather and at night there is no production at all. In a grid-connected situation where PV generation supplements another generation system, this may not be an issue⁷. However, in an off-grid situation, if the full potential of PV generation is to be exploited, then some form of energy storage is required and while extensive research continues on alternatives, batteries are the most common form of storage in small-scale PV installations. Batteries are expensive and the cost can amount to 24% of the total cost of a PV generation system (EECA, 2010, p. 24) . Furthermore, battery life is relatively short at between 5 to 12 years. While operating and maintenance requirements are relative simple, diligence on the part of operators is essential and this includes ensuring that batteries are not overworked by discharging too much as this can reduce battery life (EECA, 2010, p. 44) . Finally, if proper disposal procedures are not followed, expired batteries can create a significant environmental hazard (EECA, 2010, p. 44).

The other common application of solar energy is solar water heating which, as I note in Chapter 4, is widely used in Niue but, based on my observations, much less so in Tuvalu. In this technology, water is passed through a solar collection panel, typically roof mounted, and stored ready for household use in the form of hot water (EECA, 2012).

⁷ This is not always the case as in situations where the PV generation capacity is a significant proportion of the total generation then grid-stability can be an issue and batteries can be used to mitigate this problem. This topic is beyond the scope of this thesis but for further information on this complex matter, references include Eltawil and Zhao (2010) and Kim et al (2009). Crawley (2014) also discusses the issue of system stability in the context of the Niue power system.

Although identified in both Niue and Tuvalu as a potential source of renewable energy, the use of wind energy to generate electricity has yet to be applied on other than on an experimental basis. The potential that wind energy offers as a supplement to PV generation is noted in the Government of Tuvalu's "Enetise Tutumau 2012-2020: Master plan for renewable electricity and energy efficiency in Tuvalu" (2012b, p. 14). Wind generation involves a wind turbine-driven generator mounted several metres above groundlevel and in a similar manner to that described for PV generation above, the electricity generated can be delivered to a discrete area of consumers – "off-grid" – or into a distribution network supplied from other generation systems – "grid-connected". Wind generation suffers from the same drawback as PV generation in that it is intermittent in nature and in "off-grid" situations, batteries may be required. Furthermore, unlike PV generation systems, wind turbine generators are relatively 'high-maintenance' and prone to damage in the event of a severe storm (Government of Tuvalu, 2012b, p. 14).

The technologies discussed above all concern energy supply. Equally important is how energy is used and specifically whether the use is efficient or even necessary. Both Niue and Tuvalu refer to energy efficiency in planning documents as a means to reduce energy consumption (Government of Niue, 2009a, p. 18; Government of Tuvalu, 2012b, p. 18). The question of whether the approaches proposed in those documents are likely to be effective in reducing energy consumption is discussed in Chapters 6, 7 and 8.

1.5 THESIS STRUCTURE

This thesis is structured in three main parts: in Chapters 2 and 3, I set out the theoretical context for the thesis and the research methodology. Chapters 4 to 7 describe the results and the analysis of my research. In Chapter 8, I review and discuss the findings followed by my conclusions.

The objective of Chapter 2 is to investigate why and how energy supply has become such a critical part of people's lives in developed countries and increasingly so in many developing countries. Chapter 2 is in effect a history and is in two parts, the first part covering the industrialisation process that commenced in Britain in the late 18th century, the first phase of which is sometimes referred to as the "Industrial Revolution", and by late in the 19th century had spread to much of northern Europe and North America. Ultimately, industrialisation led to the creation of much of what was regarded the "developed" world by the 1950s. I conclude that the relationship between energy supply and industrialisation was symbiotic in that on one hand without adequate energy supply made possible by newly developed energy technologies, industrialisation would not have taken place while on the other hand, without the demands of industrialisation, the development of those essential energy technologies would not have occurred. However, I note that industrialisation was not caused by energy supply or those new energy technologies; rather, economic historians believe that British industrialisation was initiated by a range of pre-conditions – political, social and economic. A second conclusion is that those new technologies developed to meet the

demands of industry were eventually applied for the benefit of society as a whole. An outcome of 19th century industrialisation was globalisation where the economies of countries that were not industrialised became dominated by the industrialised countries of northern Europe and North America. In spite of being small and remote island communities, Niue and Tuvalu were not exempt from this phenomenon, a situation that led to colonisation in the late 19th century.

In the second part of Chapter 2, I move to the period from the 1950s to the present day and examine the approach taken by developed countries and the various development agencies to assist developing countries to improve the lives of their people with particular reference to perceived role of energy in the achievement of that goal. While the initial focus was on emulating the industrialisation that took place in northern Europe and North America during the previous 150 years, this process was subject to criticism as increasing concern arose at environment degradation and resource depletion, energy being identified as a contributor in both cases. This gave rise to the concept of sustainable development where the objectives of economic growth and the need to protect the environment and use resources in a sustainable manner were reconciled. Of significance is that the need for reliable and affordable energy supply has since about the year 2000 become recognised if development objectives are to be achieved. For example, the UN Commission on Sustainable Development in 2002⁸ stated that “To implement the goal accepted by the international community to halve the proportion of people living on less than US\$1 per day by 2015, access to affordable energy services is a prerequisite.” Furthermore, there are clear linkages between access to energy and achievement of the Millennium Development Goals (DFID, 2002; ITDG, 2002), and the place of energy on the development agenda has been cemented with it being included as one of the 17 Sustainable Development Goals (SDGs) that are set to replace the MDGs from 2015 (United Nations, 2012; 2014, p. 1). However, I identify a conundrum in that energy supply in developed countries is supported by the industrial – or increasingly post-industrial – economies while in many developing countries, particularly small resource-poor island nations, the economies lack the strength to finance the energy services that people need if their lifestyles are to be maintained, let alone improved, without external support.

The concept of sustainable development continues to be a core theme in many development programmes but there was concern by some development practitioners – notably Robert Chambers – that sustainable development as applied did not take into people’s priorities, particularly those of poor people. These concerns gave rise to the sustainable livelihood approach which is the central topic of Chapter 3 in which I outline the history and development of the sustainable livelihoods approach. I follow this with a discussion on the nexus of energy and sustainable livelihoods and how this can be used to understand how access to energy supply impacts on people’s lives. With this in mind, I use the sustainable livelihoods approach to establish the basis for the design of the methodology for gathering information during field work. Specifically,

⁸ Ninth session of the Commission on Sustainable Development (CSD9) from Pachauri and Spreng (2003, p. 1).

the design of this methodology and the analysis that follows use as a basis the DFID sustainable livelihoods framework. I discuss criticisms in the literature of the sustainable livelihoods approach and the DFID framework, particularly in respect to the nature of livelihood capitals and the appropriateness of these in a small island society. I conclude that while the criticisms are justified in some situations, both the approach and the framework are appropriate in the context of my research.

My field research methods included the semi-structured interview supplemented by casual opportunistic conversations and observation. Questions were prepared in advance for the semi-structured interviews, the objective being to gain a good understanding of people's livelihoods and the part that energy plays, directly and indirectly. Typically discussions covered wider topics than those covered by the question portfolios. A total of 40 interviews or conversations were undertaken over five field visits. Following the discussion in Chapter 3 on field research methods, I describe the development of the process of analysis that I use in Chapter 6 when analysing the primary and secondary data.

For the purposes of discussion and analysis, I have divided the period of human habitation into four historical eras of development: the pre-palagi era from initial human settlement until the commencement of sustained contact with palagi (Europeans); the trader and missionary era when life in Niue and Tuvalu was disrupted by the arrival of traders and London Missionary Society missionaries; the colonial era when Niue and Tuvalu were governed by New Zealand and Great Britain respectively, and the contemporary era from independence in the 1970s to the present day.

In Chapter 4 and 5, I provide social, economic and political profiles of Niue and Tuvalu respectively, followed by short histories of each country over the four historical eras defined above. While physically, the two countries are very different, Niue being a single island while Tuvalu comprises nine islands or atolls spread over 400 kilometres of the South Pacific Ocean, there are many similarities in terms of culture and history including conversion to Christianity by the London Missionary Society in the 19th Century followed by colonisation and ultimately independence in the 1970s. I discuss each historical era in the broad context of livelihoods and the development that took place in each era including the external influences – globalisation in particular – that drove this development. Of particular interest is the role that energy played in livelihoods in each era, changing from a small but essential role to the current situation where energy supply influences virtually every aspect of livelihood. How and why this has happened is a central concern of this thesis.

The objective of Chapter 6 is to analyse these impacts in terms of people's livelihoods using the methodology developed in Chapter 3. A series of livelihood profiles are developed for the four historical eras in each country and expressed in the form of livelihood asset pentagons. In parallel, livelihood energy pentagons are developed that illustrate the relevance of energy in terms of people's livelihood assets. Vulnerability profiles are shown for each era, suggesting that while the nature of vulnerability may change with access to

energy, energy supply itself creates a new vulnerability. In summary, while Chapters 4 and 5 provide a descriptive analysis of how energy transformed livelihoods over the four historical eras, Chapter 6 aims to understand how energy interfaces with people's day to day lives.

Chapters 4, 5 and 6 are aimed at addressing the first research question which, in summary, asks how energy has influenced transformation from pre-history to the present day. The objective of Chapter 7 is to assist in addressing the second, third and fourth research questions which considers the situation where energy supply is severely disrupted. A similar methodology is used to that adopted for Chapter 6 in that livelihood asset and energy pentagons are developed based on the contemporary era for each country but assuming a substantial reduction in the supply of energy in the form of oil fuels. This "energy-deprived scenario" assumes that only very limited oil supplies are available and that people largely have to rely on domestic sources of energy, a situation that could arise in the event of international conflict disrupting oil production or oil shipments, or perhaps a rapid decline in oil production. The results of the analysis indicate that the impacts on livelihoods would be profound and confirms that while energy has contributed positively to people's livelihoods, energy has also created a vulnerability in that people now depend on energy to maintain their livelihoods. I then examine the strategies that the governments of Niue and Tuvalu have in place to reduce dependency on imported fuels together with disaster risk management plans and conclude that these strategies and plans only go a limited way address to the expected impacts of an energy-deprived future, particularly in respect to transport fuels and to a lesser degree, household cooking fuel.

The thesis is reviewed in Chapter 8. The research questions are discussed and in respect to the first research question, I conclude that in both Niue and Tuvalu the role of energy has changed from an essential but limited role to one that impacts on virtually every component of people's livelihoods. The process of change commenced with the arrival of traders and missionaries in the 19th century and continued through the colonial eras that lasted until the 1970s. Until later in the colonial era, energy's direct role remained limited; however, I argue that through industrialisation and globalisation, energy played an indirect but significant part in the changes to both societies. In considering the second research question, based on the analysis and discussions in Chapter 7, I conclude that the impacts of a long term disruption to imported fuel supplies will be both profound and severe in both Niue and Tuvalu. In respect to the third and fourth research questions, I conclude that while both governments with the assistance of overseas partners are aiming to reduce dependency on imported fuels – unquestionably a commendable objective – the measures are directed at reducing economic dependency rather than reducing the risk of long term fuel supply disruption. The chapter ends with a recommendation that the governments of Niue and Tuvalu prepare strategic plans that evaluate the risk and impact of a severe and long term disruption to imported fuel supply and identify the range of technical solutions available together with the necessary legal and regulatory measures.

CHAPTER 2: THE ENERGY-DEVELOPMENT NEXUS

2.1 INTRODUCTION

The objective of this chapter is to examine the role of energy in the development of the modern lifestyle that not only characterises life in developed countries but also in many developing countries, including remote and small island communities such as Niue and Tuvalu. My starting point is northern Europe in the middle of the 18th century, this being where and approximately when the industrialisation that sparked development within the modern context commenced. By the end of the 19th century, industrialisation had changed the social demography of much of northern Europe and North America from primarily rural-based populations engaged in agriculture to mainly urban-based societies employed in manufacturing and related sectors. Ultimately, this “northern” industrialisation became the model for development for “less-developed” parts of the world, under the label of ‘modernisation’. As I will discuss below, energy had a critical role in this industrialisation and this role continues to be critical, albeit in a sustainable development paradigm.

The first section of this chapter looks back into history starting with the example of British industrialisation that commenced around the middle of the 18th century and continued until the mid-20th century. I am using British industrialisation as the “model” for three main reasons: firstly, there is general agreement in the literature that Britain was the first country to industrialise – see, for example, Pomeranz (2000, p. 734). Secondly, there is strong evidence in the literature that without adequate supplies of affordable energy, British industrialisation would have at best faltered by 1800 (Wrigley, 1962, p. 5). Finally, later in the 19th century and through at least the first half of the 20th century, Britain was a major colonial power in the South Pacific, an empire that included Niue (albeit through the “proxy” of New Zealand) and Tuvalu (as part of the Gilbert and Ellice Islands Colony/Protectorate) and therefore influenced development in both countries.

Following the discussion on the part that energy played in “northern” industrialisation, I move away from Britain to the newly developing world where, following the “discovery of development” in the context of the post-Second World War geo-political environment, efforts were being made by the developed countries – led by the United States – to encourage and assist other less-developed countries to industrialise and modernise. In the initial phases of this “age of development”, energy was seen as primarily a driver of economic development but as this second phase of industrialisation proceeded, the perception of energy changed from being seen as force for good to being seen as a cause of environmental degradation. Questions were also raised concerning the effectiveness of development based on industrialisation and the associated large energy projects in terms of real benefits to people in developing countries. These concerns led to the concept of sustainable development in the 1980s in which the approach to development heavily based on economic growth was modified to take account of issues such environmental impacts and resource depletion. A further evolution commenced in the 1990s when Robert Chambers and others pointed out that

improvements in people's lives are also important if development – or “good change” – is to be achieved. As part of this evolution, a better understanding of the role of energy occurred in which energy was not seen just as a driver of economic development or as a cause of economic degradation but as an essential component in people's day to day lives.

The period from 1995 and especially from 2000 onwards, is notable for the attention given to the role of energy in development, particularly in terms of poverty elimination. For example, the UN Commission on Sustainable Development in 2002 stated that “To implement the goal accepted by the international community to halve the proportion of people living on less than US\$1 per day by 2015, access to affordable energy services is a prerequisite” (Pachauri & Spreng, 2003, p. 1). It is important to understand the role of energy in people's lives: as noted by DFID (2002, p. 5), people do not want energy as such but rather the services that energy provides. At the most basic level, these services enable the fulfilment of essential needs such as cooking, heating and lighting but in a modern society, energy also plays a vital role in enabling the activities and provision of services that underpin people's livelihoods such as manufacturing, transportation, utilities and employment. Energy enables access to services such television, radio and the internet and modern transport systems, enhancing people's enjoyment of life through increased connectivity and social capital. Energy is “an essential ingredient of socio-economic development and economic growth” (Goldemberg & Johansson, 1995, p. 1).

2.2 A MODEL OF “DEVELOPMENT”: BRITISH INDUSTRIALISATION – 1750 TO 1960

As I noted in the Introduction, British industrialisation from 1750 to 1960 provides a useful model to examine the part that firstly, industrialisation had in the development of Britain from a largely rural and agricultural society to a modern largely urban society and secondly, the part that energy and energy technologies played in the industrialisation process. Conveniently, British industrialisation can be divided into two phases, the first of which covers the period 1750 to 1870, a period often referred to by historians as the “Industrial Revolution”, with 1870 being arguably the date at which Britain reached its pinnacle as the supreme industrialised country before being overtaken by other countries, notably Germany and the United States (Broadberry, 1998, p. 387. 382). Industrialisation continued during Phase 2, 1870 to 1960, which I describe as a period of “consolidation and disruption”: “consolidation” because this is the period when people's lives improved in terms of living conditions and “disruption” because the period included two world wars and a great economic depression.

2.2.1 Phase 1: The British “Industrial Revolution” – 1750 to 1870

The Industrial Revolution was a process – rather than a discrete event – that took place in Britain over about 100 years and resulted in major economic and social change (Ashton, 1968, p. 1). It included features that in the eyes of theorists characterised “modernisation” – “industrialisation, economic growth, rationalisation, structural differentiation, political development, and social mobilisation” (Tipps, 1973, p. 202) – and, as such,

it could be argued that the Industrial Revolution was the foundation of the modern, developed state. The start and finish dates for the Industrial Revolution are difficult to define and are the matter for some conjecture and disagreement amongst economic historians. I am assuming the mid-18th century as a start date and 1870 as a finish date. 1870 is selected for two main reasons: firstly, as is discussed below, this appears to be the start of the period when social development – as distinct from economic development – commenced for the majority of people in Britain in terms of improved health impacts and standard of living. Secondly, by 1870, the first wave of technical innovation particularly in respect of the steam engine which “powered” the Industrial Revolution, had reached maturity in Britain and had commenced elsewhere, notably the United States, France and Germany and was described by Pritchett (1997, p. 4) as arguably a “plausible date” for the start of the modern economic period.

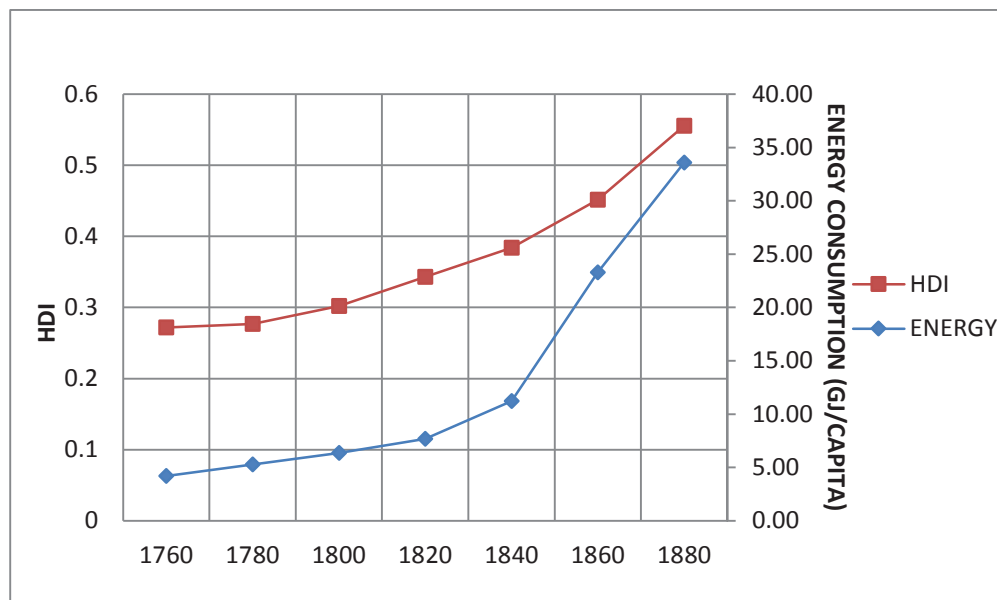
In terms of historical significance, de Vries (1994, p. 29) placed the Industrial Revolution at a similar level to that of historic “monuments” such as the “Reformation, the French Revolution, the scientific revolution and the Enlightenment”, describing the Industrial Revolution as “far the most important such monument in economic history”. During the period, a large section of British manufacturing changed from small-scale rural home-based activities to urban factory-based production and involved “a broad change in the British economy and society” (Temin, 1997, p. 63). For example, the percentage of the male labour force in agriculture fell from 52.8% in 1760 to 20.4% in 1870 while over the same period the percentage in industry increased from 23.8% to 49.2% (Crafts, 1985, p. 62).

There is common agreement in the literature that the availability of affordable energy and technical innovation were critical factors in the initial phases of British industrialisation. Three particular and closely linked technologies were of special significance: textile manufacture, iron production and the development of the steam engine. Underlying these technologies was Britain’s abundant reserves of coal as a source of primary energy. In particular, by the 1830s, the steam engine had moved to a “general purpose technology” (GPT) – that is a technology that following development becomes widely used and has many uses – including land and sea transportation (Crafts & Mills, 2004, p. 157). A massive investment in railways took place in Britain in the 1850s with the result that train miles grew from 60 million in 1850 to 200 million by the mid-1870s – virtually totally reliant on the steam engine as the means of propulsion (Crafts, 2004, p. 343). By the third quarter of the 19th century that steamships contributed significantly to productivity growth (Crafts, 2004, p. 346).. Nevertheless, it is important to keep the role of energy into perspective. While the importance of energy supply in the form of Britain’s coal reserves in facilitating the Industrial Revolution is clear, economic historians do not suggest that this caused the Industrial Revolution. Rather, as will be discussed later in this chapter, a number of reasons are put forward including the wide range of political, social and economic pre-conditions that prevailed in 18th century Britain (Ashton, 1968; Landes, 1994; Rostow, 1956).

Until the middle of the 19th century, development was largely economic at the expense of social development given the evidence that social conditions in urban Britain appear to have worsened from 1800 onwards (Huck, 1995, p. 534; Komlos, 1998, p. 7; Szreter, 1999, p. 147). From the late 1850s, improvements in living conditions started to occur, however; for example, by the late 1860s an effective public health approach was adopted with the commencement of nationwide investments in water supply and sewerage projects (Szreter, 1999, p. 149). Another factor affecting people’s living standards was the recognition of the need for improved nutrition. There was an increasing concern in Britain in the 1850s and 1860s with predictions of a lack of adequate food supplies for the growing population, and in particular, the need to find sources of protein in the form of meat (Critchell & Raymond, 1912, p. 5). This coincided with the development of refrigeration as a practical means of preserving foodstuffs – and particularly meat. Underpinning these improvements to people’s living standards were technical innovations that not only increased productivity in terms of manufacturing output, but also provided the power sources needed – for example, pumps for water and sanitation services – all of which required an energy source.

As discussed in Chapter 1, the Human Development Index (HDI) provides a useful broad indicator of the progress of social and economic development in a country. Although the HDI was not created until the 1990s and is typically used to measure the development progress in individual developing countries, Nicholas Crafts (1997a) has estimated HDI figures for Britain back to 1760 based on work by Maddison (1995).

Figure 1 – HDI and Energy Consumption in Britain – 1760 to 1880



Sources: Crafts (1997a, 1997b), Humphrey and Stanislaw (1979)

Figure 1 above uses the HDI figures developed by Crafts and energy consumption data developed by Humphrey & Stanislaw (1979) and shows a parallel growth of HDI and energy consumption per capita over the period of 1760 to 1880⁹. Figure 1 shows a steady increase in HDI over the period 1760 to about 1840 which might appear surprising given that, as described earlier in this chapter, during the early part of the 19th century living conditions in urban Britain worsened with high levels of infant mortality and static or even decreasing life expectancy. Examination of the three components contributing to the HDI in Crafts (1997a, p. 623) confirms that life expectancy dropped between 1830 and 1850 from 40.8 years to 39.5 years but was outweighed by improved educational achievement and gross domestic product – in simple terms, on average people were better off, better educated but died earlier. From 1850 onwards, the HDI increases at a slightly higher rate, suggesting that the awareness by the authorities of the need to improve living conditions – particularly sanitation – resulted in action. One beneficiary was life expectancy which by 1870, had recovered to 41.3 years (Crafts, 1997b, p. 306). Figure 1 also shows the increase in energy consumption over the period 1760 to 1880. As was the case with the HDI, from 1840 onwards the rate of energy consumption accelerated.

By 1870, the pace of industrialisation and economic growth in Britain had started to slow (Crafts, 2004, p. 50; Havinden & Meredith, 1993). During the 1870s, the pace of economic growth in other countries – notably the United States, Germany and France – was increasing (Havinden & Meredith, 1993, p. 48): the “modern economic period” with the world being dominated by a small number of industrialised countries had begun (Pritchett, 1997, p. 4). However, economic growth continued in Britain albeit at a slower rate throughout the period to 1960 (Hicks & Allen, 1999; Pritchett, 1997, p. 23). As will be described in the next section, it was a period of consolidation in terms of economic and social development but was disrupted by two world wars and a severe economic depression

2.2.2 Phase 2: Consolidation and Disruption – 1870 to 1960

In spite of rapid industrial development in other northern European countries and the United States, Britain remained the leading manufacturing nation in terms of output per capita until the turn of the century when overtaken by the United States (Broadberry, 1998, p. 378) and in Europe by Germany.

The period 1870 to 1914 can be described as the period when people in Britain started to benefit from industrialisation. Legislation in the 1870s required local governments to take responsibility for water quality and sanitation (Szreter, 1988, p. 14) and this is considered to be a major factor in the reduction of cholera and typhoid (Millward & Bell, 1998, p. 268). Food safety was also addressed, resulting in the appointment of food inspectors in the 1880s (Szreter, 1988, p. 16). These factors plus better housing and improved nutrition made possible by increased incomes during the period are considered to have resulted in better

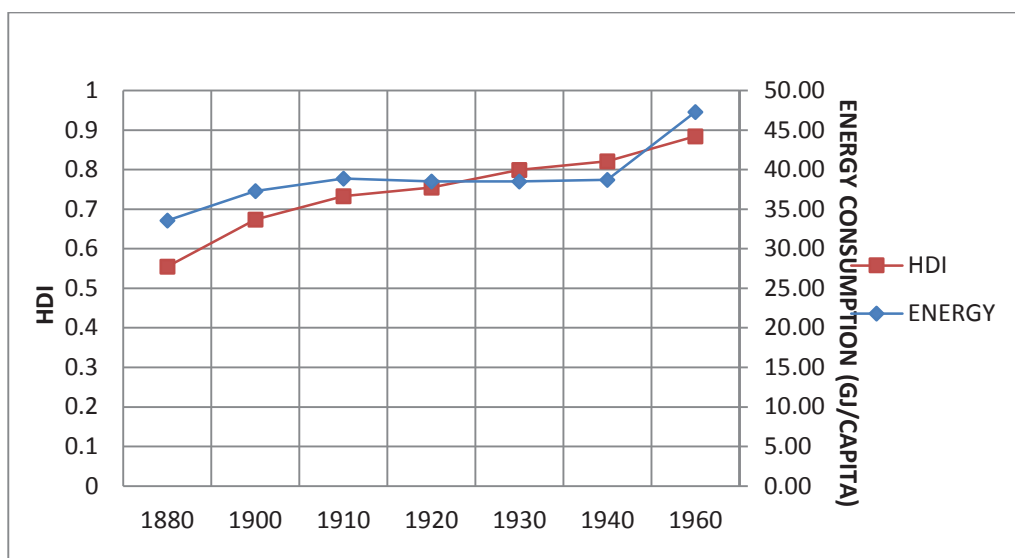
⁹ Some extrapolation was necessary owing to the unavailability of data for some years.

health and reduced mortality (Millward & Bell, 1998, p. 285), this being demonstrated by an increase in life expectancy at birth in Britain as a whole from 41 in 1870 to about 52 in 1914 (Hicks & Allen, 1999, p. 8). Literacy improved from about 75% in 1850 to 96% in 1900. (Cameron, 1985, p. 21).

In 1870, the affordability of railway travel improved with the advent of cheap fares (Freeman, 1984, p. 511) and rail travel became a mass market commodity (Leunig, 2005, p. 50). Passenger traffic doubled from 1870 to 1900, a trend that continued albeit at a slower rate (Irving, 1978, p. 61), this being attributed to the value of time saved compared with other forms of transport outweighing the cost (Leunig, 2005, p. 44). The steam engine remained the major power source for industry and transport until the 1920s (Crafts & Mills, 2004, p. 159). From the 1920s, gradually the electrical motor replaced the steam engine as the source of rotating drive and by the 1920s electric motor drive equalled central steam engine drive in terms of horsepower output and by 1940, steam engine drive only accounted for 10% of total (Devine, 1983, p. 351). From the mid-1930s, the internal combustion engine started to make an impact in terms of bus travel and the motor car and by 1950, nearly 50% of people used these forms of transport for journeys to work; however, this was instead walking or by bicycle rather than at the expense of rail travel (Pooley & Turnbull, 2000, p. 15).

The rate of household electricity connections was slow until 1920 when the rate increased rapidly and by 1940, about 80% of households were connected. In the early stages of household electrification, radios and irons were the most popular appliances followed later by vacuum cleaners and space heaters (from the 1940s). 1950 marked the start of the era when appliances such as refrigerators, washing machines, kettles and televisions became commonplace in British households (Bowers, 1988, p. 293).

Figure 2 – HDI and Energy Consumption in Britain – 1880 to 1960



Based on data in Crafts (1997a, 1997b) and Humphrey and Stanislaw(1979)

It can be argued therefore that by 1960, the majority of people in Britain enjoyed a reasonable standard of living with health and education services that showed substantial improvements from those in place in 1900 as measured by life expectancy, infant mortality and literacy. Figure 2 above shows the increase in HDI and energy consumption from 1890 to 1960, noting that data for the period 1910 to 1940 is incomplete and some extrapolation was necessary. However, the slight dip in HDI between 1910 and 1920 could be explained as an impact of the First World War while the static energy consumption could have been influenced by both the War and the Great Depression. Over the total period 1880 to 1960, the annual rate of increase in HDI from 1880 to 1960 was just over 1% compared with 0.7% from 1760 to 1880. The annual rate of increase in energy consumption per capita was far more rapid in the earlier period, however, at about 6% per annum compared with 0.5% from 1880 to 1960. The difference is likely to reflect that fact that at the beginning of the earlier period, the use of inanimate energy was very low and the period commenced from a very low base.

In terms of quality of life, electrification which was near universal by 1960, provided access to labour saving devices in the home and access to the world through radio and, as the 1960s proceeded, television. Transport systems – railways, buses, ships, aeroplanes and private motorcars – enabled people to travel quickly and affordably. These livelihood services which enabled a “modern” lifestyle, all relied on energy services with coal still “king” providing 90% of primary energy requirements in 1950 (Humphrey & Stanislaw, 1979, p. 41).

By 1960, industrialisation was essentially complete not only in Britain but also in North America and northern Europe. A decade earlier development associated with industrialisation¹⁰ had also begun in the much of the world outside of the already industrialised countries of northern Europe and North America. In the next section, I review briefly the relevance of “northern” industrialisation to Niue and Tuvalu.

2.2.3 Industrialisation, Globalisation and Colonisation in the Context of Niue and Tuvalu

Neither Niue nor Tuvalu can be described as “industrialised” as there is an absence of any form of industry as such. As I discuss in Chapters 4 and 5, in both countries the economies are largely based on the provision of services with the government as the main employer plus, particularly in Tuvalu, subsistence agriculture and fishing, and in Niue, tourism and at household level, subsistence agriculture. Yet, as I described in Chapter 1, both countries have lifestyles that in part have the characteristics of a modern industrialised society and in particular, access to and wide use of “modern” energy and the services that this enables. The

¹⁰ “Re-industrialisation” may arguably be a more accurate term as there is evidence that a number of countries outside of northern Europe and North America, notably China and India, were industrialised in the mid-18th century but progressively were overtaken by the newly industrialised “North” during the 19th century. For example, in 1750, India and China combined produced over 56% of world manufacturing production; by 1900, this had reduced to just under 8% (Simmons, 1985, p. 600).

process that commenced the transformation of Niue and Tuvalu from traditional to modern societies was 19th century globalisation. It is not my intention to enter into a lengthy discussion on globalisation, this being beyond the scope of this thesis, but it is useful at this stage to discuss briefly early globalisation as it occurred in the 19th century, a phenomenon which had a profound impact on both countries. Furthermore, there is strong relationship between globalisation and industrialisation – and also with the eventual colonisation of Niue and Tuvalu.

Bairoch and Kozul-Wright (1996, p. 3) described globalisation as a “process in which the production and financial structures of countries are becoming interlinked by an increasing number of cross-border transactions to create an international division of labor in which national wealth comes, increasingly, to depend on economic agents in other countries”. Such a definition may seem to lack relevance to the situation that applied to two remote societies living on small islands in the South Pacific. However, by the early 19th century, contact with New England whalers became a regular event for the people of Tuvalu, a result being the beginning of commerce with fish and coconuts being traded for iron tools and utensils, and pigs and poultry which became new source of food for the islanders (Macdonald, 1982, p. 24; Thurn, 1915, p. 311). Given that whale oil and coconut oil were both sought as a lubricant for steam engines and industrial plant, the whaling trade was in effect the islanders’ first brush with industrialisation and modernisation, until mineral oil became a viable substitute late in the 19th century. By the middle of the 19th century, the South Pacific generally had joined what Firth (2000, p. 181) described as the first period of globalisation during which South Pacific island communities – and as I will discuss in Chapters 4 and 5, this included Niue and Tuvalu – became integrated with the global economy. The island communities were subjected to the arrival of what Firth (2000, p. 181) described as “the buccaneers of global capitalism” including traders, both itinerant and resident, who bought products such as sandalwood and copra and sold manufactured goods from the industrialised world. In the larger islands, settlers established plantations but perhaps fortunately for both communities, the small size of Niue and Tuvalu precluded this happening. While the products available from the small resource base were limited in quantity and range, Niue and Tuvalu had one resource in great demand: human labour, a resource required by plantation owners in Queensland and other Pacific islands. In 1868, it was reported that 355 young men from Niue were working overseas – Australia, Samoa, Tahiti and the Sandwich Islands – and also serving as seafarers (J. King, 1909, p. 39). In 1899, 591 of the total population of Niue of 4,576 were reported as “absent at the guano and other islands (Percy Smith, 1983, p. 7). There appears to have been less enthusiasm for travel on the part of Tuvaluans: with the number of Tuvaluans working overseas between 1850 and 1900 being relatively small at about 500, the destinations mainly Fiji, Hawaii, Samoa and Australia (Bedford, Macdonald, & Munro, 1980, p. 213). Unfortunately, not all labour recruitment was voluntary and in 1863, Peruvian slavers kidnapped workers from both Niue (Talagi, 1982, p. 119) and Tuvalu (Kofe, 1983b, p. 107) to work in guano mines supplying fertiliser to increasingly industrialised United States. In many respects, however, the commercial activities that resulted from globalisation had less impact on day to day life in either Niue or Tuvalu than that resulting from the

arrival of the London Missionary Society (LMS), an organisation that effectively ruled both communities for a period of time in the second half of the 19th century. As I will discuss in Chapter 4, the formation of the LMS in Britain in the late 18th century had strong links with industrialisation and globalisation.

From about 1870, Britain's position as the leading industrialised nation was under challenge, particularly from Germany and the United States, a situation that created rivalry in terms of access to overseas markets and resources. The British government identified a need to ensure that Britain took a share in the colonisation or at least control of those parts of the "underdeveloped" world that remained un-colonised (Platt, 1968, p. 135). Although in terms of economic importance to Britain, Niue and Tuvalu were insignificant, concerns on the part of Australia and New Zealand in respect to political security in the South Pacific resulted in Britain reluctantly annexing Niue in 1900 and Tuvalu – as part of the Gilbert and Ellice Islands Protectorate – in 1892 (Macdonald, 1982, p. 70; Platt, 1968, p. 135; Tafatu & Tukuitoga, 1982, p. 125). As I will describe in Chapters 4 and 5, for much of the colonial era in both in terms of the impact on the way of life was minimal and it was only towards the end of the colonial era that either Niue or Tuvalu started to receive some of the benefits of the modern lifestyle experienced in industrialised nations.

2.3 THE "AGE OF DEVELOPMENT" – 1950 TO 1980

An event that is often regarded as initiating the "age of development" was President Truman's Inaugural Address of January 1949 where in Point Four of this address, he introduced the concepts of "underdevelopment" and "development". The stated aim of "development" as envisaged by the President was to help "free peoples of the world through their own efforts to produce more food, more materials for housing, and more mechanical power to lighten their burdens". To achieve these goals, measures proposed included increasing industrial activity and thereby raise "substantially" people's standards of living, elimination of the "old imperialism" (that is, colonialism), increased production through modern scientific and technical knowledge and the adoption of democracy as the "vitalising force to stir the peoples of the world into triumphant action...". (Truman, 1949).

At the heart of these proposed measures was economic growth as espoused by Rostow (1956) and achieved by adoption of two of Truman's four measures: increased industrial activity and increased production. The other two measures can be described as politically motivated: decolonisation and the advancement of democracy. While promoting decolonisation had strong moral justification, the reduction in the influence of the colonial powers – principally Britain, France, Belgium and the Netherlands – assisted the United States in its aim to achieve its economic dominance (Rist, 1997, p. 75). The advancement of democracy on the other hand was seen as a necessary component along with economic development in the fight against the spread of communism (Rist, 1997, p. 76).

The “age of development” had relevance to both Niue and Tuvalu as it was during the period 1950 to 1980 when the colonial “masters” – New Zealand and Britain respectively – commenced development programmes. Whether these programmes were motivated by the belief that economic development would result is difficult to judge but particularly in Niue, there appears to have been intent to create a level of economic self-sufficiency. Electrification was a major component of the Niue development programme while Tuvalu had to wait until 1984, six years after independence before electrification was implemented in Funafuti – and even later in the other islands.

2.3.1 The Development “Model” – Industrialisation and Modernisation

The process of development as conceived was modelled on the development that took place in northern Europe and North America in the 19th century and included political, social and economic components with sustained economic growth from industrialisation seen as the driving force (McMichael, 1996, p. 29; Rostow, 1956, p. 46). A consequence of this was modernisation theory, developed mainly in the United States in the 1960s in order to conceptualise the development process based on Western liberal democracy (Berger & Beeson, 1998, p. 488; Hjertholm & White, 2004, p. 3). Modernisation theory was centred on the modern nation-state that embraced key characteristics: industrialisation, economic growth, structural differentiation, political development, social mobilization and secularization (Tipps, 1973, p. 202). The opposite of the modern nation-state was the “third-world” state where traditional values such as kinship, caste, tribalism and religious beliefs prevailed, values which were seen by modernisation theorists as obstacles to development (Brohman, 1995, p. 125).

An organisation that reflected the approach of the United States to development during the 1960s and 1970s was the World Bank, the formation of which was conceived in 1944 primarily as a mechanism to help fund reconstruction following the Second World War (Berger & Beeson, 1998, p. 488; World Bank, 2010). The World Bank however rapidly evolved from its initial role of post-war reconstruction to one of development. Inevitably, given that the United States was the largest single source of funding during the period 1950 to 1970 and the World Bank’s headquarters are in Washington, the World Bank’s policies and activities reflected United States foreign policy objectives and the economic ethos that prevailed in the United States and its allies – bearing in mind that international relations in the 1960s and 1970s were dominated by the Cold War (Berger & Beeson, 1998, p. 488; Hjertholm & White, 2004, p. 11; World Bank, 1975). The significance of the World Bank’s activities should not be underestimated – in 1975, World Bank funding in the form of loans and grants totalled approximately US\$6.1 billion which represented nearly 25% of the total official and private investment flows from developed to developing countries (World Bank, 1975, pp. 5,8). While the World Bank was a major player in development, a similar approach was adopted during the period 1950 to 1970 by donor countries other than the United States with an underlying focus on economic development (Hjertholm & White, 2004, p. 11; Pirnia, 2010, p. 3).

Initially, the focus of the World Bank funding programmes were transportation, electric power and industrial production, but by the late 1960's there was increasing funding for agricultural development (World Bank, 1968, p. 10). During the 1970s, the World Bank's stated focus became the "alleviation of poverty", possibly because of the perceived link between poverty and the spread of communism, one result being that in 1975, 32% of World Bank funding was in agriculture (Berger & Beeson, 1998, p. 489; World Bank, 1975, p. 5). Nevertheless, during the period 1967 – 1971, electric power development – generation, transmission and distribution – seen as an essential factor in industrialisation, accounted for 27% of total World Bank funding (World Bank, 1971, p. 3).

The success of the programmes of the 1960s and 1970s in terms of improving people's lives is questioned by a number of authors. A typical criticism is that aid programmes reflected the political and economic interests of the donors, be they institutions (such as the World Bank) or countries. For example, Hjertholm & White (2004, p. 12) referred to the United States programmes of the 1950s which on one hand were aimed at preventing countries from "going communist" and on the other hand food assistance programmes that were motivated by a desire to reduce United States agricultural surpluses. Pirnia (2010, p. 2) made the observation that the big infrastructure favoured by donors in the 1970s were not accompanied by "meaningful redistributive measures" and ultimately created a third world debt problem. There is evidence of some improvement at the macro level, however; for example, estimates of changes in HDI from 1950 to 1999 in 76 countries carried out by Crafts (2002, p. 399), showed that even the worst performing countries showed some improvement.

In terms of the role of energy in improving the HDI in developing countries, I have been unable to find direct evidence in the literature that improved access to energy directly stimulated economic and social development. For example, the World Bank noted in 1971 that there is "little basis for the view" that "an abundant, reliable, low-cost supply of electric power, available in advance of market requirements, automatically stimulates industrial development" (1971, p. 4). There is evidence however, that lack of affordable energy in general adversely impacts on economic and social development. The 1970s were notable for the sharp increases in the price of oil; these increases ended the era of cheap and plentiful energy and impacted adversely on world trade, providing a double blow to oil-importing developing countries (Bajracharya, 1983, p. 235; World Bank, 1980). A consequence was slower growth in developing countries in terms of GNP per capita during the period 1970 to 1980 when compared with 1960 to 1970 (World Bank, 1980, p. 99). Another consequence of oil no longer being a cheap resource, however, was increased interest in energy issues including an appreciation of the plight of the rural poor who had no access to "modern" fuel such as kerosene and had to rely on dwindling and precarious supplies of woody biomass, the collection of which could take many hours each day, or dung thereby depriving the soil of the valuable nutrients necessary for effective crop production (Bajracharya, 1983, p. 228; World Bank, 1980, p. 17).

The “age of development” can be described as having two phases: an initial phase from 1950 to 1970 where development – economic and social – was quite strong and then followed by a second phase from 1970 to 1980 where development slowed¹¹, at least partly due to the “oil shocks” where oil prices increased rapidly. Furthermore, there was increased concern at the impact of human activities on the environment (World Bank, 1971, p. 17). These concerns were a central topic of the United Nations Conference on the Human Environment (UNHEC) in Stockholm in 1972. At that conference, energy was perceived mainly as a cause of environmental stress with little acknowledgement of the importance of energy in meeting basic human needs or in economic and social development (Najam & Cleveland, 2003, p. 127). This was possibly a consequence of the energy policies of the major development institutions – such as the Asian Development Bank (ADB) and the World Bank – whose focus through the 1960s to the 1980s was on large scale conventional power generation (fossil fuel and large hydropower) and distribution (Kieskamp, 2003, p. 8). These policies were aimed primarily at economic development and were often accompanied by adverse environmental impacts. Unfortunately, even the rural poor did not escape blame, with the suggestion that the use of woody biomass for cooking was contributing to deforestation (Bajracharya, 1983, p. 235; World Bank, 1980, p. 18). However, this suggestion was challenged by Bajracharya (1983, p. 237) who suggested that in the case of Nepal, there was evidence that deforestation could be attributed more to clearance to provide more land for cultivation than to woodfuel gathering.

Clearly, this potential conflict between development on one hand and the adverse impact of development on the environment required a new approach to development and this led to the initial development of the concept of sustainable development, an approach that is still in fashion and which is the topic of my next section.

2.4 THE “AGE OF SUSTAINABLE DEVELOPMENT” – 1980 ONWARDS

I have selected 1980 as the starting point for the era of sustainable development given that it was in that year that the International Union for the Conservation of Nature and Natural Resources (IUCN) published its “World Conservation Strategy” (1980). This document addressed the issues raised in “Limits to Growth” (Meadows, Meadows, Randers, & Behrens, 1972), a book published in 1972 and sponsored by the Club of Rome. This organisation, formed by a number of scientists, business executives, scholars and public officials, was concerned that the growth then being experienced could not be continued indefinitely without catastrophic social and environmental consequences. The main difference between the two documents was that the World Conservation Strategy moved from the “should not” be done approach of “Limits of Growth” to “should and can be done”, thereby moving towards a “sustainable development” approach (Mitcham, 1995, p. 315).

¹¹ Based on HDI figures in Crafts (2002, p. 398) and Molina and Purser (2010, p. 44)

However, it was the 1987 report of the World Commission on Environment and Development (WCED), "Our Common Future" which arguably had the greatest influence on development thinking (Mitcham, 1995, p. 316). It was regarded as a landmark document as it recognised the need to address social and institutional issues as well as the environment and economic development (WCED, 1987). This report, often referred to as the Brundtland Report (after the chairman of the WCED), extended the Stockholm agenda by taking into account human needs in development, and this theme continued at the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro in 1992 (Najam & Cleveland, 2003, p. 133). The report is also well known for its definition of sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987).

The concept of sustainable development rapidly gained wide support from the major development agencies, including the World Bank, the ADB and the Organization for Economic Cooperation and Development (OECD) (Lélé, 1991, p. 607). Key to acceptance of the concept was agreement that environmental problems were real and threatening and had to be reconciled with economic growth (Ekins, 1993, p. 277). The World Bank in the World Development Report 1992 accepted that economic growth often "exacerbated" environmental problems and that failure to recognise this by allowing environmental pollution and degradation to rise in step with economic output would be disastrous (1992, pp. 7,9). Idealistically, sustainable development was seen as a "bundle of neat fixes": technological changes that reduce pollution and resource consumption while increasing output, economic measures that incorporate environmental responsibility while encouraging growth and agriculture that is more productive while less harmful to the environment (Lélé, 1991, p. 613). Unsurprisingly, there was – and remains – a wide divergence of views on what sustainable development means and how it was to be achieved (Ekins, 1993, p. 278). However, regardless of this lack of agreement, there is reference to sustainable development in the stated objectives of major international agencies -- the World Bank (2011), ADB (2011) and the United Nations Development Programme (UNDP, 2011) and national agencies such as the New Zealand Aid Programme (MFAT, 2013) and the United Kingdom Department for International Development (DFID, 2011).

The period 1980-2000 was one when there was growing concern at both the concept of development and the effectiveness of the development process as practised by the various donor agencies. The very concept of development within a modernisation paradigm was challenged, particularly the view that traditional values are incompatible with the traits of a modern society and the belief that values that do not conform to those of "northern" industrialised countries have to be eradicated if development was to take place (Brohman, 1995, p. 124). The disappointing rate of economic growth in many developing countries, however, was attributed by some agencies in part to excessive reliance on government involvement in the economy and ODA, a view that was in line with the neo-liberal economic paradigm that was central to the globalisation agenda that commenced in the 1970s and which is described by Firth (2000, p. 185) as the "second

globalisation", the first being the 19th globalisation discussed earlier in this chapter. An outcome of this view was that institutions such as the World Bank, the International Monetary Fund (IMF) and the ADB urged developing countries, including small South Pacific island states, to institute structural adjustment programmes (SAPs) that adopted a free market approach, including deregulation, reduced government sector employment and privatisation (Connell, 2013, p. 28; W. E. Murray, 2004, p. 244).

In terms of HDI, development did occur over the period with most countries showing steady improvement. The problem was that in 2000, many developing countries still had HDIs less than 0.6 while most developed countries had HDIs of 0.90 or more (UNDP, 2010). The Human Development Report 1999 (UNDP, 1999) listed a large number of countries where more than 20% of the population had incomes of less than \$US1 per day, where more than 50% of the population did not have access to safe water and had adult illiteracy rates of 40% or more (UNDP, 1999, p. 146). The need to address this problem of entrenched poverty resulted in the Millennium Summit of September 2000, the output of which was the United Nations Millennium Declaration (United Nations, 2000), of which Article III- 1 of Declaration read as follows:

"We will spare no effort to free our fellow men, women and children from the abject and dehumanizing conditions of extreme poverty, to which more than a billion of them are currently subjected. We are committed to making the right to development a reality for everyone and to freeing the entire human race from want "

(UN, 2000: 4).

This was followed by Articles III -18, III-19 and III-20 in which a number of objectives were stated including eradication of extreme poverty, universal primary education, gender equality, a reduction in child mortality, improved maternity health, combating HIV/AIDS, malaria and other diseases and environmental sustainability (United Nations, 2000, p. 5). These objectives became the Millennium Development Goals (MDG) and are the focus of the United Nations' work programme with the overall objective of halving the proportion of people in poverty by 2015 (WSSD, 2002, p. 5) and which are discussed later in this section.

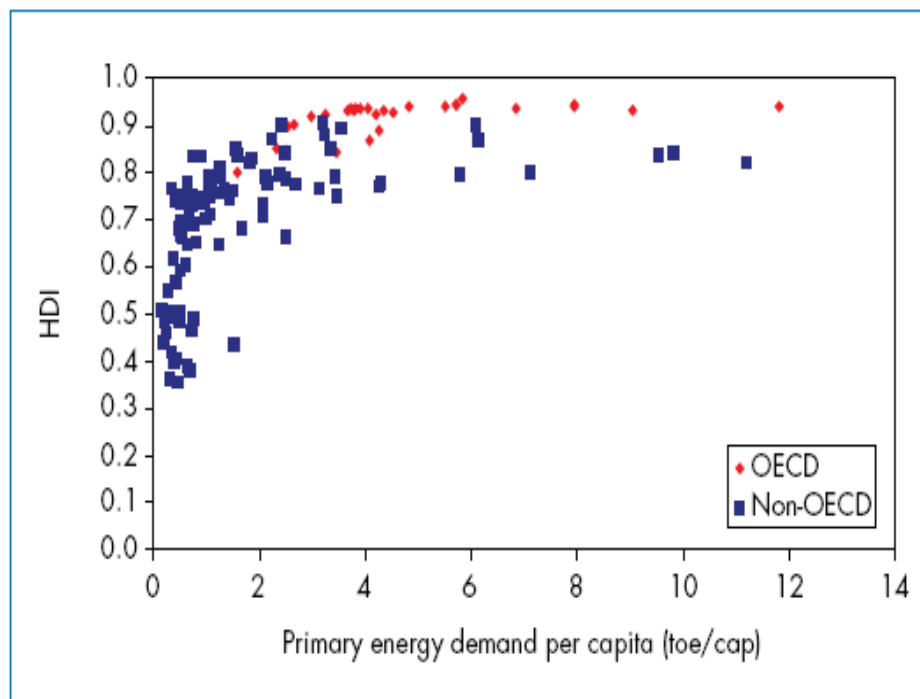
In the context of sustainable development, energy is seen as a valuable resource on one hand and a source of environmental degradation on the other. In the early formative stage of sustainable development, Meadows et al (1972, p. 69) referred to the relationship between economic growth and energy consumption and resultant air pollution from the combustion of fossil fuels and the risks associated with nuclear waste. IUCN (1980, p. 18) also referred to air pollution from combustion of fossil fuels but acknowledged that in many countries, the poor faced a serious problem in obtaining household fuel and as a consequence, sometimes were responsible for deforestation through stripping for woodfuel and reduction in soil fertility by using dung as a fuel. While the WCED report does discuss energy, it is in the context of the need to conserve and adopt "low-energy paths" (WCED, 1987).

The 1990s saw increasing recognition in the literature of the importance of the role of energy in both social and economic development, a notable example being “Energy as an Instrument for Socio-Economic Development”, edited by Goldemberg & Johansson (1995) in which it was stated that energy “is an essential ingredient of socio-economic development and economic growth” (1995, p. 1). As noted above, the role of energy in economic and social development was recognised at the United Nations Conference on Environment and Development held at Rio de Janeiro in 1992 (United Nations, 1992). Another 18 years passed, however, before the strong connection between energy consumption and poverty – the “energy poverty nexus” (Takada & Charles, 2007) – started to receive wide recognition in the literature and I will discuss this linkage in some detail in the next section.

The energy – poverty nexus

One means of demonstrating the link between energy consumption and poverty is to show the relationship between HDI and energy consumption. In Figure 3 below, the relationship between energy consumption in terms of tonnes of oil equivalent (TOE) per capita and HDI is plotted and shows that typically countries with a low HDI consume less energy on a per capita basis.

Figure 3 – The Human Development Index and Primary Energy Demand per Capita 2002



Source: International Energy Agency and UNDP (2004) in Cecelski (2005, p. 6).

Accepting that countries with a low HDI will have a significant proportion of the population living in a state of poverty, one explanation for low energy consumption is that people on low incomes cannot afford to meet their energy needs or do not have access to sufficient energy to do so. Yet in terms of relative income, people on low incomes can spend up to one third of their income on energy, mostly to cook food (ITDG, 2002, p. 7) – compared with, for example, an average of 2.8% in New Zealand (Electricity Commission, 2008, p. 55). The likelihood is that without the ability to access clean and affordable energy, opportunities for low income people to improve their lives are much reduced – a situation that entrenches poverty (Barnes & Floor, 1996, p. 499). Without modern energy such as electricity, kerosene or LPG, poor people have to rely on their own labour, animal power and biomass fuels.

Often, because of a lack of appropriate technologies, the energy that is available is used very inefficiently, the most common example being the use of simple wood fires for cooking which are very inefficient in terms of woodfuel use compared with a well-designed stove (Batiwala, 1995, p. 19; Cole and Dias, 2012, p. 16). The energy sources that are available tend to be more expensive and energy inefficient – such as candles, charcoal and batteries – meaning that the poor often pay more on a unit basis than the wealthy (DFID, 2002, p. 6; Modi, McDade, Lallement, & Saghir, 2006, p. 18).

Figure 4 below expresses the linkage in a more explicit way to that in Figure 3 by showing the relationship between energy consumption and four poverty indicators: life expectancy, infant mortality, illiteracy and total fertility rate. Considering the first two indicators, life expectancy and infant mortality, these are obviously strongly related to poor health which is both a consequence of and a contributor to poverty. And in this respect, a commonly identified cause of poor health is the use of biomass fuels for cooking, estimated to be used by two billion people who do not have access to affordable alternatives (Njie, 1995, p. 26). There is considerable evidence that exposure to biomass smoke damages health which affects women and children in particular because women traditionally undertake cooking while caring for young children (DFID, 2002, p. 10; ESMAP, 2004, p. 32; Modi et al., 2006, p. 27). A study undertaken by Bloom et al (2005, p. 43), for example, shows a strong relationship between use of biomass fuels and increased infant and child mortality and reduced life expectancies and while it could be argued that other poverty related factors will contribute to both of these, given the overall evidence in the literature (such as an estimate of 400,000 premature deaths associated with indoor air pollution in India), the link between poor health and biomass cooking fuels is hard to dispute (Waddams Price, 2000, p. 27).

Figure 4 – Correlations between Energy Consumption per Capita and Life Expectancy, Infant Mortality, Illiteracy and Total Fertility Rate



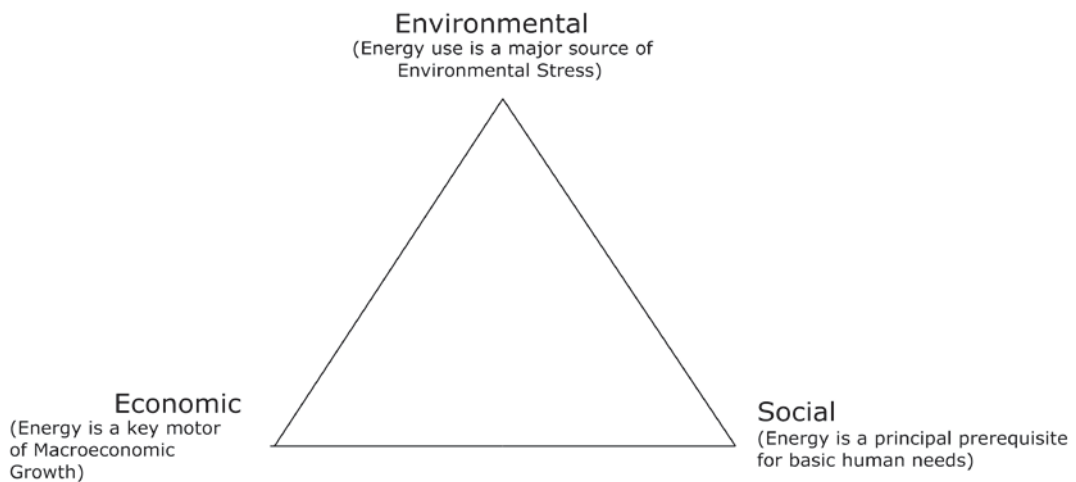
Source: World Energy Council (1993) and Goldemberg and Johansson (1995, p. 3).

The third indicator in Figure 4, the relationship between illiteracy and energy use, is complex. Lack of the most basic education leading to illiteracy can be attributed in part to lack of time for school attendance as often in poverty situations, children are required to participate in agricultural work or are heavily involved in household activities such as fuel gathering or water collection, a situation that more often applies to girls than boys (Cabraal, Barnes, & Agarwal, 2005, p. 127; Modi et al., 2006, p. 24). Another factor is that teachers

may not be prepared to work and live in areas without basic amenities such as electricity and water supply (Cabraal et al., 2005, p. 129; DFID, 2002, p. 27). Less obvious is the relationship between fertility and energy and is possibly associated with the other three indicators. One possible explanation (as suggested by Bloom & Canning (2000, p. 1209) and Batiwala (1995)) is that there is demand for large families to assist with household and farm labour where life expectancy is low and rates of infant mortality are high. Lack of knowledge regarding birth control may also be an issue which could be a result of lack of education together with cultural or religious objections (DFID, 2002, p. 28).

The World Summit on Sustainable Development (WSSD) in Johannesburg in 2002 was the first “global” conference where direct and specific reference was made to energy as a critical component of development. In the Plan of Implementation produced following the WSSD, access to energy services was ranked alongside other core issues such as health, education and water supplies in the eradication of poverty and achievement of the MDGs (WSSD, 2002, p. 5). This new perspective is represented in Figure 5 as a modified version of the sustainable development triangle showing the relationships between the three “core” components of sustainable development and energy.

Figure 5 – Energy and Sustainable Development



Source: Najam and Cleveland (2003, p. 119)

Undoubtedly energy has a role in environmental degradation but over the past decade there is increasing recognition that it is possible for the supply and use of energy to be achieved with minimal harm to the environment through the use of renewable energy systems.

If properly implemented, renewable energy systems, unlike fossil fuel usage, minimise¹² the increase in the level of greenhouse gases in the atmosphere. In the context of poverty elimination, renewable energy has particular advantages for the rural poor because it is often cheaper to operate than systems using other energy sources. The installation of renewable energy systems, however, often involves significant initial capital expenditure which can be beyond the financial resources of the community and as will be discussed later in this thesis, renewable energy projects in developing countries – such as Niue and Tuvalu – are often funded by development agencies. Another advantage is that renewable energy systems are well suited to implementation on a small-scale, decentralised model and application can provide local people with the opportunity for involvement in ownership, management and operation (ITDG, 2002, p. 3; Kammen, Bailis, & Herzog, 2002, p. 6).

As discussed above, in terms of international initiatives to reduce poverty, amongst the best known are the Millennium Development Goals (MDGs). While the MDGs make no reference to any role for energy, the Plan for Implementation produced at the 2002 World Summit for Sustainable Development (WSSD) held in Johannesburg stressed the importance of access to affordable modern energy supplies in facilitating the achievement of the MDGs (Najam & Cleveland, 2003, p. 133; WSSD, 2002). Linkages between each MDG and access to energy are identified and discussed in a wide range of literature from a diverse group of sources including (for example), DFID (2002), Kapadia (2004), Modi et al (2006) and Shell (2009). Table 1 below has been prepared using these sources and provides a summary of these linkages.

Referring to Table 1, MDG 1 refers to the eradication of extreme poverty and hunger in which energy's role is often associated in the literature with improving productivity by enabling use of machinery for, for example, irrigation and crop processing or to increase incomes from manufacturing either at home or in a workshop (DFID, 2002, p. 9; Kapadia, 2004, p. 8; Modi et al., 2006, p. 18). Such uses of energy will also “alleviate the drudgery” in the lives of poor people by reducing dependence on human or animal power (World Bank, 2001, p. 9). Post-harvest crop losses can be reduced with access to electricity which enables refrigeration and by crop drying or smoking (Modi et al., 2006, p. 33), which can be accomplished using a variety of energy sources. Furthermore, improved lighting using electricity can extend the working day and thereby increase incomes¹³ (DFID, 2002, p. 27; IDS, 2003, p. 43)

¹² The term “minimise” is used as while in renewable energy plant, the production of energy may avoid the release of greenhouse gases, the manufacture of the energy generation equipment is likely to involve processes that produce greenhouse gases.

¹³ Whether this is always a “good thing” is a matter for debate?

Table 1: Examples of Linkages between Energy and the MDG

MDG	Direct Contribution	Common Energy Sources
MDG 1: Eradicate extreme poverty and hunger	- Productivity/income generation improved through use of machinery.	Electricity, petrol, diesel
	- Lighting enables income generation outside of daylight hours	Electricity.
	- Local energy supply enterprises provide income generation opportunities	
	- Availability of farm machinery (eg electric pumps) improves agricultural production.	Electricity, petrol, diesel
MDG 2: Achieve universal primary education	- Post-harvest losses reduced through refrigeration and drying processes.	Electricity, diesel
	- Better lighting assists educational activities at school and at home	Electricity
	- Teaching assisted through access to communications and educational media.	Electricity
	- Modern energy services reduces time that children need to be involved in survival activities (fetching water, collecting firewood), especially girls, enabling greater involvement in education.	Electricity, kerosene, LPG, biogas, clean biomass stoves
MDG 3: Promote gender equality and empower women.	- Modern energy services reduce time that girls and women need to be involved in survival activities (fetching water, collecting firewood, inefficient cooking, and farm work).	Electricity, kerosene, LPG, biogas, clean biomass stoves
	- Lighting enables home study.	Electricity
	- Education assisted through access to communications and educational media	Electricity
MDG 4: Reduce child mortality	- Improved indoor air quality through use of clean cooking fuels.	Kerosene, LPG, clean biomass stoves.
	- Improved water quality through pumping and water treatment.	Electricity, diesel.
MDG 5: Improve maternal health	- Improved indoor air quality through use of clean cooking fuels.	Kerosene, LPG, clean biomass stoves.
	- Improved water quality through pumping and water treatment.	Electricity, diesel.
	- Improved health services through better lighting, refrigeration, medical equipment.	Electricity
MDG 6: Combat HIV/AIDS, malaria and other diseases	- Improved health services through better lighting, refrigeration, medical equipment.	Electricity
MDG 7: Ensure environmental sustainability	- Availability of farm machinery (eg electric pumps) improves agricultural productivity and achieves more efficient use of land and water.	Electricity, diesel.
	- Reduced use of traditional fuels assists by reducing depletion of forest resources and use of animal manure/crop residues that contribute to soil fertility.	Electricity, diesel.

Sources: DFID (2002), Kapadia (2004), Modi et al (2006), Shell (2009)

Electricity plays an important role in MDG 2, the achievement of universal primary education. Primarily, this is through the provision of better lighting which facilitates study at night but also because it enables access to information and communication technologies – radio, television and the internet (DFID, 2002, p. 11; IDS, 2003, p. 42). Another factor is the need to attract and retain teachers who may not be prepared to work in areas without adequate energy services (Modi et al., 2006, p. 24). As also discussed above, children's involvement in activities such as gathering fuel or water collection can prevent or limit school attendance which can be eliminated or reduced by the use of kerosene cooking stoves or fuel-efficient wood stoves and the availability of energy for water pumping (Cabraal et al., 2005, p. 127; Modi et al., 2006, p. 24).

Access to clean cooking fuels such as kerosene, LPG and biogas together with clean biomass stoves will reduce the adverse health impacts that can be attributed to exposure to wood smoke. This is relevant to MDG 3 – the promotion of gender equality and empowerment of women – because women typically do the cooking and are the most likely to suffer from poor health as a consequence (Cecelski, 2005, p. 9). Furthermore, women are often responsible for fuel collection – which can take many hours in the worst cases – and basic woodstoves are typically inefficient in cooking time as well as in energy use (DFID, 2002, p. 27; Modi et al., 2006, p. 25; Ramani & Heijndermans, 2003, p. 29). Both these factors reduce the time women and girls have for other activities, including education and income-generating small business activities such as food vending and agricultural processing, all of which provide opportunities for women to improve their lives (IDS, 2003, p. 14; Modi et al., 2006, p. 27; Ramani & Heijndermans, 2003, p. 30).

MDG 4 – the reduction of child mortality – and MDG 5 – the improvement of maternal health – are closely related in respect of the benefits that modern energy can bring. As with MDG 3, clean cooking fuels improves both the health of women and young children because typically young children are cared for by womenfolk in the house and will also be exposed to wood smoke in the same way as women (Cecelski, 2005, p. 9; IDS, 2003, p. 17). The availability of clean water made possible by water pumping and water treatment, both of which require modern energy, will reduce the incidence of water-borne diseases to which young children are particularly vulnerable (Cabraal et al., 2005, p. 133; Modi et al., 2006, p. 29). Improved health services are made possible through good lighting, the availability of refrigeration for storage of pharmaceuticals and vaccines and the ability to sterilise medical equipment using electricity or LPG and contribute both the reduction of child mortality and improvements in maternal health (DFID, 2002, p. 28; Kapadia, 2004, p. 5; Modi et al., 2006, p. 29).

The role of energy in combating of HIV/AIDS, malaria and other diseases – MDG 6 – is indirect and is achieved through firstly, enabling improved health services as discussed above in connection with MDGs 4 and 5 (DFID, 2002, p. 28) and secondly, through improved awareness by means of information and communication technologies – radio, television and the internet (DFID, 2002, p. 28; Modi et al., 2006, p. 29).

Given that energy is often seen as a cause of environmental stress (Najam & Cleveland, 2003, p. 119), it may appear unlikely that energy could contribute to MDG 7 – ensuring environmental sustainability. This outcome is possible however because traditional farming measures tend to be inefficient in land-use and traditional biomass fuels are far less efficient – that is, use more fuel to cook than modern fuels (or a modern woodstove) – and put greater stress on biomass resources (IDS, 2003, p. 44; Modi et al., 2006, p. 24). Increased awareness of the potential offered by renewable energy systems is particularly relevant as this offers the ability to meet energy needs in an environmentally sustainable manner – given that by definition, renewable energy is sustainable energy. As noted above, the main obstacle is that these technologies tend to have a high initial cost, which is often beyond the reach of low income people (IDS, 2003, p. 26).

As noted above, the MDGs make no mention of energy. Indicative of an increased awareness of the importance of access to energy to the achievement of development is the inclusion of access to energy as a goal in the Sustainable Development Goals (SDGs) which are a recent outcome of United Nations Conference on Sustainable Development in Rio de Janeiro in June 2012, generally referred to as “Rio+20”, and will replace the MDGs in 2015 (United Nations, 2012; 2014, p. 1). Sustainable Development Goal 7 is as shown in Box 1 below.

Box 1- Sustainable Development Goal 7

Goal 7. Ensure access to affordable, reliable, sustainable, and modern energy for all

7.1 by 2030 ensure universal access to affordable, reliable, and modern energy services

7.2 increase substantially the share of renewable energy in the global energy mix by 2030

7.3 double the global rate of improvement in energy efficiency by 2030

7.a by 2030 enhance international cooperation to facilitate access to clean energy research and technologies, including renewable energy, energy efficiency, and advanced and cleaner fossil fuel technologies, and promote investment in energy infrastructure and clean energy technologies

7.b by 2030 expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, particularly LDCs and SIDS

(United Nations, 2014, p. 10)

In summary, there is a general understanding by the international development agencies of the role that energy plays as both an essential service to meet day to need basic needs and as an important component in the achievement of economic and social development. A number of development agencies fund energy programmes – particularly if these involve locally available energy resources and, ideally, renewable – including the New Zealand Aid Programme (MFAT, 2012, p. 11), the European Union (2010) and the World Bank (2013a). It is accepted that access to modern energy has a direct and beneficial impact on a range of social indicators including infant mortality, life expectancy, literacy and productivity, all of which are factors

in reducing poverty. As I will discuss in detail in Chapters 4 and 5, both Niue and Tuvalu are beneficiaries of this acceptance that access to energy is important if current standards of living are to be maintained.

2.5 CHAPTER SUMMARY AND DISCUSSION

The two centuries of British industrialisation from 1750 to 1960 provides a historic example of energy enabling development without causing it. Industrialisation was initiated by a range of economic, social and political factors and in the early stages of industrialisation, energy was not a major factor. However, there is evidence that had there not been access to affordable energy in the form of coal, industrialisation may have faltered by late in the 18th century. The first phase of British industrialisation from 1750 to 1870 – the Industrial Revolution – provides an example of how economic development fuelled by ready access to energy supplies may not automatically result in social development. Undoubtedly the Industrial Revolution was a period of substantial economic development, but the social impacts in terms of people's health and living conditions were negative for at least the first half of the period to the extent that two generations of workers would have seen no real improvement in their day to day lives other than possibly an increase in disposable income. It was the mid to late 1850s before the energy technologies and services developed initially to meet the demands of industry started to benefit the community at large. This gives rise to the question as to whether energy related technologies such as the steam engine, railways, towns gas supply and the electric telegraph would have been developed had not the demands of industry justified the investment needed? It also leads to another question relevant to this thesis: given that Niue and Tuvalu – and other small island nations in the South Pacific – have not industrialised, how have these countries gained access to the energy and energy technologies that support the current lifestyles?

During the period 1950 to 1980, economic development through industrialisation was the main objective of the development programmes implemented by the developed countries, led by the United States both in respect to funding and philosophy. Associated with this approach were major electricity generation and distribution projects aimed at facilitating this industrial development. These included both hydro-electric and fossil-fuelled thermal power stations, sometimes with significant environmental and social impacts. The approach was modelled on western industrialisation during the 19th century and first half of the 20th century, but it can be argued that not all the lessons learnt from this experience were taken into account, notably the fact that the benefits of economic development do not automatically improve people's lives across the socio-economic spectrum, not to mention rapid, often uncontrolled, urbanisation bringing the risks associated with poor housing and inadequate infrastructure as occurred in Britain in the early and mid-19th century. By the 1980s, there was increasing realisation that this approach to development may not be working, the reasons for which were the subject of disagreement. Furthermore, there was increasing concern at the impacts of economic development in general, and energy projects and processes in particular, in respect to environmental degradation.

A consequence of concerns over the link between economic development and environmental degradation was the rise of the concept of sustainable development which recognised the need to balance the demands of development and the need to protect the environment, best enunciated in the Brundtland Report of 1987. While this report recognised the need to address social and institutional issues as well as the environment and economic development, the positive role that energy plays in all these matters was still not explicitly recognised. It was not until the 1990s that the role of energy as a means to achieve both economic and social development began to be recognised (Goldemberg & Johansson, 1995). Since 2000, there has been much increased recognition in the literature and by international development agencies of the role of energy and in particular, the part that access to energy can play in the alleviation of poverty – the “energy-poverty nexus”. A consequence has been increased funding by development agencies of energy projects, particularly where the energy sources are renewable.

The links between energy supply and the transformation of Niue and Tuvalu to societies with many of the characteristics of modernity are explored in detail in the following chapters. As a preliminary observation, the direct influence of “modern” energy – that is, energy sources other than woodfuel – was minimal until well into the 20th century. However, the impact of the globalisation resulting from 19th century industrialisation was significant and, given the part that energy played in that industrialisation process, this supports the view that energy had an indirect role in the transformation of Niue and Tuvalu.

To conclude, based on the experience from history, it is important to recognise that access to modern energy does not automatically lead to achievement of the economic and social development objectives as expressed in the MDGs for example (DFID, 2002, p. 6; Modi et al., 2006, p. 25). Access to energy may be an essential component but other socio-economic conditions must be favourable or appropriate parallel programmes be in place (Kapadia, 2004, p. 4). Nevertheless, while access to energy will not automatically result in economic and social development, if other favourable social-economic conditions are in place energy is an essential “enabler”.

CHAPTER 3: THE SUSTAINABLE LIVELIHOODS APPROACH: LINKING CONCEPTUAL FRAMEWORK, METHODOLOGY AND METHODS

3.1 INTRODUCTION

In Chapter 2, I concluded that development agencies have in recent years recognised that access to affordable energy supplies is important if people's lives are to be improved or, for that matter, to be maintained at an acceptable level. Based on the literature, it is clear that the relationships between energy supply and an acceptable lifestyle are complex and multi-faceted and that this complexity can be a barrier to understanding the linkages between energy, development and lifestyle. In part, this is because the existing literature often discusses the impacts on a sector by sector basis – for example, energy's impact on health. Yet the impacts are clearly cross-sectoral, an example being access to clean cooking fuels that leads to improved health which in turn can also increase economic productivity (Tomen & Jemelkova, 2003, p. 9). In order to properly understand and investigate these relationships, a research methodology needs to be equally multi-faceted. With this in mind I have adopted the sustainable livelihoods approach for both planning my research methods and the analysis of research data. This approach takes into account all the factors that constitute and influence people's lives by focusing on lived realities, as well as learning about and understanding those realities (Scoones, 2009, p. 172). It is therefore well suited to gaining an understanding on how energy supply influences livelihoods and as a direct result, lifestyle. The decision to apply the sustainable livelihoods approach as a framework for methodology was reinforced by my personal experience of using the sustainable livelihoods approach in the planning, design and evaluation of development projects with an energy focus which illustrated its effectiveness at understanding how energy supply has impacts across a wide spectrum of people's lives. In this way, the sustainable livelihoods approach has proven to be a useful means of evaluating these impacts and demonstrating to sometimes sceptical development practitioners that energy supply projects can result in more than just economic benefits.

Robert Chambers (2007, p. 12) defines a methodology as "a system of methods and principles". Based on that definition, the sustainable livelihoods approach is used in the design of my methodology because it provides a practical structure to identify the information required which in turn can be used to design the method – "a detailed way of proceeding or doing something" (R. Chambers, 2007, p. 12) – or methods of inquiry to obtain that information. Furthermore, the sustainable livelihoods approach is founded on a clear set of principles which combine sustainability, economic development and people's livelihoods (R. Chambers, 2007, p. 12). The use of the sustainable livelihoods approach as a basis for methodology is not new: for example, Carney (2003, p. 20) discusses three examples of sustainable livelihood (or SL) - rooted" research projects, these being concerned with policy issues and the impact of policy change on people's livelihoods. In practical terms, the sustainable livelihoods approach provides a tool for analysis by enabling

people's livelihoods to be examined in a systematic way and thereby to understand how influences – such as changes in energy supply – both from within and from outside a community, can impact on livelihoods.

I commence the first section of this chapter with a discussion on the history and development of the sustainable livelihoods approach. This involved the early development of the DFID sustainable livelihoods framework (DFID, 1999b). I then move to the linkages between the main livelihood components of the DFID framework and energy supply. The strengths and weaknesses of the sustainable livelihoods approach in both a general sense and within the framework of my research are discussed. In the second section of this chapter, I develop the methods of inquiry using the sustainable livelihoods approach and the DFID framework as a planning tool. These methods are aimed at gathering the information necessary to understand people's livelihoods and the linkages to energy in Niue and Tuvalu. This is followed by a description of the development of the process of analysis that I will use in Chapters 6 and 7. Both primary and secondary data are used in the analysis which, as with the methods of inquiry, uses the sustainable livelihoods approach and the DFID framework. The chapter concludes with a discussion on the application of the sustainable livelihoods approach as a methodology particularly in the context of energy services.

3.2 THE SUSTAINABLE LIVELIHOODS APPROACH

In the first part of this section, the development and principles of the sustainable livelihoods approach are outlined, followed by a discussion on the DFID sustainable livelihoods framework as a practical tool for application. I then review the relationships between the components of the DFID framework and energy supply. In that context, energy can be viewed in two ways: firstly, as an essential component – or asset – in people's livelihoods even if this may be at the most basic and bare subsistence level, an example being wood to cook food. Secondly, energy can be an asset that supports the activities that will help to improve a livelihood through socio-economic development (Goldemberg & Johansson, 1995, p. 1) or as an enabler or "fundamental and strategic tool" for development (Suarez, 1995, p. 9).

3.2.1 History and Development

The term "poverty" has a number of different meanings but deprivation in one form or another is common to all the meanings (R. Chambers, 2007). Critical to a satisfactory livelihood is the achievement of "wellbeing", a useful term which can be described as the ability to achieve a quality of life beyond subsistence and the ability to make choices (R. Chambers & Conway, 1991, p. 4; Sen, 2008, p. 277). Clearly, a livelihood which includes deprivation cannot be reconciled with the achievement of well-being. Poverty reduction is therefore a vital step in the achievement of a satisfactory livelihood and is the main focus – explicitly or implicitly – of the international development agencies – for example, the New Zealand Aid Programme (MFAT, 2013), DFID (GOV.UK, 2013) and the World Bank (World Bank, 2013c). Equally important is the prevention of poverty – that is, ensuring that communities that are currently not in a state of poverty do not move into a

state of poverty. This last point – prevention of poverty as distinct from lifting out of poverty – is germane to conditions in both Niue and Tuvalu.

Because of the ability to analyse complex and multi-faceted situations, the sustainable livelihoods approach has been adopted by a number of development agencies – including the United Nations Development Programme (UNDP), the (United Kingdom) Department for International Development (DFID and CARE¹⁴ – as a means of analysis and programme planning (Krantz, 2001, p. 2). It also aims to understand issues from a “people-centred” point of view, rather than developing/assessing these from the point of view of an outsider (DFID, 1999a, p. 1.1). It is an asset-based approach which was influenced by Amartya Sen (1984, 1985, 1993) and his conceptual understanding that endowments in the form of assets were the basis for capabilities that provide the opportunity for the achievement of wellbeing (Morse, McNamara, & Acholo, 2009, p. 6; Oughton & Wheelock, 2003, p. 3; Scoones, 2009). Ashley and Carney (1999, p. 1) described the sustainable livelihoods approach as a “way of thinking about the objectives, scope and priorities for development”. In fact, it is more than an approach because a sustainable livelihood can be described as an objective in its own right (Baumann, 2000, p. 7). In summary, the sustainable livelihoods approach can be interpreted in three ways:

1. As a set of principles guiding development interventions (whether community-led or otherwise).
2. As an analytical framework to help understand what a livelihood and what can be done to change for the better.
3. As an overall developmental objective.

(Farrington, 2001, p. 3)

Solesbury (2003, p. 5) attributed the adoption of sustainable livelihoods as a practical concept to Robert Chambers. In his book “Rural Development: Putting the Last First”, Chambers observed firstly, that deprivation was best approached from the perspective of the poor people themselves rather than that of outsiders and secondly, that poor people are often forced to adopt survival measures that damage the environment such as overgrazing, over-cropping and excessive woodcutting to meet household energy needs (R. Chambers, 1983). It was by “putting poor people first” and helping them to replace these measures with techniques that were sustainable in that not only the environmental degradation was stopped but that this also provided people with an adequate quality of life. Chambers went on to propose that “livelihoods thinking” be added to the two components of sustainable development, namely “environmental thinking” and “development thinking”, so that poor people’s livelihoods become a priority – “putting the last first” (1986, p. 7). This he described as “sustainable livelihoods thinking”, a synthesis of environmental thinking,

¹⁴ The name CARE is not an acronym. The organisation was originally named as ‘Cooperative for American Remittances to Europe and later changed to ‘Cooperative for Assistance and Relief Everywhere’ but has since adopted the name CARE.

development thinking and livelihoods thinking, taking components from each of the three “thinkings” (1986, p. 12) . A paper co-authored by Robert Chambers and Robert Conway in 1991 is described by Scoones (2009, p. 175) as “the starting point” of the sustainable livelihoods approach. In this paper, the authors proposed the following “working” definition of sustainable livelihoods:

A livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living: a livelihood is sustainable which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in the short and long term. (R. Chambers & Conway, 1991, p. 6).

Chambers and Conway (1991, p. 5) described sustainable livelihoods as an “integrating concept” combining “capabilities, equity and sustainability”, these fundamentals forming the centre of the overall sustainable livelihoods concept. These are summarised in Box 2 below:

Box 2- The Fundamentals of the Sustainable Livelihoods Approach.

Capability was defined by Amartya Sen as being that which “people can do or be with their entitlements” (Scoones, 1998, p. 6) It can be described as providing the freedom for people to access (or not to access if that is their choice) endowments, these being the financial, social and human capitals that are available within the limits that may be imposed by formal or informal institutions (Oughton & Wheelock, 2003, p. 9). Capability is more than the ability to access adequate food, health services and energy resources - it also means the ability to cope with stress and shock, to adapt to changed circumstances and to seek out and exploit new opportunities (R. Chambers & Conway, 1991, p. 4).

Equity is a “less unequal” distribution of assets, capabilities and opportunities including the removal of discrimination against vulnerable members of a society (R. Chambers & Conway, 1991, p. 4).

Sustainability” includes not only environmental sustainability but also social sustainability which includes the ability of a society to withstand outside influences and pressures (R. Chambers & Conway, 1991, p. 4). Environmental sustainability applies to the use of natural resources in a manner that avoids over-exploitation or over-use resulting in depletion or degradation, and includes adopting methods and systems that can withstand disturbances to these stresses (a regular and predictable disturbance) or shocks (a major infrequent and unpredictable disturbance) (Scoones, 1998, p. 7). Social sustainability means maintaining the capabilities on which livelihoods are based while improving those livelihoods (R. Chambers & Conway, 1991, p. 5) including the ability to better withstand outside pressures, thereby reducing vulnerability (R. Chambers & Conway, 1991, p. 9).

To provide some context in terms of this thesis, I will briefly discuss each of these three fundamentals in terms of relevance to Niue and Tuvalu. As defined, capability is of particular interest as the size and remoteness of these and some other South Pacific islands can mean that the individuals in these communities are to some extent inhibited from accessing their endowments. The inhibition is a consequence of people not having the tools to make use of endowments (Jasek-Rysdahl, 2001, p. 317). Such endowments include, for example, potential sources of energy such as solar and wind which cannot be exploited owing to a lack of the financial capital required to purchase the technology and a lack of indigenous technical capability to operate and maintain after installation. Both of these inhibiting factors can be mitigated by assistance from overseas donors providing the necessary financial capital and assistance in the form of technical expertise and capability building. In this role, the overseas donors are acting as agencies as defined by Sen as providing the means for people to convert entitlements to capabilities (1999, p. 19) (cited in Jasek-Rysdahl (2001, p. 317)).

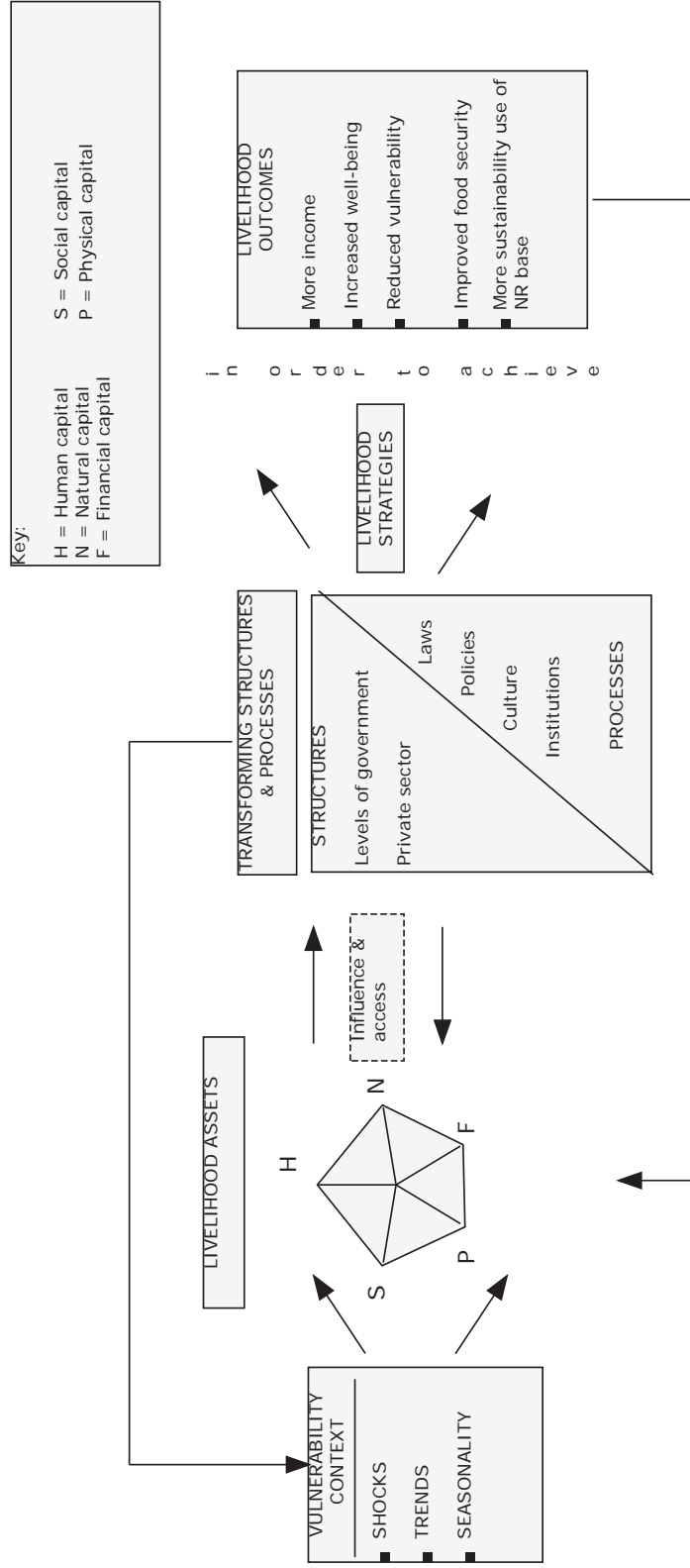
In terms of equity, both Niue and Tuvalu appear superficially to have relatively equal societies but closer examination suggests that while generally true, there are groups within both communities that are disadvantaged to some degree. In Niue, the most recently published poverty analysis found that about 8% of households spent less than what was considered "sufficient to meet both essential and discretionary expenditures" (Government of Niue, 2004, p. 7). In the case of Tuvalu, a 2010 report by ESCAP (2010) noted that while extreme poverty did not exist, about 30% of households lived below the national poverty line and as a consequence had insufficient access to education, health and other basic services and economic opportunities (2010, p. 4).

Sustainability is undoubtedly a major concern in both countries with environmental sustainability being an issue in Tuvalu as it is confronted with sea level rise due to climate change (PCCSP, 2011, p. 4) and the environmental and social impacts of the high population density in Funafuti (ADB, 2006, p. 111; Connell & Lea, 2001, p. 180). Arguably, social sustainability is the main issue in Niue with chronic depopulation followed by concerns over economic sustainability with the heavy reliance on ODA. All these issues are investigated as part of the thesis field research and analysis and are discussed in detail in Chapters 5 and 6.

3.2.2 The DFID Sustainable Livelihoods Framework

While Chambers and Conway (1991) played an important role in the development of the concept, further work was needed in order to produce an approach that could be applied to development practice, in which lead roles were adopted by the Institute of Development Studies at the University of Sussex and DFID (Krantz, 2001, p. 7). One outcome was the DFID "Sustainable Livelihoods Guidance Sheets" (DFID, 1999b), a central feature of which is the DFID Sustainable Livelihoods Framework shown in Figure 6 below.

Figure 6 – The DFID Sustainable Livelihoods Framework



Source: DFID (1999b, p.2.1)

As discussed earlier in this chapter, the sustainable livelihoods approach is asset-based and as a consequence, the framework is built around an asset pentagon which includes five categories of assets and shows the linkages with the various influences – vulnerabilities and external processes – that can impact on people's livelihoods. The framework is intended as a "tool to improve our understanding of livelihoods, particularly the livelihoods of the poor" (DFID, 1999b, 2.1). It is intended to summarise the "main components and influences on livelihoods" rather than being a list of all the issues to be examined and importantly, it is intended to be adaptive to suit circumstances (DFID, 1999b, p. 2.2). I will discuss below each of the main components and the linkages between these followed by a discussion of the links with energy supply.

3.2.3 Livelihood assets

Human capital is the first of the five categories of assets and represents "the skills, knowledge, ability to labour and good health that together enable people to pursue different livelihood strategies and achieve their livelihood objectives" (DFID, 1999b, p. 2.3.1). It comprises both quantitative and qualitative elements: for example, in the case of a household, "quantitative" can refer to the number of household members that can engage in income-earning activities while "qualitative" can mean the levels of education, skills and health status of the household members (D. Carney, 1998, p. 7). Examples of the links between energy supply and human capital include enhanced employment opportunities in activities that rely on or are facilitated by mechanical power (i.e. machinery) and in some cases, employment in energy supply facilities (A. Barnett, 2001, p. 30).

Natural capital is described by DFID (1999b, p. 2.3.3) as "the natural resource stocks from which resources flows and services (e.g. nutrient cycling, erosion protection) useful for livelihoods are derived". It includes tangible assets which can be used for production to support day to day life such as land, forests, rivers, fossil fuels and the sea together with ubiquitous assets which are critical for life such as the atmosphere and the sun. Together with physical capital, it can be a source of useful energy. Access to natural capital is critical if the asset is to be considered as a livelihood capital.

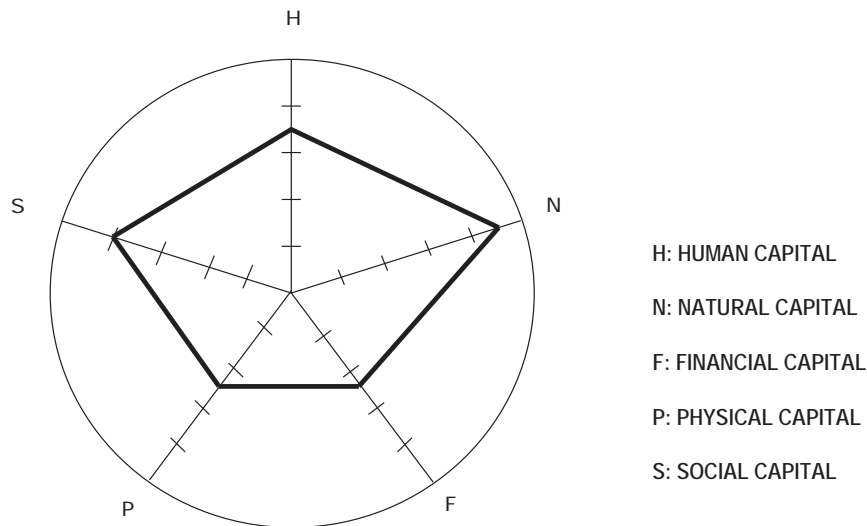
Social capital is less easy to define than natural or human capital. DFID (1999b, p. 2.3.2) notes that: "There is much debate about what exactly is meant by the term 'social capital'. In the context of the sustainable livelihoods framework it is taken to mean the social resources upon which people draw in pursuit of their livelihood objectives". Bebbington (1999, p. 2036) argued that social capital is hard to measure with indicators that are "largely surrogate and indirect" – but which is at the same time regarded as "something very important to society". A definition of social capital by Bourdieu (1986, p. 21) was that social capital is "the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition – or in other words, to membership in a group – which provides each of its members with the backing of the collectively-owned

capital, a “credential” which entitles them to credit, in the various senses of the word”. Summarising, social capital can be described as the support that an individual or a household receives from and gives to others in their livelihood activities. Social capital tends to be most influential when strong relationships exist between heterogeneous groups within a community; conversely, isolated groups, such as ethnic minorities, while having a strong sense of internal identity, can be at a disadvantage owing to lack of influence with the powerful within or outside of the community (Narayan & Cassidy, 2001, p. 60).

Physical capital is defined as comprising “the basic infrastructure and producer goods needed to support livelihoods” (DFID, 1999b, p. 2.3.4). Basic infrastructure includes transport, shelter, water supply and sanitation, energy supply and communications, while producer goods include the tools and associated equipment which enable people to function productively (D. Carney, 1998). Unlike energy supply from natural capital, energy supplied as physical capital is typically supplied from outside of a community.

Financial capital is defined by DFID (1999b, 2.3.5) as “the financial resources that people use to achieve their livelihood objectives”. These resources include income from wages, businesses and investments, savings, credit, remittances and pensions (D. Carney, 1998, p. 7) and form a critical role in providing access to other livelihood assets.

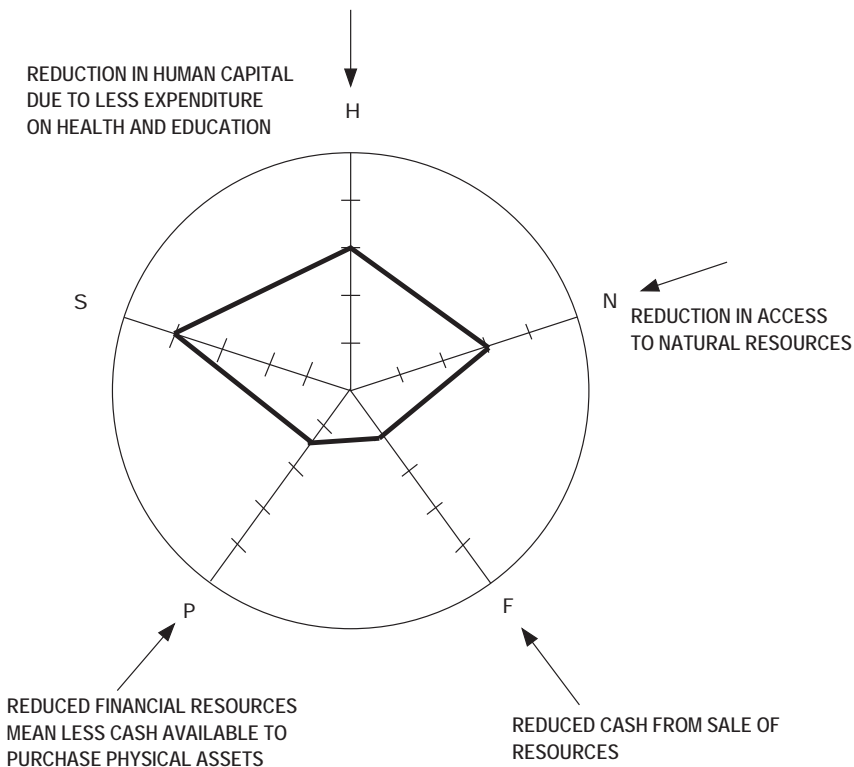
Figure 7 – Asset Pentagon (1): an example of a rural livelihood



The livelihoods asset pentagon shown in Figure 7 provides a useful means of illustrating the relative strengths of the assets held in a community. As an example, Figure 7 shows a community that is rich in natural capital but with limited financial capital. This could represent a situation where a community has

access to farmland but lack of financial capital means that they cannot develop an irrigation scheme that would enable them to move from subsistence farming to cash cropping. This in turn also impacts on other assets: lack of financial capital means less to spend on health and education, thereby limiting the development of human capital, also less to spend on physical capital, such as electricity and other fuels. Whether social capital could also be affected will vary from community to community. Therefore in my definitions above while I have treated the five capitals of the asset pentagon as discrete entities, it would be wrong to view these as such as there are strong interrelationships across the asset pentagon. Using the same logic, changes in one capital will impact on other capitals and this can also be represented visually. Referring to the same community as represented in Figure 7, Figure 8 below shows a situation where a reduction in access to natural capital impacts on financial capital. This situation could occur, for example, where a farmer is denied access to land for growing crops and as a result, has less produce to sell for cash. The reduced financial capital could in turn mean the farmer is unable to increase physical capital and also probably human capital through a reduced ability to pay for services such as health and education.

Figure 8 – Asset Pentagon (2): an example of the effects in a reduction in access to natural resources



In order to prepare an asset pentagon that compares capitals it is necessary to attribute a value to each capital. In a resilient livelihood, the value of all capitals would be on the outer ring of the circle while in a

deprived or highly vulnerable livelihood, the values would be close to the centre point. This raises the question of how to attribute a value to a capital and in this respect, while suggesting indicators for human and social capital, DFID (1999c) offered no methodology as such to calculate values. There are, however, examples in the literature: Shivakoti and Shrestha (2009) described the use of the asset pentagon to assess the performance of farmer managed irrigation systems in Nepal using quantitative data to provide a value for each of the five capitals. Chen et al (2013) used both qualitative and quantitative data obtained through questionnaires to compare livelihoods in 2010 with those of 2006 in a community based co-management (CBCM) forest project in China. The objective of the analysis was to identify the changes to each of the five capitals over the period 2006 band 2010 and thereby gain an understanding of asset development including any differences between participants and non-participants in the CBCM. Of relevance to the topic of this thesis, Cherni (2004) described the post-evaluation of renewable energy projects in Central and South America using the asset pentagon to illustrate and to assist in understanding the success or otherwise of the projects. The analysis used a computer model, the multi-criteria decision-support system to evaluate extensive data collected through a series of questionnaires sustainable livelihoods.

The above examples in the literature provide useful guides as to how the sustainable livelihoods approach and in particular, the asset pentagon can be used to evaluate the impact of an intervention – such as energy supply – on livelihoods. In the context of this thesis, the objective is similar in that it aims to compare a range of livelihood situations and the impacts of changes in energy supply or related influences. In such a comparison process, the most important factors are clarity and consistency in the parameters used in the assignment of values to capitals throughout the process and later in this chapter I will discuss these parameters and the adopted methods of evaluation.

While a community may have adequate assets at a given time, often these assets – or access to these assets – can be threatened by a range of risks, hazards, shocks and stresses from external sources over which people in the community have little control, a situation that tends to be worse in poorer communities (Moser, 1998, p. 3). This is referred to in the DFID framework as the “vulnerability context” and is discussed below. The asset portfolio exists within this vulnerability context.

3.2.4 The Vulnerability Context

DFID (1999b, p. 2.2) describes the vulnerability context as framing “the external environment in which people exist”. Vulnerability threatens the well-being of a community by creating insecurity from changes in the environment in which the community functions, changes that can be ecological, economic, social and political (Moser, 1998, p. 3). This is of particular relevance to small isolated island communities, such as Niue and Tuvalu, where there is reliance on imported goods and services to maintain current livelihoods and standards of living. Often – and definitely in the case of Niue and Tuvalu – the economic resources

possessed by the communities are insufficient to pay for these imported goods and services and as a result, the support of official development assistance (ODA) is required if the lifestyles are to be maintained. ODA, by its very nature, is often politically motivated and a factor over which the island communities have very limited control.

The framework lists three categories of vulnerability: trends, seasonality and shock. Trends tend to be longer term and include such factors as population increase or decrease, economic trends, political trends and changes in resource stocks. Seasonality refers to recurring seasonal changes that affect the prices of purchased goods, the prices received for produce and related employment opportunities. Shocks are short-term but can be both unexpected and severe and include illness (in the context of a household), epidemic, economic crisis (such as crop failure), conflict and natural disaster (Rakodi, 2002, p. 14). Any of the above can result in a reduction of livelihood assets – for example, family illness can reduce the human capital in a household by preventing the sick person from working, the result of which can flow through to impact on financial capital.

While the factors that make up the vulnerability context are by their nature difficult to eliminate and often cannot be predicted, the resilience of a community to manage and recover from shocks and other changes to the external environment is highly relevant (DFID, 1999b, p. 2.2). Two communities may share vulnerability in terms of exposure, an example relevant to the South Pacific being tropical cyclones, but the ability to withstand and recover from the impact of such an event may be quite different. Vulnerability can therefore be defined as comprising two dimensions: a community's sensitivity to the impact of an external event and its resilience in terms of the ease and speed at which a community will recover from that impact (Moser, 1998, p. 3).

Although by definition, the vulnerability context refers to factors outside of people's control, it is possible to implement measures to reduce vulnerability by, for example, improving resilience. Coping strategies may be appropriate as short-term responses to a disturbance. Often, though, such disturbances can be part on an evolving and cumulative process, such as climate change and in such circumstances, adaption that embeds the coping strategies into people's livelihoods is necessary if livelihood resilience is to be achieved (Alwang, Siegel, & Jorgensen, 2001, p. 11).

There is a strong link between asset ownership and vulnerability and the more assets people have, the greater the ability to avoid or reduce vulnerability (Rakodi, 2002, p. 15). For example, in a community with strong social capital people are more likely to work well together in a crisis owing to a high level of trust and cooperation (Moser, 1998, p. 13) – that is, their resilience is higher. Asset diversity is also important: as the possession of a diverse range of assets can mean that where one asset is damaged another asset can

reduce the impact. For example, a loss of a food crop owing to adverse weather can be mitigated if there is sufficient financial capital to purchase food until the next crop becomes available. Often this requires assistance of some form from other parties either within the community (such as community-based organisations) or external to the community (donor or government). Alternatively, actions of other parties can reduce people's asset portfolios – for example, a powerful group within a community may prevent access by the poor to natural capital, such as woodfuel. Government regulations can be promulgated to counter such imbalances and are an example of what are shown in the DFID framework as “transforming processes and structures”.

3.2.5 Transforming structures and processes.

DFID (1999b, p. 2.4) defines transforming structures and processes as “the institutions, organisations, policies and legislation that shape livelihoods”. In this definition, the institutions and organisations (the structures), include both public and private sector organisations. These organisations can range from central government to both formal and informal community-based organisations (Rakodi, 2002, p. 15). Structures form the governance framework in which people pursue livelihoods and, as such, define the processes that influence how individual and organisations interact (Rakodi, 2002, p. 15). Furthermore, structures form the interface where people and policy meet and as such access to these structures and their decision making powers is a critical influence on livelihoods (Pasteur, 2001).

Policies and legislation (the processes) can be formal including laws (national and sub-national) and regulations, semi-formal and informal (such as having “rules of the game”), power and gender relationships and social norms (Pasteur, 2001, p. 12; Rakodi, 2002, p. 15). Processes can influence access to assets in both positive and negative ways – for example, appropriate policies enacted in law can ensure that people's land access entitlements are protected against appropriation by the more powerful while on the other hand, laws could be passed to have the opposite effect (DFID, 1999b, p. 2.4.2). Returning to the fundamentals discussed earlier in this chapter, these processes can strongly influence the way that people can convert endowments into capabilities (Oughton & Wheelock, 2003, p. 11).

3.2.6 Livelihood strategies

The term “livelihood strategies” is defined by DFID (1999b, p. 2.5) as “the overarching term used to denote the range and combination of activities and choices that people make/undertake in order to achieve their livelihood goals (including productive activities, investment strategies, reproductive choices, etc.)”. In this respect, the goal of a household can be described as a livelihood that is at least resilient in terms of vulnerability to shocks and stresses and dynamic. This goal could be achieved in a variety of ways including investing to increase a livelihood asset, substituting one asset for another and sale of assets (although this is obviously not without risk) (Rakodi, 1999, p. 318). The outcome of successful livelihood strategies could

be described as the achievement of well-being and for a household will include as a minimum objectives such as:

- Food security, both in terms of year-round food availability and nutritional adequacy.
- A healthy living environment – adequate housing, availability of clean water, adequate sanitation.
- A secure livelihood – the ability to either grow or buy sufficient food and sufficient financial resources to meet health and education needs.
- Savings or other tradable assets that are available in the event of shock.
- Self-respect and the ability to exert control over the future – the ability to make choices.

(Rakodi, 1999, p. 321).

In summary, a sound livelihood strategy could be described as mobilising a mix of livelihood activities involving a range of capitals, recognising that in developing countries in many cases people have to engage in multiple activities if they are to survive (Rakodi, 2002, p. 7). A key objective of the use of the sustainable livelihoods approach, however, is not just the achievement of a basic survival lifestyle but to assist people to achieve positive outcomes (DFID, 1999b, p. 2.6).

3.2.7 Livelihood outcomes

Very simply, livelihood outcomes are the achievement or outputs of livelihood strategies (DFID, 1999b, p. 2.6). Clearly, if the outcomes are to be positive, the objectives of the livelihood strategies must be achieved with the overall aims of increased well-being and reduced vulnerability (Rakodi, 2002, p. 16). The livelihood outcomes that people aim for are likely to include basic or improved food security, adequate infrastructure and access to services such as health and education, all of which contribute to well-being and which can be described as the opposite of living in poverty.

Context and a locally derived vision of wellbeing are important: for example, in a rural electrification project in Africa, Wilkinson (2002, p. 11) observed that while the two participating communities had similar aspirations in terms of more income, improved food security and increased well-being, the priority put on these aspirations varied. For example, in one village, in terms of increased well-being, the main benefit from electrification was identified as improved water supply while in the other village, the availability of electricity for household use was the priority (Wilkinson, 2002, p. 11). Given that sustainability is at the centre of the sustainable livelihoods approach (R. Chambers & Conway, 1991, p. 4), if the outcomes are to be long term, these must be locally defined and sustainable: environmentally, socially and economically.

3.2.8 Energy and Sustainable Livelihoods

DFID makes just a single reference to energy supply and that is as a component of physical capital in the form of “clean, affordable energy” (1999b, p. 2.3.4). This can be explained by the fact that energy supply is not a capital asset in itself but is an output from a capital asset – for example, natural capital in the form of wood can be used to produce heat for cooking or warmth. Nevertheless, it is not difficult to identify strong relationships between the components of the sustainable livelihoods framework and energy supply.

The links between energy supply and natural and physical capitals are direct as these two capitals provide the sources of energy. Examples of natural capital energy resources include natural resource stocks such as solar radiation, wind, flowing water, biomass (in various forms), tidal flow, geothermal (hot water or steam) and local fossil fuel resources. Typically, in poor and isolated communities, natural capital will provide the main source of household energy in the form of biomass – wood, dung, crop residues – for cooking, heating and lighting (Dyner, Alvarez, & Cherni, 2005, p. 6). Unlike energy that is often derived from natural capital within the community, energy in the form of physical capital is supplied from outside the community and will include electricity and its associated supply infrastructure and fuel supplies, such as petrol, kerosene, LPG and woodfuel (where supplies not available in within the community). Physical capital also includes access to technologies that convert the supplied energy into a useful form – for example, lighting appliances, machines and motors (A. Barnett, 2001, p. 30). Compared with energy supply derived from natural capital, energy in the form of physical capital is less likely to be developed by or under the control of the community and there is a risk that the energy supply may not meet the most critical energy needs of the community (A. Barnett, 2001, p. 31).

Access to energy supply can enable people to both increase individual assets and the range of assets held. Farm productivity can be increased by irrigation using electric or diesel powered pumps or by improved crop preservation such as refrigeration or using crop driers rather than sun drying which is commonly used in developing countries and which is often subject to losses due to rot and bird attack (Cole, 2007, p. 52). This in turn can increase financial capital through the enhanced sale of cash crops or food surpluses. Improved lighting that electricity can bring will provide the opportunity for people to read during evenings for both educational and recreational purposes, thereby increasing human capital (A. Barnett, 2001, p. 30). Similarly, the use of clean cooking fuels – such as kerosene and LPG – or clean biomass stoves will improve indoor air quality which in turn will result in improved health (A. Barnett, 2001, p. 32). Access to electricity enables refrigeration which has wide application in health care as well improving food safety and nutrition. Improved education and health will result in people being able to work more effectively which in turn will result in increased income and increased financial capital. Not to be underestimated is the contribution that energy supply makes to well-being by assisting people to achieve good health and a steady income but also the ability to travel using modern transport systems and to communicate using telecommunications and to

access television and radio and increasingly the internet. Far more complex is the relationship between energy supply and social capital which can be positive or negative: on one hand, if the social capital in a community is strong, then the probability is that the cooperation necessary to operate and manage energy supply services is far more likely than in a community where social capital is weak (Dyner et al., 2005, p. 7). On the other hand, access to energy resources in the form of natural capital – such as woodfuel – can be influenced by social relationships and status with the result that without some form of intervention, the “elite” within a community can restrict access by others and appropriate the benefits leading to increased inequality (A. Barnett, 2001, p. 31).

Regardless of the availability of energy supply either in the form of natural or physical capital, a community may be faced with barriers to access, the most common of which is lack of financial capital. For example, in the case of a poor community that relies on woodfuel for cooking needs, even where physical capital in the form of electricity is available, the risk exists that most people would be unable to afford to buy the electricity or the necessary cooking equipment if they are to use electricity for cooking (Wilkinson, 2002, p. 16). While the increased use of energy from local natural capital resources can reduce the need to purchase energy, often people in developing countries have insufficient financial capital to provide the initial investment required (A. Barnett, 2001, p. 30). A recently completed project in Sumatra provides a good example of a situation where ample natural capital in form of cattle dung and rice straw was available. The dung was either left in piles around villages or dumped into a convenient river while the straw was burnt because the farmers did not have the knowledge of technology to utilise the waste material in an effective manner and lacked sufficient capital in any event¹⁵. The project, funded by the New Zealand Aid Programme, developed and funded a number of household-scale biogas digesters that used the waste to generate gas as a clean cooking fuel but also produced a high quality fertiliser in the form of the digester slurry¹⁶, enabling farmers to reduce chemical fertiliser use by about 75% (Cole and Dias, 2012, p. 13). The success of the project was such that the local government development agency is now funding a continuation of the project (Cole and Dias, 2012, p. 20).

Both natural capital and physical capital as the sources of energy supply are subject to all three of the categories of vulnerability discussed above either directly or indirectly. A trend in the form of population increase could put stress on natural capital energy stocks, such as woodfuel while a weather-related shock such as drought could reduce power available from local hydro-power generation (A. Barnett, 2001, p. 31). Historically, electricity supply infrastructure has been developed by governments although in some cases the recent trend to privatise electricity supply has created vulnerability, albeit sometimes mitigated by

¹⁵ Using cattle dung as a fertiliser was considered by farmers as unsafe for health reasons. In the case of rice straw, I was told that leaving the rice straw in the rice field would make cultivation difficult because rice straw does not easily rot.

¹⁶ Slurry is the term used for the effluent from the digester at the completion of the process.

government regulation (A. Barnett, 2001, p. 31). One often-used approach is to subsidize the retail price of energy sources – such as electricity, kerosene and LPG – on the grounds that affordable energy is a critical factor in people's livelihoods (Cecelski, 2000, p. 22). However, this creates a vulnerability in that a change in government policy that results in reduction or elimination of the subsidy can cause more harm to people's livelihood than would have been the case had the subsidy never been applied because with the subsidy, people will have built livelihoods on a foundation of low cost energy, a foundation that can collapse.

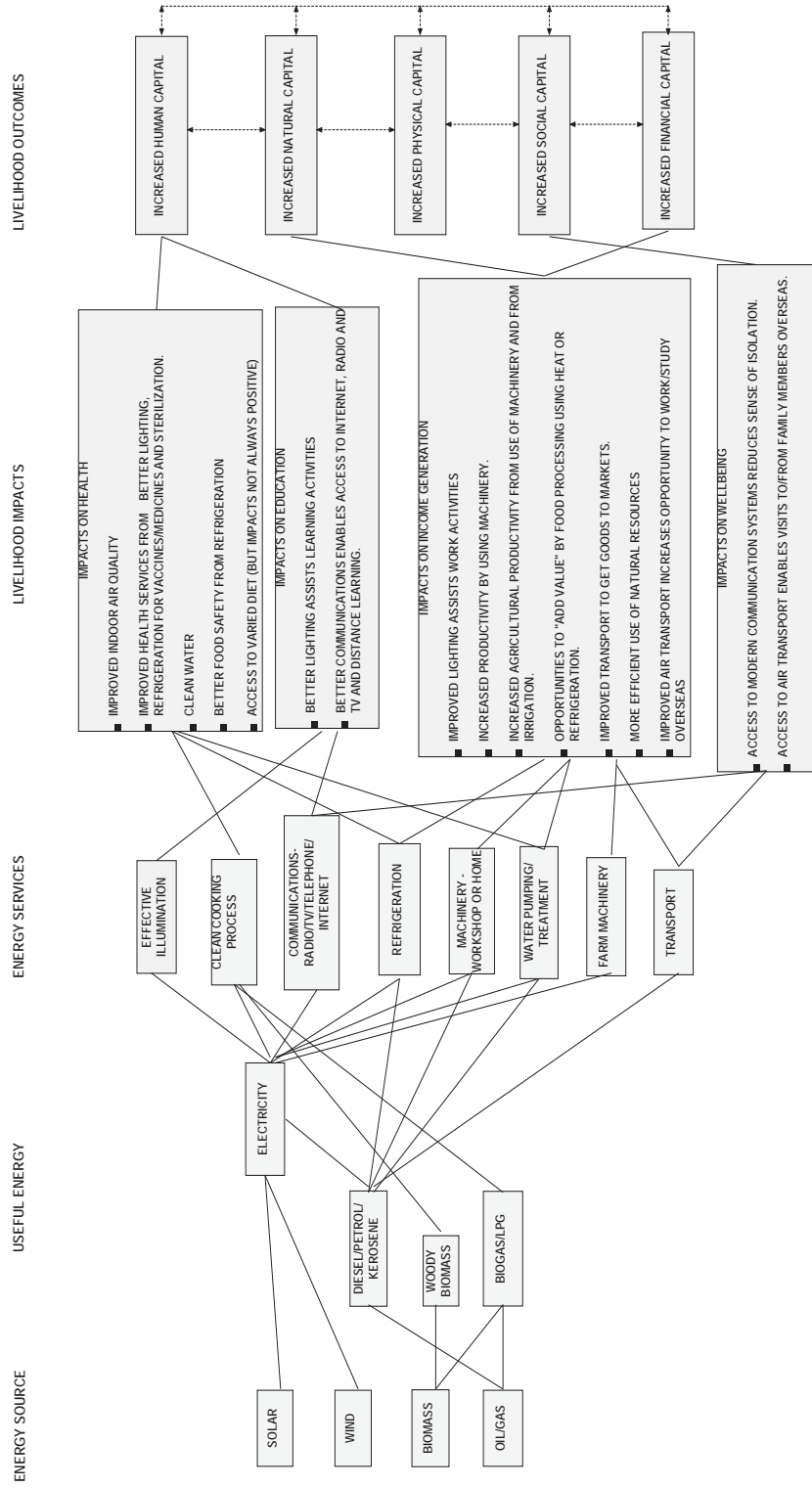
But trends can be positive: a technological trend in the context of energy is the development of small scale power generation technologies – wind and photovoltaic (PV) in particular – which means that community and household scale power generation is possible and is becoming affordable (A. Barnett, 2001, p. 31).

Structures and processes influence energy supply in a number of ways. These can include regulation of energy markets to ensure a fair price, a process that is often necessary as typically electricity suppliers are monopolies. However, in my experience, price controls need to strike a careful balance between achieving the lowest price possible for the consumer and ensuring that the supplier receives adequate return to cover costs. At household level, access to woodfuel can be influenced by power relationships within the community or by government seeking to conserve forest resources (A. Barnett, 2001, p. 31).

The availability of affordable and clean energy is not a livelihood outcome as such but as discussed above, can assist people to increase their livelihood assets and with an increased asset portfolio, vulnerability is reduced (Moser, 1998, p. 3). The examples given in Table 1 in Chapter 2 of how energy can contribute to achievement of the MDGs can equally apply to the achievement of sustainable livelihoods. For example, increased productivity through the use of machinery driven by electricity or a diesel engine can add to financial capital while better lighting that helps education adds to human capital. These impacts enable people to increase their asset portfolio, thereby reducing vulnerability (Moser, 1998, p. 3).

To illustrate this process, Figure 9 below has been developed and, as shown, provides examples of how various energy sources can be used to provide energy services that have livelihood impacts which result in livelihood outcomes in the form of increases to the five capital assets of the livelihoods pentagon. Figure 9 will be used as a conceptual model in Chapter 6 to demonstrate the energy to livelihoods transformation process for each of the four historic eras and also to examine the possible impacts of future changes in energy supply.

Figure 9 – A Conceptual Model Linking Energy and Livelihood Outcomes



Sources: Bamett (2001), DFID (2002)), Takada & Charles (2007)

There is no guarantee that providing people with an improved energy supply automatically results in improved livelihoods; for example, a community may possess physical capital in the form of a hydro-power station but if other capitals are inadequate, access to the electricity produced by the hydro-power station will not by itself create a more sustainable livelihood (Wilkinson, 2002, p. 6). Indeed, the experience over the years of governments and development agencies confirms this point: investment in energy supply projects does not automatically result in the expected livelihood or even financial benefits (Dyner et al., 2005, p. 3).

My conclusion is that if an energy supply project is to make a positive impact on people's livelihoods, it must meet a number of "sustainable livelihoods potential" criteria including:

- People must be able to physically access the energy and be able to afford it in terms of payment for the services or have access to funds for any initial investment.
- People must have a level of control – this can be by ownership or by some form of protection from outsiders, such as government regulation.
- The energy resource must be sustainable, both environmentally and economically.
- The energy supply must meet people's needs and compliment other livelihood assets.

There are criticisms in the literature of the sustainable livelihoods approach and these are discussed below together with the steps I take – where relevant to the topic of this thesis – in consideration of those criticisms.

3.2.9 Criticisms of the Sustainable Livelihoods Approach

A common theme in a strength and weakness analysis of the use of sustainable livelihoods approaches in 11 countries carried out by Ashley and Carney (1999, p. 99) was the complexity of the analyses, reflecting the fact that livelihoods are, by their very nature, complex. In some situations, particularly at a micro-level involving a range of scenarios which in turn result in an even larger range of outcomes that need to be evaluated, application is likely to result in a mass of data which has to be processed and analysed, a task that may prove difficult (Wilkinson, 2002, p. 16). However, as I will discuss in Chapters 4 and 5, the Niue and Tuvalu communities are both small and relatively homogenous societies and this limits the level of diversity in livelihoods and livelihood outcomes; furthermore, the energy supply options are limited. Undoubtedly, there is level of complexity in some aspects of the analysis, particularly in respect to livelihood strategies and impacts and this issue will be discussed further in Chapters 6 and 7.

A strength of the sustainable livelihoods approach – and the DFID framework for that matter – is that it is adaptive in that it can be modelled to suit a given context. Hence Carney (2003, p. 56) provided examples of alternative sustainable livelihood frameworks prepared by various organisations to suit particular circumstances (for example agri-system projects) and different locations. Dorward et al (2001, p. 327) also provided a modified framework that emphasised the importance of the linkages between livelihood outputs

and demand for the goods and services produced, a theme that also received some attention by Oxfam which recognised the importance of access to markets if sustainable livelihoods are to be achieved (D. Carney, 2003, p. 66).

The asset pentagon is seen as problematic by some authors and in particular, whether the five capitals in the DFID framework are adequate to enable people's livelihoods to be understood and analysed. Discussion appears to centre on the adequacy of "social" capital as a single entity and a number of authors have suggested that other capitals should be added, notably "political" and "cultural". The argument for political capital to be included is based primarily on the view that people's rights are central to the achievement of sustainable livelihoods and without political power, people will not be able to assert these rights (D. Carney, 2003, p. 42). For example, Baumann (2000, p. 19) argued that an understanding of the political basis of a development policy is critical and this requires political capital to be considered as a livelihood asset in its own right. The context of Baumann's argument, however, is natural resource management in rural India, a society where there are strong power imbalances and endemic corruption (2000, p. 21) and whether the argument for a separate political capital – rather than being part of social capital – is valid for all societies is a moot point and perhaps needs to be considered on a case by case basis. Cahn (2002) made a strong case for the inclusion of "cultural capital" as a separate livelihood asset for the reason that livelihoods in the Pacific Islands are strongly influenced by culture and tradition across the full range of livelihood components, examples including the influence of societal norms, traditional politics, access to and control of resources (2002, p. 4). Cahn's argument was supported to some degree by Bebbington (1999, p. 2034), albeit in the context of the High Andes; however, the rider was added that while the importance of cultural capital and its potential loss is important, it is difficult to quantify. In a similar vein, the International Fund for Agricultural Development (IFAD) added "personal capital" on the grounds that this made the framework more "people-centred" and draws attention in particular to the need to understand how people are motivated to change and assert their rights (Hamilton-Peach & Townsley, 2003, p. 3). A more fundamental criticism was put forward by Arce (2003, p. 205) who questioned the concept of capitals across all societies, noting that the concept of capital is bound to the "capitalist regime of production". Arce argued that in some societies, livelihoods are "organised around complex mixtures of collective and private ownership" and as such the concept of individual ownership will not be appropriate when assessing livelihoods in terms of sustainability and vulnerability. To some degree, Arce is supported by Carr (2013, p. 78) who noted that in livelihood analysis, it is assumed that material needs are seen as predominant in the achievement of well-being while neglecting social goals.

The above criticisms signal that care is required in the application of the sustainable livelihoods approach particularly if the goal involves an intervention that will impact on people's livelihoods. Under such circumstances, there will be need for extensive participation by the people involved in the planning and

implementation of the methodology including, for example, a review and if necessary redefinition of livelihood capitals. It is important however, not to lose sight of the utility of the sustainable livelihoods approach in achieving an understanding of the impact of an external influence or intervention across livelihoods rather than on one aspect – or as described by Scoones “it provides an essential counter to the monovalent approaches that have dominated development enquiry and practice...” (2009, p. 183). Given that the objectives of my research are to provide firstly an overview of how energy supply has impacted on people’s lives over history and secondly a guide to the development of future energy policy, my decision was that in the context of my research, the utility of sustainable livelihoods approach outweighs the potential pitfalls – as long as these are recognised.

As Carney (2003, p. 16) observed, the DFID framework – or any sustainable livelihood framework – is a tool and the application is set by the user; in other words, if a tool is poorly used, the end result will be poor. This view is shared – emphatically – by Scoones (2009, p. 171) who referred to problems arising from “simplistic application of synthetic frameworks ..” Rakodi (2002, p. 8) made the valid comment that any diagram or framework is an oversimplification and should be treated as “a guide or lens to view the world”. These comments underline the need to avoid simplistic application when dealing with complex livelihoods. The DFID framework, however, is a useful “tool” in that it provides a base with which to evaluate the large number of variables that determine a sustainable livelihood (Baumann, 2000, p. 5). As with any tool, the manner in which the framework is used will determine the effectiveness of the evaluation and in this regard, I note that the purpose of my research is to gain an understanding of the impact of energy on livelihoods rather than to plan an intervention.

I considered the criticisms discussed above in respect to the adequacy or appropriateness of the five capitals in the DFID asset pentagon, particularly in regard to the implied materialism but I concluded that the reality is that both Niue and Tuvalu exist within “ a capitalist regime of production” (Arce, 2003, p. 205). The implication of this, then, is that materialism is central to lifestyles on the islands, largely imposed as a consequence of globalisation, albeit in a form modified by the cultural and environmental context.

I also gave consideration to the need to add political and cultural capitals but concluded that this was unnecessary in the context of Niue and Tuvalu for reasons that in both societies, culture is woven into day to day life while politics are conducted openly with the opportunity for participation. As such, social capital as defined by DFID encompasses both those capitals. Based on the above conclusions, I have adopted the five capitals in the DFID Framework without the addition of these further categories.

3.3 RESEARCH METHODS

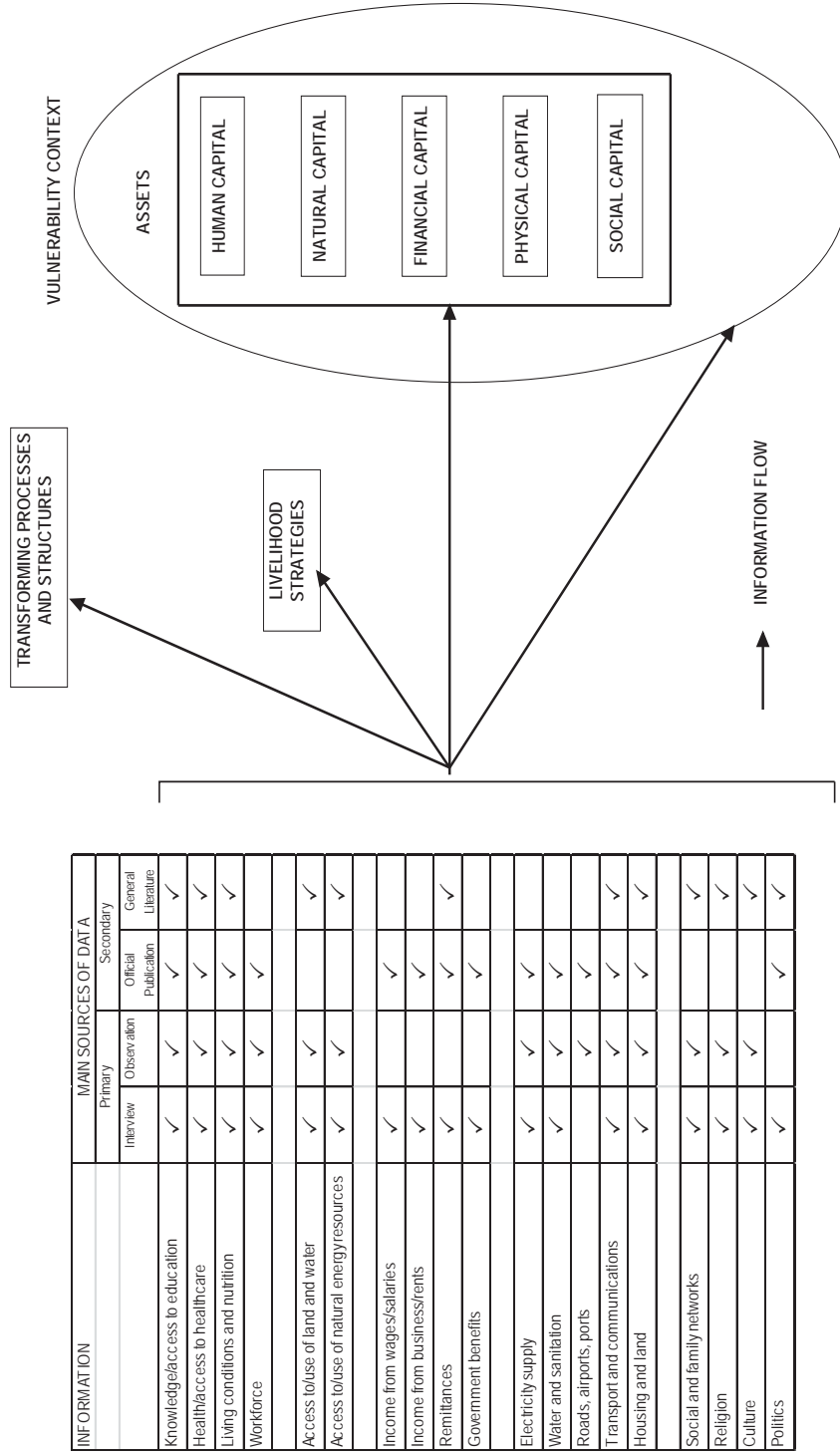
The DFID framework and the associated DFID “Sustainable Livelihoods Guidance Sheets (1999) make no attempt to provide a recipe for methodology (D. Carney, 2003, p. 28). Rather, the sustainable livelihoods approach as expressed in the framework and in the DFID Guidance Sheets sets the parameters for research with the emphasis on it being “people centred” and “holistic” (Ashley & Carney, 1999, p. 45). Importantly, the framework in particular provides a guide to a way of thinking and analysing the various opportunities and constraints that impact on people’s livelihoods (Ashley & Carney, 1999, p. 8). In practice, the methodologies that have used the sustainable livelihood approach as a guide vary considerably depending on the context and the objectives (D. Carney, 2003, p. 28).

In order to address the four research questions, information is required that covers both the past and the present. As will be discussed in detail in Chapters 4 and 5, the histories of both countries can for convenience be divided into four historical eras as follows:

- The pre-palagi era – from early human habitation to the middle of the 19th century. The dates of arrival of the first inhabitants are uncertain but estimates are 500 AD for Niue (Kumitau & Hekau, 1982, p. 83) and around 1300 AD for Tuvalu (Macdonald, 1982, p. 3).
- The trader and missionary era, that is from about 1850 in the case of Niue and 1830 in the case of Tuvalu. These dates are approximate only as the influence of traders and missionaries may have started before these dates but had not become universal.
- The colonial era, that is 1901 to 1974 in the case of Niue and 1892 to 1978 in the case of Tuvalu.
- The contemporary era: independent nationhood, from 1974 onwards in the case of Niue and 1978 onwards in the case of Tuvalu.

As shown earlier in this chapter (Figure 9), the influence of energy supply goes beyond the direct uses that people identify with such as electricity for lighting, petrol for their motorcycle or car and LPG or wood for cooking. In order to understand this influence, it is necessary to take a wide view of people’s livelihoods rather than focus on the direct role of energy supply in their day to day lives. Figure 10 below shows the information needed to obtain this wide view in the context of livelihoods together with the information sources and the information flows. The information required is divided into groups that broadly match the five livelihood capitals; it is noted that the grouping is somewhat arbitrary and information matched to one capital may also be relevant to another, a factor that will be taken into account in the analysis. The information sources are split into two main categories: primary and secondary. Primary source data were collected using interviews, conversation and by observation: these methods are discussed in detail below. Secondary source data included official publications and general literature.

Figure 10 – Research Information: Sources and Information Flows



Official publications comprised reports produced by the colonial authorities in the colonial era, official statistics, development plans and reports from various development agencies, both international (such as the MFAT, World Bank and the ADB) and regional (such as the Secretariat to the Pacific Community (SPC)). The general literature used comprised country histories, including those semi-official histories co-published by the Niue and Tuvalu governments and the University of the South Pacific (Chapman & et al, 1982; Laracy, 1983), sociological and anthropological studies, such as those carried out by Loeb (1926) and Percy Smith (1983) and economic studies, notably Bertram & Watters (1984, 1985) and MacDonald (1971, 1975, 1982). In the cases of the pre-palagi and the trader and missionary eras, all the information was inevitably from secondary sources as no informants were available. This situation also applies to much of the colonial era although a number of informants who could recall some aspects of the last 20 years of that era were able to provide useful information.

3.3.1 Research Ethics

Prior to the first field visit in September 2009, in consultation with my supervisors, a submission setting out the proposed research approach and methodology was prepared for the Development Studies in-house ethics committee. This was reviewed and approved by an in-house peer review committee on 30 March 2009 following which a Notification of Low Risk Research/Evaluation involving Human Participants was submitted to the Massey University Research Ethics Office. Ethics Committee approval for the research was granted in July 2009.

3.3.2 Primary Research Methods

The main objective of my primary or field research was to gain an understanding of people's livelihoods. I also aimed at raising awareness of the role that energy played in their lives beyond what might be regarded as obvious – for example, while using LPG to cook food is an obvious use, the role that energy plays in water supply either by pumping from wells (as in Niue) or by desalination (as in Tuvalu) is less so. Discussions (interviews and conversations) were framed so as to be a dialogue rather than for me to take the role as an interrogator in a question and answer session. I commenced by introducing myself, followed by a discussion on the objectives of my research carefully so that informants understood the aims of my research. In most cases, the participants were happy to engage although there was initial shyness in some cases.

In some respects my approach to primary research was similar to rapid rural assessment (RRA) for the reason that RRA is suited to short term studies and is ideal for "learning by outsiders" (R. Chambers, 1994, p. 1438; Webber & Ison, 1995, p. 108). In this context, short term means days or weeks (Webber & Ison, 1995, p. 108) rather than months or years and my research programme involving two or three visits to each of the research sites lasting between seven and 10 days is clearly in that category. RRA is, as noted above, aimed at learning by outsiders and this can be seen as a pejorative in that it is "extractive and elicitive"

and may do little for the local people who are the participants in the research (R. Chambers, 1994, p. 1438). While my research was overtly “extractive and elicitive”, I attempted to ensure that there was a level of participation by encouraging discussion on issues and hopefully enlarging people’s understanding of energy supply as something that affects all aspects of their livelihoods.

Before commencing research for this thesis, I had been involved in energy-related consultancy work in Niue and Tuvalu and had visited both countries. This was of considerable advantage as it meant that I had some understanding of the physical environment and social conditions together with detailed knowledge of the energy sectors, particularly electricity. Of equal value were the people I met during the visits, a small number of which became key informants for my research. Having these informants already in place and familiarity with Niue and, in the case of Tuvalu, Funafuti, meant that I was able to commence research activities immediately on arrival.

Primary research comprising interviews, conversations and observation was a major source of information for the contemporary era. Older participants could also recall the later stages of the colonial eras in both countries. As noted above, the primary research was supplemented by secondary data in the form of literature and official publications. The results from primary research are discussed in Chapter 4 (Niue) and Chapter 5 (Tuvalu). My principal tool for inquiry was the semi-structured interview, also known as the interview guide approach (Patton, 2001, p. 343) The main characteristic of this approach is that it is conversational, not interrogative, and unstructured in terms of the order in which questions are put and while relatively informal, a question portfolio or guide is prepared beforehand. This portfolio ensures that all matters for which information is required are covered and in a reasonably uniform way (Patton, 2001, p. 349). While ensuring that the prepared questions were put to the informant, I encouraged as much as possible a free-flowing discussion as this proved to be useful means of obtaining a good appreciation of people’s day to day lives and importantly, in many cases their perspective on energy supply and utilisation issues. However, most people do not think of “energy” as a finite asset as for them, it is the service that energy enables that matters – as Figure 9 above illustrated under the heading “Livelihood Impacts”. Using the information requirements set out in Figure 10, question portfolios were prepared before each visit. These were intended to cover people’s day to day lives and thereby provide a useful overview of people’s livelihoods including their priorities. The question portfolios are included as Appendix 1.

Where participants were older people, my questions were also aimed at obtaining information on life before widespread electrification when the services that rely on modern energy were not generally available. These services – which I refer to in this and following chapters as “livelihood services” – include services such as health, education, water supply, transport and communications. Referring to Figure 9, these services rely on energy services to achieve the desired livelihood impacts.

Questions put to government officials focussed largely on policy and planning issues:

- The role of the informant.
- National development plans, issues and challenges.
- Energy planning and strategies for the future.

Interviews with government officials tended to be more constrained than was the case when interviewing other participants. As was expected, the information largely provided followed the official government line; this included interviews with both New Zealand government officials (such as from the New Zealand Aid Programme within Ministry of Foreign Affairs and Trade) and government officials in Niue and Tuvalu. This is not intended to suggest these interviews were of no or little value; to the contrary, these interviews provided useful information on policies and plans and without exception, the government officials were cooperative and friendly.

I note that in both categories of interviews, in several cases, the questions in the portfolio acted as a catalyst for a discussion that covered a wider range of topics than those set out in the question portfolio. Wherever possible, the quality of information received from an informant was cross-checked against that received from other informants and, ideally, against published information – although this triangulation was not always possible.

Informants fell into two categories:

- Key informants.
- General informants.

As I noted above, prior to commencing field research, I identified and contacted people in Niue and Tuvalu who I had met previously and who I considered had good knowledge of society in general and the energy sector in particular. This first group of key informants assisted me to identify additional key informants as my field visits proceeded. I aimed to select key informants with good insights into the way their communities function and including government officials, people employed in the public and private sectors and the general public. In Niue, it was relatively easy to identify participants who worked in the private sector, mostly with some connection with tourism. In Tuvalu, however, I had difficulty in identify private sector informants and as a result, my private sector informants were limited to people involved in seafarer recruitment. Key informants included people from older age groups who could recall the days before modern energy was available. Interviews generally followed the semi-structured format described above and I aimed to interview some key informants on at least two visits.

General informants were drawn from a wide range of people and as far as possible representing a cross section in terms of age and gender but as I will discuss below, there were some constraints to this. Often, discussions with general informants were opportunistic and conversational in nature and the topic or topics discussed evolved as the conversation proceeded rather than to a formal schedule. Nevertheless, the information gained from such discussions was of great value in providing an insight into life in general and supplemented the more formal approach adopted in the semi-structured interviews with key informants. The general informant discussions were also useful in obtaining information not directly related to my research but still of relevance, an example being discussions with economists from an international development agency visiting Tuvalu to provide advice on the government's budget.

In addition to interviews and conversation, I used observation, a useful means of gathering background information on life and livelihoods in both Niue and Tuvalu. Typically, this involved casual conversation in shops, the hotels, cafés and other public areas and covered a range of topics or involved simply walking around a village looking at how people live and their surroundings.

In terms of energy usage, I obtained information from government sources such as the electricity corporations and fuel importing agencies. In parallel, I visited major government and private sector energy consumers such as hospitals, schools and hotels. The objective of these visits was twofold: firstly, to discuss with staff the services that these institutions provide and secondly, to gain an understanding of the reliance that these institutions have on energy supply – particularly electricity – to maintain those services.

I considered the use of questionnaires as one method of obtaining data on household energy use. However, data was available from government sources on electricity use in particular albeit up to five years old (SPC, 2012a, 2012b). In the case of other household fuels – including personal transport – good general data was available on a “global” basis – that is for the country as a whole but it was also possible and useful as a check for individual household data gathered through semi-structured interviews.

3.3.3 Field Visit Programme

A total of five visits were undertaken as listed below:

Table 2: Schedule of Field Visits

Country	Month/Year
Tuvalu	September 2009
Niue	March 2010
Niue	September 2010
Niue	March 2011
Tuvalu	March 2013

Visits were between seven and 10 days duration. Prior to each visit, the key informants that were identified as critical if my visit was to be successful were contacted and arrangements made to meet. As noted above, in the case of the first field visits to each country, these were people I had met during earlier visits, that is before commencing research for this thesis. In some cases, this meant rescheduling a visit if a particular key informant was unavailable. As each visit proceeded, additional key informants were identified and arrangements made to meet.

Tables 3 and 4 below show profiles of informants in terms of age and sex for Niue and Tuvalu respectively. I note that the ages of informants are my estimates as I did not ask for this information (although it was volunteered in one or two cases) and could be inaccurate!

Table 3: Informant Profiles by Age and Sex– Niue

Category	Total number	Male	Female	18 -29	30-39	40 – 49	50 - 59	60-69	70+
Key informant	13	8	5			3	6	3	1
Informant	7	2	5	2	2	2	1		
TOTAL	20	10	10	2	2	5	7	3	1
Percentage of total informants		50%	50%	10%	10%	25%	35%	15%	5%

Table 4: Informant Profiles by Age and Sex– Tuvalu

Category	Total number	Male	Female	18 -29	30-39	40 – 49	50 - 59	60-69	70+
Key informant	14	8	6	1	4	2	6	1	
Informant	6	1	5	2	2	2			
	20	9	10	3	8	4	5	2	
Percentage of total informants		45%	55%	15%	40%	20%	25%	10%	

Table 5: Age Profile of Population as Percentage aged 18 and over – Niue and Tuvalu

Category	Total 18 yrs and over	18 -29 ¹⁷	30-39	40 – 49	50 - 59	60-69	70+
Niue	1049	24%	15%	18%	19%	14%	10%
Tuvalu	6769	35%	17%	18%	17%	8%	5%

¹⁷ Census data is provided in 5 year groups and to allow for 18 and over, 50% of the data for the group 15 to 19 has been used as an approximation and was added to data for 20 to 24 and 25 to 29.

Table 5 is based on demographic data from the 2010 population estimate for Niue (Government of Niue, 2010a) and preliminary data from the 2012 census in Tuvalu (Tuvalu Central Statistics Department, 2013). In this table, I have omitted data for children aged under 18 as this age group was intentionally avoided for interview purposes for ethical reasons. Table 5 indicates that in terms of participant profile, the age group 18 to 29 is under-represented especially in Niue. This was due to some degree by the fact that people in that group were typically more reluctant to be interviewed even on an informal basis. Conversely, people in the age groups from 40 to 59 were keen to be interviewed and generally had strong and well-articulated opinions on issues confronting their countries. Both the relative reluctance of younger people and the willingness of older people to be interviewed or engage in discussion may also have been influenced by me being in the older age group.

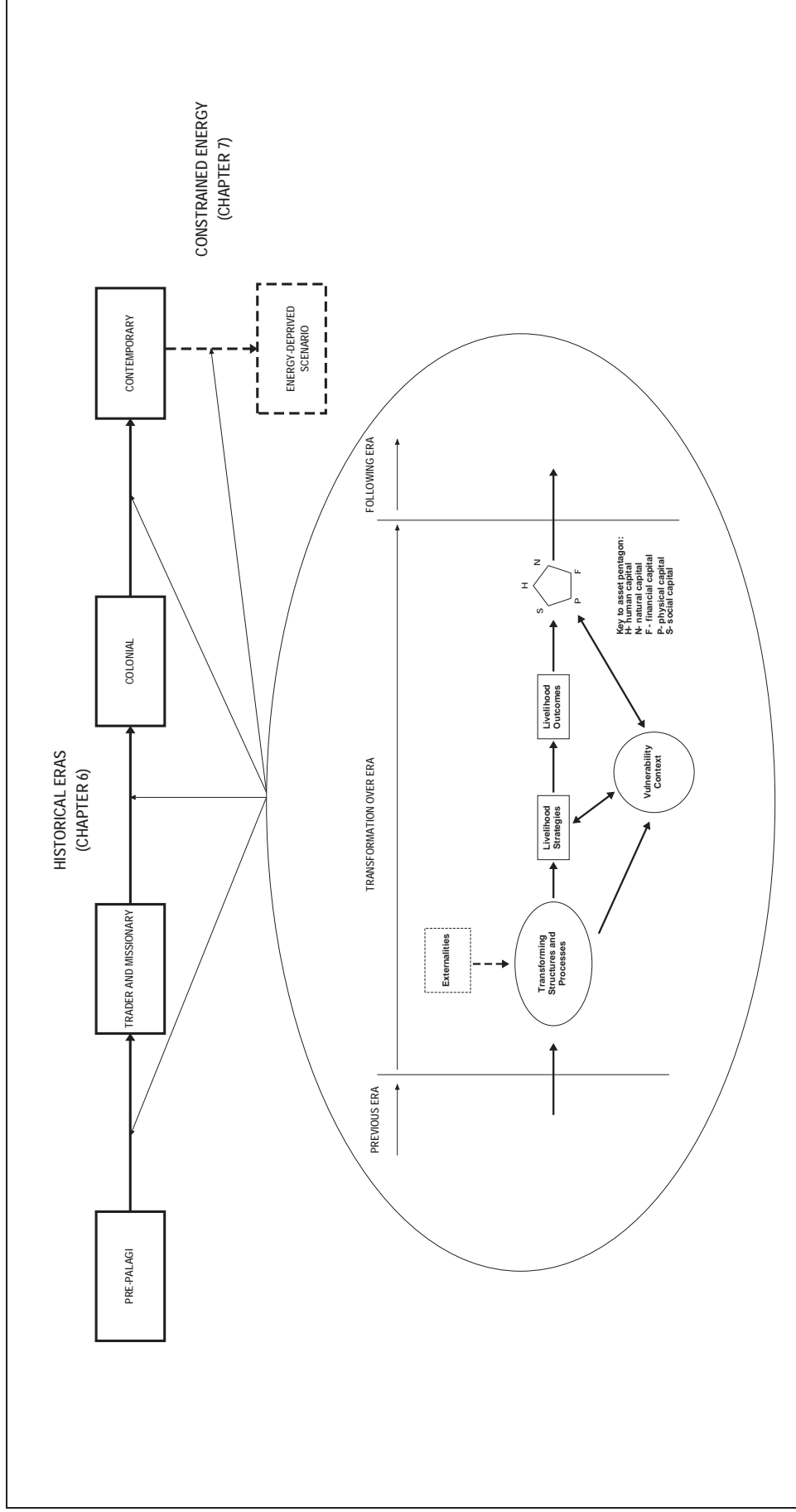
In both countries, the government sector is the major employer (MFAT, 2014c, 2014d) and this is represented in Table 6 especially in the case of Tuvalu. In Table 6, "Official" means the informant was being interviewed in his or her capacity as a representative of government and includes officials in Niue, Tuvalu and New Zealand. "Government" includes government ministries, departments and state owned enterprises (for example, the electricity utilities). "International Development Agency" includes personnel from agencies such as the World Bank and the ADB. "Private sector" includes privately owned enterprises and enterprises that are often partly government owned but operate on a quasi-commercial basis (for example, the Matavai Resort in Niue). In fact, all the private sector informants interviewed in Niue were involved in some way in the tourism-related sector. "Student" refers to those in tertiary education (for example, the University of the South Pacific satellite unit in Funafuti).

Table 6: Occupation Profile of Informants – Niue and Tuvalu

Category	Official	Government	International Development Agency	Private sector	Student	Retired
Niue	3	8		8		1
Tuvalu	4	8	3	3	2	

Responses are detailed and discussed in Chapters 4 and 5. In addition to the prepared list of questions, conversation ranged across a variety of topics which produced some useful insights into life in Niue and Tuvalu and particularly people's priorities. The information from the responses together with secondary data is drawn on in the analysis section of Chapter 6 using a process described in the following section of this chapter that is based on the sustainable livelihoods approach.

Figure 11 – Process of Analysis



3.3.4 Methods and Processes of Analysis

The methods and processes of analysis used are based on the DFID sustainable livelihoods framework and the process used is as shown in Figure 11 above. Two series of analysis are carried out, the first being the analysis of each of the four historical eras in each country as introduced earlier in this chapter. A description of the process of analysis and the outputs is provided in Chapter 6 with the details of each analysis set out in Appendix 2. The objective of this first series of analysis is to assist in addressing the first research question.

The second series is an analysis of the impact of a constrained energy situation in each country, referred to as the “energy-deprived scenario”. A description of the process of analysis and the outputs is provided in Chapter 7 with the details of analysis set out in Appendix 3. Chapter 7 will also include a description of the energy-deprived scenarios and the rationale used in the derivation of the scenarios. The analysis will use the same methods as those used in Chapter 6 for the four historical eras and the purpose will be to assist in the addressing of the second research question by investigating the possible consequences of energy deprivation. The process of analysis is summarised below:

Transforming structures and processes: the analysis will consider that factors that influenced livelihoods in the four historical eras and could influence livelihoods in an energy-deprived scenario. Of particular interest are those external influences – externalities – that had or could have a transforming impact and the part of energy in the transforming process. The output of the analysis will be a series of tables covering the historical eras (Appendix 2) and the energy-deprived scenario (Appendix 3) and summarising the influences under three headings: structures, processes and externalities.

Livelihood strategies and livelihood outcomes: for the purpose of analysis, these two livelihood components are treated together for the reason that there is a strong link between strategies and outcomes. The output of the analysis will be presented in graphical format that shows the livelihood strategies adopted by the societies in Niue and Tuvalu in each of the historical eras and could possibly be adopted in the energy-deprived scenarios, together with the linkages between these strategies and the resultant livelihood outcomes – noting that an impact of a strategy as indicated by linkage can be positive, negative or neutral in outcome.

Livelihood assets: the outputs of the analysis are discussed in Chapter 6 and 7 and are presented illustratively in the form of asset pentagons in a similar manner to that shown in Figures 7 and 8. In order to construct the asset pentagon, data from primary and secondary sources is used to assess and attribute a value to each capital with the contemporary era being used as the benchmark for each country.

Details of the analysis are provided in Appendix 2 for the four historical eras and in Appendix 3 for the energy-deprived scenarios in each country. In parallel to the asset valuation process, an energy factor will be attributed to each capital based on my assessment of the level of support that energy contributes to that capital. Using these factors, livelihood energy pentagons will be developed for each country and era in order to illustrate the influence of energy on livelihoods and are shown alongside each asset pentagon.

Vulnerability context: a series of vulnerability profiles are developed to illustrate the nature of the vulnerability context for each country during the four historical eras as previously defined and in the energy-deprived scenario. The DFID framework refers to three categories of vulnerability: trends, seasonality and shocks; however, based on information in the literature and from informants, seasonality is not considered to be an issue at present. Trends and shocks are considered in the analysis and a profile is developed for each category for each of the historical eras and for the energy-deprived scenario and combined to provide an overall vulnerability profile. These profiles are based on my assessments and as such are essentially subjective in that the assessments are not based on quantitative data, the main purpose being to identify change in vulnerability and what, if any, what was the role of energy either in the creation of vulnerability or countering vulnerability. Events that create vulnerability are identified and assessed

3.4 REFLECTIONS ON THE USE OF THE SUSTAINABLE LIVELIHOODS APPROACH TO DESIGN A METHODOLOGY

In the introduction to this chapter, I gave my reasons for adopting the sustainable livelihoods approach as a basis for designing the methodology: it is people-centred and holistic and as such provides a useful means of exploring the role of energy supply in people's livelihoods. In this section, I will review the design process and comment on the utility of the sustainable livelihoods approach in practice as a tool for research design.

Firstly, the three fundamentals of the sustainable livelihoods approach as defined by Chambers and Conway (1991, p. 5), namely capability, equity and sustainability, provided a useful underlying theme for the methodology as a whole. For example, the concept of capability embraces not just people's entitlements or assets, but their ability to access and utilise these assets, giving rise to the question as to whether or not barriers exist that prevent people in Niue or Tuvalu from accessing assets that could contribute to their impending energy supplies. In a similar context, equity is important at both in-country and international levels to enable an understanding of inequalities that might be impeding access to energy supplies. Sustainability raises a number of contrasting social and environmental issues with the high population density of Funafuti and population decline in Niue and the Outer Islands of Tuvalu and Niue – plus the potential risk of inundation that global warming poses for Tuvalu.

The DFID framework provided a useful tool for planning the inquiry process as it sets out clearly the components of a sustainable livelihood and the linkages between the components. While the linkages are

complex, these reflect the reality that livelihoods and the factors that impact on livelihoods are complex. With this in mind, primary research in the form of interviews, conversations and observation process was aimed at gaining a wide understanding of life in Niue and Tuvalu from the perspective of the people and their priorities. A similar approach was taken in secondary research, particularly in gaining historical perspectives. While information on energy use was collected as both primary and secondary data, this was just part of gaining an overall perspective rather than the main objective. In terms of practical application, the sustainable livelihoods approach as a means of learning about and from people provided a useful ethos when undertaking field work.

As discussed above, the purpose of the analysis is to use the primary and secondary data to develop an understanding on how energy supply has influenced livelihoods. The analysis is modelled on the DFID framework and as such, it provides a useful step by step approach to enable influences such as energy supply to be understood, as well as assisting with the development of sustainable livelihood profiles. The process also lends itself well to considering different options or scenarios. As noted earlier, there are concerns in the literature regarding the nature and selection of the capitals used in the pentagon and the risk that material needs will dominate at the expense of social considerations. Both societies, however, exist within “ a capitalist regime of production” (Arce, 2003, p. 205) but moderated by cultural and environmental influences. Energy supply, furthermore, is essentially a materialistic construct, enabling physical and financial capital with flow-on effects to other capitals, notably human and social capital. This is illustrated in the three case studies I refer to above where the pentagon is used to evaluate the impacts on livelihoods of interventions (Shivakoti and Shrestha (2009), Chen et al (2013) and Cherni (2004)). These studies were primarily aimed at evaluating the material benefits that resulted from the projects – irrigation, forest governance and renewable energy respectively – but also evaluated the impacts on human, natural and social capital. The evaluations provided useful information and there is justification for accepting that the approach was entirely appropriate for the application – that is, a *post facto* evaluation. In the context of this thesis, there is a similarity in that the goal is to understand the impact of an external influence over livelihoods in qualitative terms and in the interpretation of the analysis, using the pentagons to illustrate the results of the analysis in terms of impacts on livelihood assets.

In summary, my conclusion is that the sustainable livelihood approach in conjunction with the DFID framework provides an appropriate basis for planning and designing research methodology both in terms of methods of inquiry and for analysis. However, further comment on the practical application of the methodology will be made in the chapters that follow.

The following Chapters 4 and 5 discuss the transformation on Niue and Tuvalu respectively from the “pre-palagi” era through to contemporary society. The discussions are in narrative form, written as a history and are based on information from both primary and secondary sources and draws on the methodology

described in this chapter. While Chapters 4 and 5 are not intended to be livelihoods analyses as such (this being the role of Chapter 6), the underlying structure of the chapters is based on livelihoods with the focus on transforming livelihood structures and processes and the part these played in changing society. For each of the historical eras defined earlier in this chapter, the discussion starts with an outline of the socio-political factors that were the primary societal influences and were the main drivers of transformation. The discussion continues with a review of people's day to day lives and the activities they pursue as a means of living. The focus then shifts to those factors or livelihood services that support these livelihood activities; as discussed earlier in this chapter, examples include those services, informal or formal, that enable the gaining of knowledge and the achievement of good health, both of which are important factors in achieving a satisfactory livelihood at even the most basic level.

CHAPTER 4: TRANSFORMATION OF SMALL PACIFIC ISLAND SOCIETIES FROM PRE-PALAGI TO MODERNITY: PART 1- NIUE.

4.1 INTRODUCTION

This chapter sets out as a narrative the transformation of Niue from a self-sufficient traditional island community to a modern society highly dependent on imported goods, notably energy. The objective is to gain an understanding as firstly to why and how this transformation occurred and secondly the extent to which energy supply influenced the process of transformation, thereby addressing the first research question.

Following this introduction, a brief profile of Niue is provided in which the current political and economic situation is summarised. A number of features stand out: the high GDP and high HDI relative to most other South Pacific island nations, the large merchandise trade deficit and the high level of energy imports in the form of petroleum products as a percentage of total imports, all of which are made possible by the substantial financial support received from New Zealand in the form of ODA. The profile is followed by a history of the development or transformation of Niue society from a traditional society to modernity, a history that can be divided into four distinct eras, each of which has different characteristics in terms of society and the influences that determine the shape of that society. As noted in Chapter 3, for the purpose of discussion and analysis, these eras are the traditional society period from circa 500 AD to 1830, the trader and missionary era from 1830 to 1901 during which life in Niue was influenced by the London Missionary Society (LMS) and by traders, individuals and companies, the colonial era from 1901 to 1974 when Niue was governed by New Zealand and the contemporary era from independence in 1974 to the present day. The chapter finishes with a summary which outlines the process of transformation, the role of energy supply in that process and the issues that arose, particularly in respect to contemporary Niue.

This chapter will illustrate how, as Niue society underwent transformation towards increased development, the extent and complexity of livelihood services increased. In the traditional society, all that was required to maintain livelihoods was sufficient knowledge to enable natural capital to be used for the essentials of food, clothing and shelter together with the social structure necessary to maintain stability and unity within a community. In contemporary Niue, while this traditional knowledge remains of value, day to day life relies on health and education services, electricity, potable water supplies, an economic system that enables people to be paid for their labour on one hand and to purchase goods and services on the other, and transport and communication systems that provides connectivity within Niue and with the world at large. With all these services, energy supply has a part to play to a greater or lesser degree. In the traditional society, the main requirement for energy supply was in the form of woodfuel for the cooking of food and therefore can be described as having a direct role. However, as discussed in Chapter 3 and as shown in

Figure 9, in contemporary society, energy supply has both direct and indirect roles. An example of a direct role is the use of liquefied petroleum gas (LPG) which is commonly used to cook food. An example of an indirect role is where energy supply in the form of diesel oil is used to generate electricity which has become essential for the provision of health services, for water supply and for communications and while arguably not essential, supports the provision of education and other public services and household activities.

The information on which this chapter is based was obtained from both secondary and primary sources. In the cases of the traditional society and trader and missionary eras, I rely totally on secondary sources ranging from histories based on legend through to contemporary accounts from European visitors during the missionary era. Similarly, much of the discussion on the colonial era is based on secondary sources including descriptions of life in Niue in general literature such as Chapman et al (1982) Loeb (1926), Percy Smith (1983) and Wilson (1969) and official publications produced by the colonial authorities. A number of older informants could recall life in Niue from the 1950s onwards which provided a useful counterpoint to the official publications and other secondary sources which were mainly accounts of life in Niue written by outsiders. The discussion on the contemporary era relies equally on both primary and secondary sources. As noted in Chapter 3, primary sources comprise 20 informants, of which 13 are categorised as “key informants” as people with good insights into the way their communities function and who showed in the first series of interviews some understanding of energy related issues. Key informants were all aged 40 or over and all had management or leadership roles. All but three were employed or had been employed in a government department or state owned enterprise (Niue or New Zealand). The other seven informants spanned a wider and younger age group and included a greater proportion of people employed in the non-government sector. When referring to informants, I avoid detailed descriptions of the informant because except where otherwise noted, all interviews were conducted on the basis of strict anonymity and in a small community such as Niue, care has to be taken not to include information that could lead to identification of an informant. However, to provide some context, where appropriate, I identify the sex of the informant, the approximate age and the date of the interview or conversation – for example, a male informant aged 45 years interviewed during September 2010 is identified as follows (male, > 40, September 2010).

4.2 POLITICAL AND ECONOMIC PROFILE

Niue is located in the south Pacific approximately equidistant from Tonga, Samoa and the Cook Islands and is a single island formed of coral rock following subterranean volcanic activity involving several uplifts ultimately creating a periphery terrace about 50 metres above sea level and an interior plateau which rises to 68 metres (Wade, 2005a, p. 1). The total land area is in the order of 261 square kilometres and as shown in Figure 12 below, the 12 main villages of Niue are located around the coastal perimeter. According to the 2011 census, the population was 1,460 (Government of Niue, 2011, p. 14) and in terms of population Niue is one of the world’s smallest self-governing states (Europa, 2006).

Figure 12 – Map of Niue



(from www.vidiani.com)

Niue is a parliamentary democracy with the Head of State being Queen Elizabeth II who is represented by the New Zealand High Commissioner. The parliament, the Niue Legislative Assembly or Fono Ekepule,

meets in the village of Alofi and consists of 20 members, 14 of which are elected from village constituencies and six from a common role (Government of Niue, 2012a).

Modern Niue's founding document is the Niue Constitution Act of 1974 (New Zealand Government, 1974), following the passing of which by the New Zealand parliament, Niue became a self-governing state in October 1974 (Chapman, 1982, p. 138).

With a gross domestic product (GDP) in the order of \$16,575 per capita in 2009 (MFAT, 2014d), people in Niue cannot be regarded as poor. In economic terms, though, the Niue community is vulnerable. In 2011, exports totalled just over \$345,000 while imports totalled just over \$14 million (MFAT, 2014d). Exports are specialist horticultural products such as honey, noni juice, vanilla, taro and coconut (Government of Niue, 2009b). Imports include those goods regarded as essential in a modern community including fuels (diesel, petrol, kerosene and LPG), foodstuffs (meat, bread, beverages), vehicles and household appliances. Of these imports, in 2011 fuels accounted for over \$4 million, constituting just under 29% of total imports (Government of Niue, 2009b). The government is the main source of employment with around 400 employees which based on data in the 2011 census accounts for nearly 50% of the population aged between 20 and 65 (Government of Niue, 2011, p. 16). To maintain the standard of living currently enjoyed, Niue is heavily reliant on development assistance, the main donor being New Zealand with a contribution of \$18.72 million in 2010/11 (MFAT, 2014d). The following three sections address the question as to why and how this situation has come about including the various causative influences; the first of these looks back at early Niue prior to the arrival of missionaries from the London Missionary Society (LMS).

4.3 TRADITIONAL SOCIETY – THE PRE-PALAGI ERA: CIRCA 500 AD TO 1830

The purpose of this section is to provide a guide on life in Niue from the time of first human settlement to 1830, the point at which Niue started to receive attention from the LMS. This period is remarkable for its longevity – over 1,300 years – and demonstrates the sustainability of the traditional Niue society. Other than the brief description of Niue and its inhabitants provided in the journals of Captain James Cook when recounting the visit made in H.M.S. Resolution in June 1774 during which his attempts to land were met with great hostility (Cook, 1974, p. 434), there are no written accounts of life and livelihoods before 1830. However, in spite of this lack of written accounts, it is possible to draw a picture of life during this pre-history era from legends and stories, some of which were published in Chapman et al, (1982), by Percy Smith (1983) and by Loeb (1926) together with the accounts of the early visits made by the missionaries and Royal Navy ships in Ryan (1984).

Based on linguistic studies, the origins of the early Niuean society are attributed to “waves of migration” from Tonga and Samoa and possibly also the Cook Islands (Kumitau & Hekau, 1982, p. 84). Carbon dating of human remains suggests that the first inhabitants arrived around 500 AD (Kumitau & Hekau, 1982, p. 83).

There is some evidence that the population was divided into two main groups, one located in the north of the island and the other in the south, possibly due to migration from different parts of the South Pacific (Loeb, 1926, p. 23). From these beginnings, a number of magafaoa or extended families were established with each family being controlled by the family chief, or takitaki magafaoa, also referred to as tiki or patu (Percy Smith, 1983, p. 178; Vilitama, 1982, p. 91). Inheritance of this chiefly role was through the male line to the eldest son, with women having no rights of inheritance either in terms of leadership or possessions (Vilitama, 1982, p. 92). Within a magafaoa, there was strict hierarchy with the chief having supreme power particular over the "lower orders" (Percy Smith, 1983, p. 178). Spiritually, people worshiped various gods who typically were the early settlers who had evolved into deified ancestors (Etuata & Tanaki, 1982, p. 97).

There appears to have been four main settlements located inland, rather than on the coastal perimeters, plus a number of forts (Vilitama, 1982, p. 93). It is clear that the pre-historic era was not peaceful either due to fighting between the south and north groups and between magafaoa or due to hostile invaders from Tonga, Samoa and the southern Cook Islands (Loeb, 1926, p. 128; Percy Smith, 1983, p. 61; Talagi, 1982; Turner, 1856, p. 469). Fighting between magafaoa was frequent and resulted in villages being destroyed and the women and children of the vanquished being enslaved or killed (Loeb, 1926, p. 143; Percy Smith, 1983, p. 65). The reasons for what appears to be an almost constant state of warfare are unclear from the literature but a possible reason was access to land and fisheries given that access to both was essential for the well-being of the magafaoa (Loeb, 1926, p. 128; Percy Smith, 1983, p. 61). Possibly in an effort to stop fighting between magafaoa, at times a kingly system operated where a supreme chief or patuiki exercised supreme control over the magafaoa but there were long periods when no man¹⁸ had the support necessary to exercise that control (Vilitama, 1982, p. 94).

In traditional Niue society, the primary needs were those basics of food and shelter. Based on estimates by the early missionaries who visited Niue in the 1830s and 1840s it is likely that the population was somewhere between 4,000 and 5,000 and with a land area of 261 square kilometres the population density would have been in the order of 20 people per square kilometre (Gill, 1871, p. 130; MFAT, 2011; Turner, 1856, p. 521). The land was largely forested indicating a reasonable level of fertility and enhanced by a relatively benign climate: warm and humid but without extremes and normally (but not always) a good rainfall (Cook, 1774, p. 435; Percy Smith, 1983, pp. 6,28). With these factors in mind, comments by early visitors suggesting that shortage of food was not a problem appear justified: for example, A.W.Murray (1863, p. 358) described Niueans as "fine, robust, noble-looking people". Food sources comprised both wild and cultivated including berries, yams, taro and coconut plus fish, birds and land crab (Gill, 1871; Kunitau & Hekau, 1982, p. 89; Loeb, 1926; Vilitama, 1982, p. 101). However, given the rocky nature of the land and the thin layer of topsoil, cultivation of root crops such as taro and yams in bush gardens must have been hard work relying entirely

¹⁸ As noted earlier in this chapter, only men could become an iki or patu.

on human labour and knowledge without any form of mechanical or animal assistance, rats and flying foxes being the only indigenous mammals, and made even more difficult by a lack of metal tools (Fisk, 1978, p. 1; Percy Smith, 1983, pp. 6, 22). Fish was a staple and a main source of protein and was mainly caught from canoes, made from a single tree, with an outrigger spar, using nets made from the bark of a tree (Erskine, 1853, p. 26; Percy Smith, 1983, p. 71). Early accounts in Ryan (1984), suggest that paddles were the main form of propulsion although Percy Smith (1983, p. 71) referred to a sail but gave no clue as to the material from which the sails were made and this may mean that sails were introduced by the missionaries. Plant material was also the source of clothing which was made from of bark cloth or tapa (Skinner, 1951, p. 43). Fibrous material from trees and plants was also used in plaitwork for mats and girdles and making personal adornments (Percy Smith, 1983, p. 37). Houses were built using wooden poles for the framework with coconut palm fronds for the roof and walls (Loeb, 1926, p. 90).

It has proved difficult to find information on traditional medicines and healers in Niue. According to Loeb (1924, pp. 397,399), curing was at times performed by shaman or *taula-atua* using a variety methods including the calling on gods, potions made up from leaves and herbs and massage. However, it appears that by the 1920s, the role of the *taula-atua* had largely disappeared (Loeb, 1924, p. 398). Barker (1994, p. 67) who, when referring to the role of the *taula-atua*, noted that in contemporary Niue these tended only to be used by the elderly and were relatively secret and officially discouraged.

Drought is likely to have been a major threat. Niue is made up of uplifted coral and as a result, rather than accumulate in ponds or lakes and flow to the sea in rivers, rain water permeates down through the coral rock and forms a fresh water lens above the saline water that sits under the island (SOPAC, 2007a, p. 13). This lack of rivers or lakes meant that access to fresh water was limited to brackish pools of water in deep caverns (Hood, 1863, p. 25; Percy Smith, 1983, p. 6). For drinking, coconut juice took the place of water, the water from the pools only being used when drought affected coconut production (Percy Smith, 1983, p. 7). Whilst apparently occasional rather than regular, droughts impacted on crop production and if severe, could result in famine (Etuata & Tanaki, 1982, p. 100; Percy Smith, 1983, p. 28). Under such circumstances, the only recourse people had was to prevail on the *taula-atua* to cast the necessary spell to break the drought (Loeb, 1924, p. 396).

Energy use will have been limited to the burning of woody biomass including wood and coconut shell¹⁹ for cooking and a lack of pots or pans of any kind meant that food had to be baked or roasted. Given that staple root crops such as taro and yams require long cooking the traditional oven, the *umu*, would probably have been used in closed or open form (Loeb, 1926, p. 105). Unlike the typical Pacific islands *umu* which involves digging a hole about 700 mm deep in the ground, the Niue *umu* is above ground because the hard limestone

¹⁹ Referred to from here on by the generic term "woodfuel".

rock is very close to the surface making the digging of a hole difficult²⁰ (Loeb, 1926, p. 105). Wood fires may also have been used for warmth given that during the middle months of the year temperatures at night can drop to below 20°C. Given that Niue at this time was heavily forested, the collection of woodfuel is unlikely to have been a problem (Cook, 1774, p. 435; Etuata & Tanaki, 1982, p. 101; Percy Smith, 1983, p. 6).

The probability is that Niuean society changed little from 500 AD to the early 1800s. This lack of change in people's lives can in part be attributed to little contact with the outside world, possibly owing to a deliberate policy to make visitors unwelcome. Etuata & Tanaki (1982, p. 101) suggested that this was a form of quarantine to ensure that new diseases were not introduced, a policy that may explain the hostile reception given to Captain James Cook when in June 1774 his attempts to land were met with great hostility (Cook, 1774, p. 434). However, while James Cook was successfully repulsed, his visit was a precursor of change to come because Cook's accounts of his visit meant that people in Britain and elsewhere became aware of the existence of Niue. As a consequence, by early in the 19th century, this period of isolation dating back to around 500 AD was, unbeknown to the Niueans, was about to change.

4.4 THE TRADER AND MISSIONARY ERA – THE FIRST PHASE OF TRANSFORMATION: 1830 TO 1901

One organisation that took interest in Cook's accounts was the London Missionary Society (LMS), an evangelical organisation founded in Britain in 1795 (Lovett, 1899, p. 15; Stanley, 1990, p. 56). The LMS was created during a period of great political and social change with British industrialisation, the French Revolution taking place across the English Channel and increasing activism on the part of the "non-conformist" churches in Britain, that is, those churches not part of the established church, the Church of England (Lovett, 1899, p. 4). The LMS was part of a movement initially led by the Baptist Church with the objective of "propagating the Gospel amongst the Heathen" based on a belief that as Christians, the members of the movement had a clear obligation to convert non-Christians to Christianity (Lovett, 1899, p. 5; Stanley, 1990, p. 56). However, according to Horne (1894, p. 4), the movement became inter-denominational. There is a strong link between industrialisation and the formation of the LMS. As discussed in Chapter 3, as British industrialisation progressed, by the late 18th century, industrial output exceeded local demand for goods and manufacturers had to find new markets in the non-industrialised world for their goods. A group of people with strong religious convictions including wealthy merchants believed that if Britain was to justify selling goods to "savage" people, then there was an obligation to offer them "the hopes of the Christian Gospel and the resources of the Christian civilisation" (Horne, 1894, p. 2).

²⁰ The umu consists of a hole dug in the ground and lined with smooth stones. A fire is made on the stones and when burnt out, the ash is removed. The cavity is lined with fresh banana leaves on which food wrapped in leaves is placed. A thick layer of more large leaves is placed over the food and covered in rocks and the food allowed to cook in the residual heat from the fire.

The first recorded meeting of the LMS occurred early in 1795 and the first group of missionaries set off for Tahiti in a ship called "The Duff" in October 1795 (Lovett, 1899, p. 45). The choice of the South Pacific for the first mission was probably inspired by reports from Cook's three voyages between 1768 and 1780 and his accounts of the "primitive" peoples of the "South Seas" (Stanley, 1990, p. 56; Thurn, 1915, p. 311).

On 19 June 1830, John Williams, arguably the best known of the LMS missionaries active in the South Pacific, attempted to land two Aitutakian teachers on Niue (Horne, 1894, p. 218; Talagi, 1982, p. 111). The reception was such that the Aitutakians were unenthusiastic at the prospect of settling amongst the Niueans and instead, Williams induced two youths to come aboard his ship and then sailed away to the Society Islands (Williams, 1838, p. 298). In spite of this what might be regarded as a rather "un-Christian" act, the two youths were converted to Christianity and later returned to Niue with the objective of better informing their people of the good intentions of the missionaries. Sadly, these overtures were unwelcome and both were killed not long after landing (Gill, 1871, p. 131). However, the LMS persisted and a further visit was made in the 1840s and eventually in 1846 a missionary – Peniamina – who was a Niuean who had been trained in Samoa by the LMS, was allowed to land and stay effectively heralding the start of missionary influence (Gill, 1871, p. 132). By 1859, Christianity was well established and the old pagan ways had been largely abandoned with an organised church in place, much of this being due to the efforts of Samoan teachers (Talagi, 1982, p. 117). From 1860 to 1900, Niue was effectively governed by the LMS missionaries, George Lawes and his brother, Frank, resulting in many changes to people's way of life (Talagi, 1982, p. 118).

The LMS introduced a number of complexities by introducing a form of politics through a centralised form of governance. The fono set up by George Lawes in 1864 was an attempt to provide a form of law and order (Talagi, 1982, p. 119). Each village was represented on the fono by one elected member, this person having been elected by the village fono, which was made up of the magafaoa chiefs or iki residing in the village (Talagi, 1982, p. 118). The kingly system was reinstated in 1876 by the LMS when King Tuitoga was elected although the rationale for the reinstatement is not entirely clear in the literature (Tafatu & Tukuitoga, 1982, p. 124). A formal set of written laws were introduced by George Lawes in 1875, mainly related to personal behaviour covering matters such as theft and adultery (Loeb, 1926, p. 66). A justice system was established with laws being administered by magistrates with a police force set up for enforcement although it appears the system was not always effective, particularly later in the era (Tafatu & Tukuitoga, 1982, p. 123; Talagi, 1982, p. 119). Land ownership was settled by consultation based on genealogy rather than by warfare, but remained (and remains) a contentious and complex issue (Loeb, 1926, p. 67). Villages with a church as the social hub located on the coastal perimeter replaced the inland magafaoa settlements (Talagi, 1982, p. 117). Other impacts of the missionaries on day to day life included the adoption of European clothing, basic education, basic healthcare and warfare ceasing to be the means of settling disputes between families; otherwise, the church appeared to fit in well with the traditional lifestyle (Talagi, 1982, p. 118). In terms of

diet and food production, during the missionary era, the main sources of food continued to be that grown in bush gardens and from fishing as in the pre-historic era but with the addition of “exotic” crops that included arrowroot, tapioca and bananas and meat mainly from pig raising (Percy Smith, 1983, p. 21; Tafatu & Tukuitoga, 1982, p. 122). Water supply continued to be an issue and vulnerability to drought continued (Brenchley, 1873, p. 24; Hood, 1863, p. 25). Houses built using coral, wood and plaster with sugar cane roofing were introduced by the missionaries who found the traditional houses too cold (Loeb, 1926, p. 90).

An economic structure where payment for one’s labour or the goods that one makes or grows was introduced by George Lawes but subsistence agriculture remained the main occupation. Lawes encouraged commercial development through the growing of cash crops over and above the crops that people grew for their own consumption and the production of handcrafts, in particular ladies hats (Tafatu & Tukuitoga, 1982, p. 122). The crops, including cotton, arrowroot and copra and the handcrafts were sold to traders for export, part of the income from which was used to pay for imports of clothing and other products that could not be produced locally including bibles and religious tracts (J. King, 1909, p. 40; Tafatu & Tukuitoga, 1982, p. 122). As a consequence of people receiving payment for their labour the concept of financial capital was introduced. Cash income became available for discretionary expenditure – although it seems that the LMS appropriated a portion of that income for various activities including the purchase of bibles, supporting village pastors and contributing to LMS activities in other parts of the world (Tafatu & Tukuitoga, 1982, p. 123). Furthermore, Niue had become part – albeit a very small part – of the global economy through the trading of goods and the supply of labour and as such participated in what Murray (2001, p. 137) described as the “First Wave” of globalisation or “Colonial Globalisation” that began in the 1870s and finished in 1914. As I discussed in Chapter 2, this globalisation process was a consequence of industrialisation in northern Europe and North America and the need in the industrialised world for raw materials and markets. Up until the trader and missionary era, the Niue economy was entirely subsistence, a situation maintained by the lack of contact with the outside world. It was 19th century globalisation that exposed Niue to the global economy with the introduction by George Lawes of commercial development.

Closely related to this commercial development was the introduction of shipping services from the mid-1860s in the form of schooners, mainly owned by the ship’s master. The schooners provided shipping services around the South Pacific, responding to the needs of traders that had set themselves up in the various islands, including Niue (Young, 1993). The schooners were typically built in New Zealand or Australia and were designed to meet the need for a vessel of sufficient seaworthiness while being capable of negotiating reef passages and shallow lagoons typical of small islands with no port facilities (Young, 1993, p. 36). The schooners provided both cargo and passenger services and thereby facilitated the globalisation process by the introduction of “Western socio-cultural values” by traders and labour recruiters as well as by the missionaries (Firth, 2000, p. 3). The exposure to these external influences increased the awareness of Niueans of the outside world and a perception that opportunities for the young were limited in Niue, at least

by the young themselves (Heyn, 2003, p. 17). This perception led to young men in particular leaving Niue to seek work overseas. In 1868, it was reported that 355 young men were working overseas – Australia, Samoa, Tahiti and the Sandwich Islands – and also serving as seafarers (J. King, 1909, p. 39). This situation continued and in 1899, 591 of the total population of 4,576 were reported as “absent at the guano and other islands (Percy Smith, 1983, p. 7). Working overseas was seen as a means of obtaining capital to enable a new life on return to Niue while in the meantime escaping the sometimes “harsh control of the missionaries” (Heyn, 2003, p. 17). This was blamed at least in part for a period of unrest occurred in the 1860s which was attributed to men going to work in other Pacific islands and Queensland and bringing back “bad ways” and also traders and missionaries being seen as profiting excessively from trade with New Zealand, Australia and other Pacific islands (Tafatu & Tukuitoga, 1982, p. 123). Towards the end of the century, a fortnightly steamship service commenced although it appears that this may not have lasted with services reverting to schooners in the early part of the 20th century (Tafatu & Tukuitoga, 1982, p. 129).

From a perspective of day to day energy use, not a great deal of change took place during the missionary era as far as the general population was concerned. While I have been unable to find any direct reference to cooking practices in the literature other than the introduction of “quicker cooking techniques” which probably meant the use of metal pots and pans, it is assumed that woodfuel continued to be the main source of cooking fuel (Tafatu & Tukuitoga, 1982, p. 122). It is likely that the missionaries themselves will have used candles and oil lamps for lighting but to what extent these were adopted by the general population is a matter for speculation. The introduction of a regular steamship service, albeit seemingly for a short period only, reliant on a then modern energy technology and energy source in the form of coal, while not indigenous in any sense, would have had some benefit in terms of improved transport services and connectivity.

Unfortunately, as well as creating unrest, the globalisation process disrupted what was generally reported to be a relatively peaceful life; these included epidemics and in 1863, the kidnapping of 109 men by Peruvian slavers to work in the guano mines in Peru (Moss, 1889, p. 13; Talagi, 1982, p. 119). Collectively, these impacts of globalisation were changing people’s perceptions and to some degree challenging the missionaries and their influence on day to day lives. Furthermore, globalisation was increasingly becoming geo-political in nature and the South Pacific was not exempt, and as the 19th century moved towards its end, further changes to the socio-political structure in Niue were about to happen.

4.5 THE COLONIAL ERA: STAGNATION AND TRANSFORMATION - 1901 TO 1974

As I discussed in Chapter 2, globalisation gave rise to great power rivalry in the South Pacific from the 1870s. Concern at this rivalry grew in Niue and the possibility of British protection of Niue was raised in 1879 followed by formal petitions to Queen Victoria in 1889, 1895 and 1899 (Scott, 1993, p. 17; Tafatu & Tukuitoga, 1982, p. 125). In 1886, as part of an Anglo-German convention, Niue was declared to be neutral territory although apparently Niueans were not told of this. However, following the acquisition of Western

Samoa by Germany under the Samoa Convention of 1899, Britain finally agreed to the requests from Niue for protection and a Treaty of Cession with Britain was signed in April 1900 (Tafatu & Tukuitoga, 1982, p. 125). This ended the rule of the LMS – but not their influence – and was the beginning of colonisation by New Zealand which lasted for just over 70 years. As discussed below, the colonial era can be characterised as comprising three periods: an initial period of indifference where it seems that the New Zealand authorities having been “given” Niue did not know what to do with it, a transition period in the 1950s when the authorities woke up to the need to do something about their colonial charges and a period of rapid development in the 1960s and early 1970s as a precursor to independence in 1974.

4.5.1 Indifference and Stagnation- 1901 to 1950

Following cession to Britain in 1900, control was transferred to New Zealand in 1901 (Tafatu & Tukuitoga, 1982, p. 126). This transfer by the British to New Zealand was against the wishes of the Niueans and was to meet New Zealand’s desire for “Empire” and to compensate for not having been “given” Samoa as a colony (Tafatu & Tukuitoga, 1982, p. 126). To add to the discontent, Niue was initially administered as part of the Cook Islands but following strong representations by Niueans, it was agreed that Niue would have a separate administration and in 1903, the first Resident Commissioner arrived (Tafatu & Tukuitoga, 1982, p. 126). Having been granted an “empire”, however, one gains the clear impression that successive New Zealand governments did not know what to do with this tiny and remote territory and general indifference prevailed until the 1950s (Chapman, 1976, p. 6). In terms of development, this was a period of stagnation for Niue. The fono set up by George Lawes during the missionary era was restructured by the first Resident Commissioner, S. Percy Smith, and continued to “represent” the people of Niue (Parsons, 1968, p. 243; Rex & Vivian, 1982, p. 127). In reality, the real power lay in the hands of the New Zealand Resident Commissioner of the time as the president of the island fono, with the role of the king being largely eliminated (Chapman, 1976, p. 6; Rex & Vivian, 1982, p. 128). However, the LMS, now transformed into the Ekalesia Niue, remained an important influence on Niue society for much of the colonial era (Rex & Vivian, 1982, p. 127). Progressively, the administration and justice systems set up by the LMS were revised by the Resident Commissioner who took over control of the police force and assumed the role of magistrate (Rex & Vivian, 1982, p. 128).

Land tenure remained a contentious issue with the Resident Commissioner taking over the role of mediator or arbiter. This situation continued until the passing of the Niue Act 1966 which attempted to codify land tenure and included the setting up of a Land Court (New Zealand Government, 1966). However, I suspect that there were some issues of concern as the land provisions of the 1966 act were substantially amended by the Niue Amendment Act (no 2) 1968 (New Zealand Government, 1968).

It is likely that subsistence agriculture remained the main occupation through the colonial era although working on coconut and banana plantations would have been a source of cash income, particularly banana

from 1920 onwards (Rex & Vivian, 1982, p. 129). For much of the colonial era, the diet remained largely unchanged from that of the trader and missionary era but according to an informant who could recall the 1950s, by that time, people were starting to develop a liking for imported foods – canned meat, sugar and flour (male, >70, March 2011).

As noted above, during their time of rule, the LMS had provided some basic education and this was continued in 1909 with the establishment of the first primary school by the Ekalesia (Davies, 1969, p. 288). However, the primary objective was to enable Niueans to read and write sufficiently to participate in religious instruction (Chapman, 1976, p. 7; J. King, 1909, p. 37). Access to “Western” medicine had been introduced during the missionary era by George Lawes, probably at a very basic level given that there is no evidence that Lawes had formal medical qualifications (J. King, 1909, p. 37). Some improvement occurred in the early part of the colonial era with the appointment of a medical officer in 1911, followed by the building of a hospital in 1922 (Chapman, 1976, p. 7; Cook Islands Administration, 1922, p. 11; Wilson, 1969, p. 50). Yaws was a significant problem in the 1920s and it appears that tuberculosis and filariasis remained a significant health problem in Niue through to the 1950s (Cook Islands Administration, 1922, p. 11; 1926, p. 28; Department of Island Territories, 1955, p. 82). One informant somewhat wryly commented to me that while the health services introduced by the colonial authorities might have improved the health of Niueans, most of the diseases were introduced by outsiders in the first place (male, >70, March 2011).

In terms of energy supply and use, the majority of people continued to use woodfuel for cooking. It is likely that colonial officials would have used kerosene lamps and stoves from the early days of the era and from discussions with older informants, kerosene lamps were in common use in the 1950s. By 1929, there were six motor vehicles on the island: two cars and four lorries (Cook Islands Administration, 1929, p. 34). In 1926, a telecommunication service was in place enabling telegrams to be sent from a radio station which was supplied with electricity from an on-site diesel generator (Cook Islands Administration, 1926, p. 36). Shipping services showed improvement during the period: in 1922, services were limited to four visits by the barquette “Ysabel” plus pastoral visits by the LMS ship “John Williams” (Cook Islands Administration, 1929, p. 10) but by 1929, New Zealand Government ships (motor or steam powered) were providing monthly passenger and cargo services, a service that was later taken over by the Union Steamship Company of New Zealand (Cook Islands Administration, 1929, p. 24).

For much of the colonial era, there was little economic development. Subsistence agriculture was the main activity with copra being the main export, cotton production having failed (Rex & Vivian, 1982, p. 128). For the first 30 years of colonisation, for most years Niue achieved a positive trade balance with exports exceeding imports with revenue from copra accounting for over 80% of export income (Cook Islands Administration, 1926, p. 24). A decline appears to have set in from about 1929 and it was reported in 1932 that a hurricane in the previous year followed by drought had severely disrupted agricultural production

(Cook Islands Administration, 1932, p. 15). By 1955, significant quantities of bananas, kumara and plaited ware were also exported but unfortunately disease largely wiped out banana production in the late 1950s (Bertram & Watters, 1984, p. 190; Department of Island Territories, 1955, p. 65; Rex & Vivian, 1982, p. 129).

4.5.2 The First Signs of Change – the 1950s

By the 1950s, there were signs that the New Zealand government had recognised the need to provide some degree of economic and social development in Niue, possibly reflecting the new concept of “development” promoted by the United States and discussed in Chapter 2. The role of the Ekalesia as the education provider finished in 1952 when the colonial administration took over (Davies, 1969, p. 289). By 1958, secondary education had been introduced and by 1960 education had become the biggest single item of government expenditure (Chapman, 1976, p. 10; Davies, 1969, p. 290). This change of attitude occurred just in time to ensure that at independence in 1974, Niue had a resource of well-educated people to govern and administer, examples being three of my informants who received primary and some secondary education in Niue in the 1950s and 1960s followed by further secondary education and tertiary study in New Zealand. Ultimately, all three took major roles in government either as politicians or as senior public servants. However, secondary education was restricted on a competitive basis until 1971 after which all children were entitled to free secondary education up to third form level (Chapman, 1976, p. 7). By 1964, health services improved to the extent that tuberculosis had largely been eliminated although there were still a few reported incidents of filariasis (Department of Island Territories, 1964).

In terms of energy infrastructure, in 1954/55, a power station was built with three 25 kW diesel generators to supply parts of Alofi and to supplement the generators at the hospital and the wireless station (Department of Island Territories, 1955, p. 65). A telephone service was in place with 59 subscribers in 1955 and the wireless station provided an overseas telegraph service (Department of Island Territories, 1955, p. 72). However, the majority of people continued to use woodfuel for cooking and kerosene lamps for lighting in the 1950s and for much of the 1960s. One informant recalled with a shudder cooking over wood fire and the impact on her lungs and eyes. She also recalled using a charcoal iron and the risk of getting charcoal on the clean linen being ironed and making a home-made kerosene lamp from a jam jar and a cloth wick so that she could study at night after the rest of her family had gone to bed (female, >60, March 2010). As noted above, there was increasing demand for imported foods but given the lack of refrigeration, the range of imported foods was limited (male, >70, March 2011).

Drought continued to be a serious threat throughout the colonial era. Some improvement occurred when in 1950s, seven water storage tanks were built including two 50 cubic metre tanks at the hospital that were provided with a diesel pump to enable replenishment from the underground water lens (Department of Island Territories, 1955, p. 64). During drought, water was delivered to villages by water tanker filled from the well supplying the hospital and another at the Public Works Department (White, 1964, p. 15). One informant

recalled fights taking place as villagers jostled to fill their buckets from the tanker (male, >50, March 2010) while another recalls his mother giving him a bucket of water in the morning which was his supply for drinking and washing for the day (male, >60, September 2010).

Without an airport, the only recourse in the event of an emergency had been seaplanes (if the weather permitted) and emergency parachute drops of supplies (Department of Island Territories, 1964, p. 15). For most Niueans motor transport was not readily available until the late 1960s although by 1955, the total number of vehicles – cars, trucks and motor cycles – had increased to 46 (Department of Island Territories, 1955, p. 70). Older informants recalled the days before widespread motor vehicle ownership with little sentimentality. One informant told me that when he was a boy in the early 1950s, there were two cars, one driven by the Resident Commissioner and the other by the Chief Missionary (male, >70, March 2011). Until well into the 1960s, transport was mainly by foot and some bicycles plus weekly truck services that enabled villagers to visit the Saturday market in Alofi to buy provisions, implying that most people did not travel for employment purposes. Children had to walk to and from school involving distances of up to 10 kilometres – one informant said her mother looked back at this with such horror that after moving to New Zealand some years ago, she never wanted to return to Niue (female, >50, September 2010). Another informant described her joy when her father purchased a second-hand bicycle for her to ride the eight kilometres to school – however, tyres were scarce and she was in constant fear of getting a puncture (female, >60, March 2010).

The Ekalesia remained an important factor in day to day life on Niue during the colonial era although the direct influence had started to wane even before the end of the 19th century (Parsons, 1968, p. 244). The “dethronement” of the Ekalesia and replacement as de facto ruler by the New Zealand administration resulted in a relationship that was difficult at times (Parsons, 1968, p. 244). This came to a head in 1947 when the Resident Commissioner, C. H. W. Larson, required ships to be unloaded on Sundays, an activity to which the church was totally opposed (Parsons, 1968, p. 244; Rex & Vivian, 1982, p. 130). It is apparent that Larson was a forceful personality and while many of the measures he implemented were of real benefit, the manner in which these were imposed met with resentment (Rex & Vivian, 1982, p. 130). Larson’s term as Resident Commissioner ended tragically when in 1953 he was killed by three escaped prisoners. The killing of Larson brought Niue to the attention of the New Zealand public and as a consequence, the government realised that it had responsibility for the welfare of its “colonial charges” (Chapman, 1976, p. 10). As a result of what has become known in New Zealand as the Larsen Affair, the New Zealand Government reviewed not only the role of the Resident Commissioner but also the way in which Niue was administered (Scott, 1993).

To add to the disruption to the apparently tranquil life that had prevailed in Niue before the Larsen Affair, successive cyclones in 1959 and 1960 destroyed most houses (White, 1964, p. 5) and resulted in considerable loss of life.

The cyclones destroyed the copra industry, Niue's largest export accounting for about two-thirds of export revenue in 1958, and it was not until 1964 before it fully recovered (White, 1964, p. 23). As a result of the destruction, the New Zealand government commenced an accelerated development programme that according to Chapman (1982, p. 135), changed life in Niue dramatically.

4.5.3 Transformation – the Development Programme 1960 to 1974

The most immediate response to the cyclones of 1959 and 1960 was the construction of new houses (Barker, 2000, p. 198). The replacement houses were bungalows constructed with concrete walls and corrugated steel or asbestos cement roofs²¹, generally referred to as "hurricane houses" and according to the 2011 census, these still make up about 50% of the current housing stock (Government of Niue, 2011, p. 82). While the rehousing programme was the priority, it was quickly followed by the infrastructure development programme that commenced in the mid-1960s, a programme that had a major impact on people's day to day lives, both directly and indirectly.

From 1967 onwards, a programme to expand electrification was implemented and by 1974, 257 households, businesses and government buildings were connected to the island electricity system (Department of Island Territories, 1966, 1974). Expansion of the distribution network to supply all villages continued after independence using financial aid promised by the New Zealand government (Department of Island Territories, 1974, p. 17). The benefits of the electrification programme included the displacement of woodfuel as the main cooking fuel which, according to one informant, was much appreciated (female, >60, March 2010). Following the improvements of the 1950s, the ability to cope with impact of drought was increased in 1964, when 19 bores were drilled in a number of villages, at three schools and in six government establishments. Most of these were fitted with hand pumps although two were driven by windmills; by 1974, there were 42 bores (Department of Island Territories, 1964, 1974). Road improvements included the construction of all-weather roads between villages and between the villages and Alofi and by 1965, there were 413 registered motor vehicles; by 1974, the number of vehicles had increased to 682²² (Department of Island Territories, 1964, p. 15; 1974; Fisk, 1978, p. 2). Arguably, the most dramatic event was the opening of the airport in 1971 which allowed the introduction of a regular air service between Niue and New Zealand (Department of Island Territories, 1971, p. 17).

²¹ Unfortunately, however well intentioned, the use of asbestos cement roofing material has created a disposal problem when houses are demolished or roofs replaced.

²² The fleet comprised 415 motorcycles, 214 cars, 44 heavy vehicles and nine buses (Department of Island Territories, 1974).

Table 7: Niue Merchandise Trade – 1922 to 1971
(expressed in 2012 dollars²³)

Year	Imports (\$,000,000)	Exports (\$,000,000)	Trade Balance (\$,000,000)	Fuel Imports (\$,000,000)	Fuel imports as % total	Population (approx.)	Imports per capita	Exports per capita	Fuel imports per capita
1922	\$2.41	\$1.53	-\$0.88	NA	NA	3,800	\$635	\$403	NA
1929	\$1.71	\$1.65	-\$0.06	\$0.12	7.3%	3,800	\$450	\$434	\$33
1952	\$5.60	\$4.53	-\$1.07	NA	NA	4,700	\$1,191	\$963	NA
1953	\$6.09	\$3.79	-\$2.30	NA	NA	4,725	\$1,289	\$802	NA
1954	\$6.99	\$3.41	-\$3.58	NA	NA	4,750	\$1,472	\$719	NA
1955	\$7.65	\$3.79	-\$3.86	NA	NA	4,775	\$1,602	\$794	NA
1956	\$7.68	\$3.00	-\$4.68	NA	NA	4,800	\$1,599	\$625	NA
1961	\$10.00	\$1.46	-\$8.54	NA	NA	4,900	\$2,040	\$298	NA
1962	\$7.42	\$1.21	-\$6.21	\$0.80	10.8%	4,950	\$1,500	\$244	\$161
1963	\$6.45	\$2.02	-\$4.43	\$0.69	10.7%	5,000	\$1,291	\$404	\$138
1964	\$8.45	\$3.00	-\$5.46	\$0.88	10.5%	5,050	\$1,674	\$593	\$175
1965	\$9.28	\$2.41	-\$6.86	\$1.24	13.4%	5,100	\$1,819	\$473	\$243
1967	\$9.99	\$1.72	-\$8.27	\$0.00	0.0%	5,000	\$1,997	\$344	\$0
1968	\$11.29	\$0.91	-\$10.38	\$1.30	11.5%	4,800	\$2,352	\$190	\$271
1969	\$11.94	\$1.08	-\$10.85	\$0.85	7.1%	4,500	\$2,652	\$241	\$188
1970	\$11.00	\$2.85	-\$8.15	\$1.95	17.7%	4,200	\$2,620	\$679	\$464
1971	\$10.73	\$2.37	-\$8.36	\$1.62	15.1%	4,000	\$2,683	\$593	\$405

Sources: Cook Island Administration (1922, 1929), Department of Island Territories (1955, 1956, 1972)

²³ Conversion from the published figures in New Zealand pounds and later dollars, was carried out using the Reserve Bank of New Zealand "Inflation Calculator" downloaded on 19/07/12 from www.rbnz.govt.nz/statistics/0135595.html

From the 1960s onwards, attempts to create export industries were made by the New Zealand government, notably the Passionfruit Development Scheme that commenced in the late 1960s and continued after independence in 1974. While showing much initial promise, by 1976, a decline in passionfruit output had commenced which could not be reversed, the final blow occurring in 1980 when most remaining vines were destroyed by Cyclone Ofa (Bertram & Watters, 1984, p. 190). According to Bertram & Watters (1984, p. 190), the failure of the passionfruit project could be attributed to a number of factors, the most important of which was the lack of an adequate pool of labour needed for passionfruit cultivation at the scale required if the project was to be economically viable.

As can be seen from Table 7 above, the merchandise trade imbalance rapidly worsened on a per capita basis from 1961 onwards due in part to the value of exports for 1961 to 1963 still being badly affected by the two severe cyclones in 1959 and 1960. At the same time, there was an increasing demand for imports from the 1950s onwards. For example, the per capita figures for imports and exports for 1922, 1929 and 1952 show a relatively small trade imbalance while from 1953, the trend is for imports to increase while exports decrease. An informant who grew up in Niue in the 1950s recalled an increasing demand for consumer goods such as flour, sugar and tinned meat as people developed a taste for these foods (male, >70, March 2011). A significant contributor to the trade imbalance was the infrastructure programme which resulted in increased demand for imported energy to generate electricity and to provide fuel for motor vehicles and fishing boats. Electricity generated from imported diesel oil was largely replacing woodfuel for household cooking and kerosene for lighting while motor vehicles, particularly motorcycles, using petrol and diesel were increasing in number. The extent of the increase can be seen in Table 7: in 1929, the value²⁴ of fuel imports per capita were \$33 and represented 7% of total imports. By 1971, fuel imports had increased to \$405 per capita and represented 15%, double that of 1929. Also having an impact on energy imports were those services such as health, education and communications that are facilitated by electricity (as discussed in Chapter 3 and specifically as shown in Figure 9). In summary, the enhanced livelihoods achieved through electrification, access to modern transport and improved services, all increased wellbeing but created a new vulnerability in the form of dependency on imported fuels.

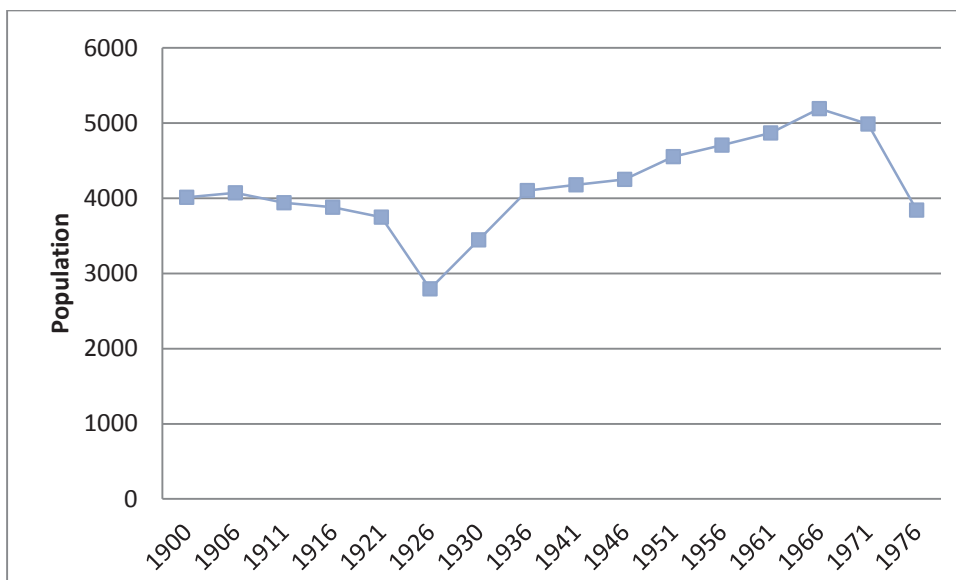
Figure 13 below shows the population trends over the course of the colonial era between 1900 and 1971. As can be seen, based on figures presented by Bertram & Watters (1984, p. 197), between 1900 and 1961, the population increased from 4,015 to 4,868 although for reasons I have not been able to establish with

²⁴ Expressed in 2014 dollars.

certainty, at times the population dropped to below 4,000. A possible reason is young men leaving the island to work in plantations in other Pacific islands (Rex & Vivian, 1982, p. 128). The steady population increase overall could have been due to strict controls on emigration which included a requirement that would-be migrants had to prove to the Resident Commissioner that they had accommodation arranged in New Zealand and have adequate means of support before they were allowed to leave Niue (Department of Island Territories, 1956, p. 74).

The construction programme that followed the cyclones changed and improved people’s lives in Niue. There were significant negative impacts, however, in terms of Niue’s long term economic and social viability as a self-sustaining community. In 1960, New Zealand began importing unskilled contract labour from a number of South Pacific islands including Niue (Goss & Lindquist, 2000, p. 392). One consequence was that Niueans became aware that they wanted more than just a subsistence lifestyle: “People had finally become aware that a subsistence way of life was no longer appropriate, unfortunately, they did not have an economic base on which to achieve their material aspirations” (Chapman as cited in Haas 1977, p.72). While the importation of the contract labour soon stopped, a Niuean community had now been established in New Zealand, thereby providing an ideal base for would-be migrants (Heyn, 2003, p. 29). The impact was not immediate as the population of Niue reached a peak of about 5,200 in 1969 but by 1976, had fallen to just over 3,800 (Bertram & Watters, 1984, p. 197). As will be seen in the following section, this was a trend that was to continue.

Figure 13 – Population of Niue: 1900 to 1976



Source: Bertram and Watters (1984, p. 197)

4.5.4 The Path to Independence

In parallel to the infrastructure programme and the related improvements to services that were taking place in the 1960s, political changes were taking place and the New Zealand government's role in Niue's affairs was on borrowed time – at least in terms of day to day government. Niue's status as a colony had received attention from the United Nations and pressure was put on New Zealand to grant independence and the New Zealand government announced that as a first step, internal self-government would be granted by 1965 (Chapman, 1982, p. 134). Niueans were in no hurry, however, and insisted on an effective consultation process that would address a number of concerns, including the need to maintain strong links with New Zealand and recognition of the inability of Niue to become self-supporting economically (Chapman, 1982, p. 135). A consultation process commenced in 1965 and resulted in the Niue Act of 1966 which provided a framework for a gradual transition of real power from New Zealand to the Niue Assembly (Chapman, 1982, p. 135). The transition process ultimately resulted in the Niue Constitution Act of 1974, acceptance of which was put to the people of Niue in September 1974 and following a clear majority, Niue became a self-governing state in October 1974 (Chapman, 1982, p. 138).

To summarise, in less than 150 years, Niue had been transformed from a traditional and self-sufficient society to one that possessed many of the characteristics of a modern society. Self-sufficiency, however, had disappeared with a substantial merchandise trade imbalance as shown in Table 7 above. Contributing to the trade imbalance were the energy imports required for the electrification programme and the increasing numbers of motor vehicles. As will be seen in the next section, this was the beginning of a trend that continues to the present day.

4.6 CONTEMPORARY NIUE - 1974 TO THE PRESENT DAY

An important feature of the Niue Constitution Act 1974 is that it provided for independence with “free association” with New Zealand and essentially this meant – and continues to mean – that New Zealand would continue to provide economic and administrative assistance²⁵ and Niueans would continue to be New Zealand citizens (Chapman, 1982, p. 137; New Zealand Government, 1974). Undoubtedly, this was a highly satisfactory arrangement as far as Niue was concerned in that independence was achieved without having to give up financial support from the former colonial power and furthermore, retaining the right to New Zealand citizenship. The Act established the Niue Legislative Assembly or Fono Ekepule, which meets in the village of Alofi. The Fono Ekepule consists of 20 members, 14 of which are elected from village constituencies and six from a common role (Government of Niue, 2012a; New Zealand Government, 1974, p.81). The topic of local politics did not arise in interviews or conversation to any great extent. Politicians are

²⁵ Article II Part 6 of the Act states that “It shall be a continuing responsibility of the Government of New Zealand to provide necessary economic and administrative assistance to Niue.” (New Zealand Government, 1974, p. 2).

part-time and live and work in the community so lack of access is not an issue. Not surprisingly, given the small population, there are no political parties as such but during my visits, from reading the local newspapers, differences of opinion occur between politicians and these were openly expressed and debated. While only occasionally raised and then indirectly, the contemporary political relationship with New Zealand was recognised by informants as all-pervasive, undoubtedly due in part to the high level of dependency on ODA from New Zealand. The complexity of the relationship with New Zealand is illustrated by the role of the New Zealand High Commissioner which extends well beyond normal diplomatic representation. For example, the High Commissioner attends the sittings of the Niue parliament, albeit in an observer role as the Queen's representative²⁶. The performance and personality of the various High Commissioners and the way that he or she participated in the community was commented on by informants, sometimes in quite frank and not always favourable terms²⁷.

Independence coincided with a move internationally towards neoliberal economics – the “second wave of globalisation”, the first wave being the 19th century globalisation discussed in Chapter 2 (Firth, 2000, p. 181; W. E. Murray, 2001, p. 138). In the context of the South Pacific, the second globalisation started to impact in the 1970s and is characterised by pressure from donor agencies, international financial institutions and banks to reduce the size of the public sector, reduce tariffs and encourage private enterprise with the overall objective of becoming “more competitive” in the global economy (Firth, 2000, p. 185). As I discuss later in this chapter, Niue was not exempt from globalisation, resulting in some stress at times in the relationship with New Zealand.

4.6.1 Contemporary society

At first sight, contemporary Niue appears to be a modern society with an airport served by jet aircraft, a high level of car ownership, near 100% electrification, bars, cafés and restaurants. However, some important characteristics of traditional society remain. The extended family or *magafaoa laulahi* continues to be the principal social institution in contemporary Niue (Ministry of Social Welfare, 2012, p. 7). Whether this is as strong now as it was in the past was questioned by one informant who suggested that with marriage outside the extended family and migration to New Zealand, kinship beyond immediate family was less important than in the past. This informant, well-educated and well informed, considered the village and the church to be central to people's lives and, while in the past a village may have been mainly inhabited by people of a shared kinship, he believed that this no longer is the case (male, > 50, March 2011). I discussed this issue with two other informants in general terms and while somewhat equivocal on the importance of the *magafaoa*, they both stressed the importance of the village and the church in their day to day lives (Female,>

²⁶ As noted earlier, the High Commissioner represents the Queen on behalf of the Governor-General of New Zealand – an interesting constitutional relationship.

²⁷ This should not be assumed as referring to the then incumbent (2011) who was generally well liked by informants.

50, March 2010; male, >50, March 2010). It is clear that while the influence of the Ekalesia over day to day life may have declined, religion remains an important part in people's lives with, according to the 2006 census, over 90% of people belonging to a Christian denomination (Government of Niue, 2008, p. 9) of which about 62% of the population belong to the Ekalesia (Government of Niue, 2008, p. 9). All Niuean informants told me that they attend their village church on Sunday except for one who described himself as a 'lapsed Mormon" (male, >60, September 2010). Shops are closed on Sundays and boating and fishing are not allowed. However, the restriction on cafés and bars opening on Sundays was challenged about four years ago and at the time of my September 2011 visit, the "Washaway" bar in the village of Avatele was a popular venue on Sundays for both local people and visitors.

Based on observation, the standard of housing is generally high and provided with mains electricity and a safe water supply. About 50% of houses are the bungalows known as "hurricane" houses which, as discussed above, were built to replace houses destroyed in the cyclones of 1959 and 1960 (Government of Niue, 2011, p. 82). Figure 16 below shows a typical village scene with a well-kept village "green" and a row of "hurricane" houses in the background.

Figure 14 – Liku Village



Source: Author

Houses built more recently include some with two storeys and the construction materials and designs appears to be similar to those used in New Zealand. Most occupied houses are maintained in reasonable condition and from all accounts have stood up well to the impact of cyclones over the years. However, 43 houses were destroyed and 20 have had to be abandoned as a result of Cyclone Heta in 2004 with the worst damage being caused by storm surge (J. Barnett & Ellemor, 2007, p. 3). According to informants, most households have “mod-cons” such as refrigerators, washing machines, electric or LPG stoves (or both) and televisions but air conditioning appeared to be uncommon in households, this information being largely supported by data in the 2011 census (Government of Niue, 2011, p. 103).

When visiting Niue, it is not long before one sees evidence that aspects of traditional lifestyles remain particularly subsistence agriculture and fishing. When I asked informants what it is that they most like about living in Niue, without exception I was told that it was the “way of life” and culture that kept them in Niue. This applied to younger informants as well as older. Most informants had lived in New Zealand at some stage, some having attended secondary school there, an example being a young woman who said that she “loved living in Niue”, village life and the warm climate being the most important attractions (female, <30, March 2010). One informant in his 40s told me that he decided to move to New Zealand following Cyclone Heta but in spite of finding a good job in New Zealand, he missed the village culture, the church, fishing and growing crops in his bush garden and the warm climate and returned to Niue (male, >40, March 2010). Village “Show Days”, of which I have attended two, act as a showpiece for Niuean culture with singing, traditional dancing and food prepared in an umu for sale.

All Niuean key informants told me that their families relied on bush gardens or the weekly market for vegetables as imported foods were regarded as expensive but also said that they enjoy working in their bush gardens – although one person said that to save the cost of petrol, she was considering buying a motorcycle so that she could use that rather than her car (female, >50, March 2010). Driving through the central parts of the island, one sees numerous bush gardens and at weekends, people working on them. Based on discussions with a number of informants, the most commonly grown crops are taro, breadfruit, kumara and yams and this was confirmed to a large degree by McNamara and Lisimoni-Togahai (2012). I was told by more than one informant that growing taro was a cultural imperative for Niuean men and often more is grown than can be consumed by the family (male, >70, March 2011); I asked one informant if he sold the surplus and was told no because this would impact on those that grow taro for a living (male, >50, March 2011). Another informant mentioned that his family have started to show a preference for rice over taro as the staple, particularly his daughter (male, >50, March 2011). Other informants reported a similar trend especially amongst younger people and this trend was noted by McNamara and Lisimoni-Togahai (2012, p. 11) who concluded that there is a move away from this traditional reliance on crops grown in bush gardens, particularly amongst the young. A study by Ali (2004, p. 234) in 1999 confirmed that the

contemporary diet has moved away from the traditional diet of the 1950s that largely (but not entirely) comprised locally produced food, resulting in a greater reliance on imported foods. Possibly therefore, the importance my informants placed on bush gardens may reflect the fact that most were over 40 years of age.

During visits, I often saw people fishing from canoes, dinghies or off the reef and seafood gathering (weather permitting). Hunting for coconut crabs and fruit bats was also mentioned as enjoyable pastimes. About 40 to 50% of households rear pigs (Government of Niue, 2011, p. 114) otherwise meat is mainly imported in either frozen²⁸ or tinned form (McNamara & Lisimoni-Togahai, 2012, p. 11). Fish is an important component of the diet and according to J. Barnett (2008, p. 36), 73% of households eat fish each day. Other imported components which informants considered to be essentials include dairy products, flour, tinned meat and fish, sugar and beverages – tea, coffee, soft drinks and beer²⁹. The trend for imported foods to be an increased part in people's diets is not unique to Niue and according to Connell, is characteristic of small island communities (Connell, 2013, p. 86) .

While subsistence agriculture remains important both as a source of food and as a cultural pursuit, there remains a need for an income to purchase food that cannot be grown or caught and to pay for the goods and services regarded as essential in a modern society. The contemporary era is marked by a steady increase in the number of people employed in the public service as a ratio of the total population. In 1984, Bertram and Watters commented on the public service as being "grotesquely large relative to the society being administrated " (1984, p. 183) and calculated the number of inhabitants per (public service) post to be 4.5 (1984, p. 204). According to MFAT (2011), the number of public servants in 2010 was 400, and using the 2011 population of 1460 (Government of Niue, 2011), this shows that the number of inhabitants per post has reduced to 3.65. Of the 20 informants, 16 received income primarily in the form of salary or wages, three were self-employed receiving income from business activities and one was retired. Of the 16 receiving salaries or wages, four were employed either by the New Zealand Government or by an international agency, seven were employees of the Niue public service and the remaining five were in private sector employment. The three self-employed informants all received income mainly from tourism related activities including provision of holiday rental accommodation, cafés and bars, car rental, bush walks and fishing trips. In two cases, motor repair work was also carried out. All three informants told me that if an adequate income was to be achieved, it was necessary to pursue more than one business activity (male, > 40, March 2010; female, > 50, September 2010; male, > 50, March 2011).

²⁸ According to several informants, in spite of the large number of feral chickens to be seen in the villages happily foraging for food, people still prefer expensive imported frozen chickens.

²⁹ On some trips to Niue prior to the current research programme, I noticed a number of polystyrene containers being handed over at Auckland airport as passengers' baggage. On inquiry, I was told that these contained frozen Kentucky Fried Chicken, requested by family in Niue. This practice appears to have been discontinued possibly because of airline baggage restrictions introduced in recent years.

The most recent official information on household income is in the Household Income and Expenditure Survey carried out in 2002 (Government of Niue, 2002). According to that survey, the average annual household income was \$32,487 and while clearly out of date, this figure is similar to the figure of \$33,800 suggested to me by an informant during my March 2010 visit (female, > 60, March 2010). In the case of the Niuean informants, I did not seek information on income but was told by several informants that without produce from bush gardens, it would be difficult to maintain the current standard of living. A welfare benefit system is in place (J. Barnett, 2008, p. 34); one informant told me that because he is over 65, he receives a pension of \$100 each week from the Niue Government (male, >60, September 2010). This informant was still working and I was told that the pension was not means tested. Remittances from Niueans living overseas were not mentioned as a source of income by any informant and do not appear to be a significant feature of the economy. One informant somewhat wryly suggested that remittances were more likely to flow from Niue to family members in New Zealand (male, >50, March 2011), a view that is confirmed at least partly by Connell & Brown (2005, p. 4) and Bertram and Watters (1985, p. 503). Poverty is not considered to be of concern in Niue (PIFS, 2013, p. 19); during visits to Niue, I drove through most if not all villages and saw no signs of poverty in the form of poor housing³⁰.

To a large degree, the above examples of the way of life and culture of Niue and the value that informants placed on these confirmed the cultural values identified by Jon Barnett (2008, p. 37) as of importance to Niueans, constituting "a bulwark against the corroding effects of western lifestyles and values". However, some activities have a flavour of New Zealand culture, for example, after-work drinks in one of the local bars on Fridays, fish and chips at the Matavai Resort on Fridays where locals and tourists meet³¹ and Saturday nights at the Rugby Club which continue to the early hours of Sunday morning³². Rugby Union is a favourite sport and Super 15 and All Black test matches attract a big audience at the Matavai Resort. During one field visit, I watched a village cricket team practicing for their next match in the village cricket competition. The impression I gained was that Niuean culture remains strong but with some New Zealand influence no doubt an inevitable consequence of 70 years of colonisation. Having said that, I also gained the impression that the acceptance of New Zealand cultural influence was on Niuean terms in that they have adopted the parts they like while keeping their own culture in place.

4.6.2 Population decline

Most informants expressed contentment with life in Niue but also expressed concern about the future, notably the lack of opportunities for young people. This lack of opportunity and the associated employment opportunities has resulted in a steady outward migration since independence, mainly to New Zealand and

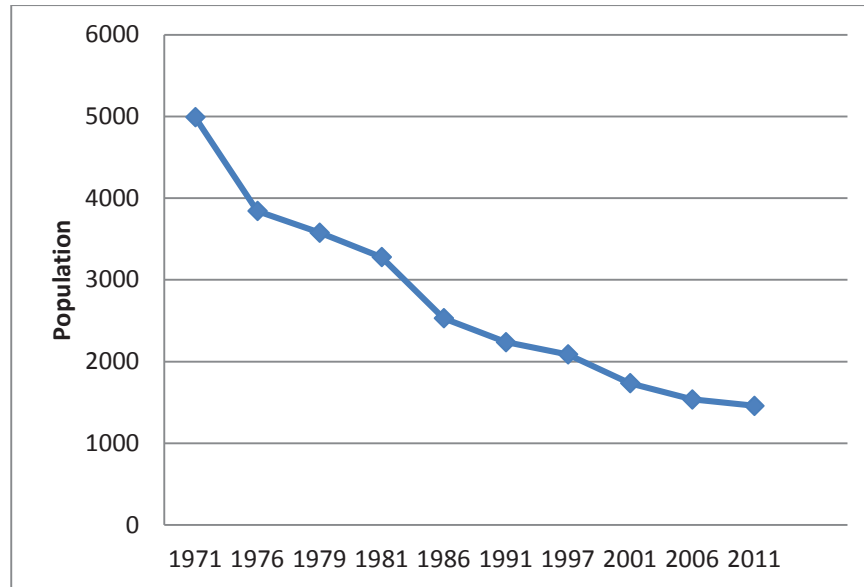
³⁰ This observation refers to occupied houses – there are a large number of unoccupied houses in poor or derelict condition.

³¹ It has been suggested to me by a recent visitor to Niue that since the upgrading of the Matavai Resort as part of the Tourism Project, less local people visit. However, I have no means of confirming this or otherwise.

³² However, I was told that being late to bed was no excuse for not attending their village church on Sunday morning.

Australia. As shown in Figure 15 below. In 1963, the population was 5,046 (White, 1964, p. 2) but at the time of the 2011 census was 1,460 (Government of Niue, 2011, p. 14).

Figure 15 – Population of Niue: 1971 to 2010



Sources: Bertram and Watters (1984, p. 197); Government of Niue(2008, 2011).

Clearly, the attractions of the Niue way of life have been insufficient to persuade many not to leave. When asking informants for their views on this issue, the common view was that migrants were seeking a life with better economic and educational prospects and also were attracted by the “bright lights” of city life. Those views coincided with a survey carried out by Heyn (2003, p. 34) involving young people and which suggested while most would prefer to stay in Niue, the lack of employment opportunities, a desire for further education and the perception that that a better way of life exists in New Zealand and Australia all provided reasons to leave. Also mentioned by informants were issues related to Niue’s relative isolation – flights in and out limited to one per week, lack of technicians and trades-people, the cost of imported materials and the need to travel to New Zealand for anything more than relatively basic health problems (Cole, 2007, p.65, Lincoln International, 2002, p. 17).

Interestingly, Connell (2008, p. 1034) suggested that while the Niuean culture was a factor that kept people in Niue, the commitments and obligations that were key parts of the culture were seen by others as hindrances contributing to their decision to leave, a suggestion supported to some degree by Heyn (2003, p. 38). However, as shown in Figure 14 below, there are indications that the rate of population decrease has

slowed a little over the past five years. The reasons for this slowing are unclear, one possible explanation being the global financial crisis making migration to New Zealand or Australia appear less attractive.

An attempt was made to address issue of population decline in 2002 when Lincoln International were commissioned by MFAT as a first step in a two stage process “to identify, in consultation with the Niue community, what Niueans’ aspirations would be for a living community, and what attributes they considered essential, and which optional, in order to create a set of goals which can be realistically attained” (Lincoln International, 2002, p. iii). The Lincoln International report included recommendations for a next stage but I have not found any record that the recommendations were acted upon or accepted by either government or that a “next stage” actually took place.

4.6.3 Economic Development

Closely associated with population decline is economic development – or more correctly, the lack of economic development. A situation exists where on one hand the lack of economic development results in limited opportunities for young and educated people resulting in outward migration while on the other hand, the lack of young and educated people inhibits economic development. Attempts have been made to at least mitigate if not cure this and in 2003, the Niue Government published a strategic plan – Halavaka ke he Monuina – covering the periods 2003 to 2008 which set six strategic objectives³³ aimed at securing Niue’s future (Government of Niue, 2003). To what extent the strategies were implemented is hard to judge but regardless, there was very little impact on Niue’s economy and the heavy reliance on overseas development assistance from New Zealand and outward migration. However, the strategic plan did identify strategies for economic development including fisheries and tourism (Government of Niue, 2003, p. 8).

As I note earlier in this chapter, Niue is not exempt from the pressures of globalisation with economic development seen as a priority with an overall objective of reducing dependency on ODA (W. E. Murray, 2004, p. 245). Two sectors have and continue to be seen as having potential for sustainable economic development: agriculture and tourism. Until the early 1980s, coconut products – copra and later coconut cream – had been a traditional and important export product. By the late 1980s, coconut cream production had ceased and copra a few years earlier (W. E. Murray, 2004, p. 247), the evidence of this failed agro-

³³ The six objectives of Halavaka ke he Monuina were:

- 1) Financial Stability – Ensure there are sufficient financial resources to manage and develop the country in a responsible and sustainable manner.
- 2) Governance – Provide governance that is stable, transparent and accountable.
- 3) Economic Development – Maximise benefits from Niue’s resources in a sustainable manner.
- 4) Social – Enjoying a lifestyle of a thriving, educated and healthy community that has access to a wide range of quality social infrastructure, services and development opportunities.
- 5) Environment – Sustainable management of Niue’s natural resources for future generations.
- 6) Taoga Niue – The sovereign and ethnic standing of the people of Niue will be secured and will thrive as the driving force in the development and sustainability of Niue as a viable living community.

industry being a number of senile coconut plantations that can be seen when travelling around Niue, one example being that shown in Figure 16 below.

Figure 16 – Niue: Senile Coconut Plantation



Source: Author

Attempts have been made to replace this and the banana industry which had also failed, but unfortunately, the track record of development projects in Niue has not been impressive, one example being the passionfruit project discussed earlier in this chapter. This was followed by the taro export boom that started in 1992 that can be attributed to supply constraints as a consequence of the outbreak of taro leaf blight in Samoa (W. E. Murray, 2004, p. 252). Even though the high quality of Niue taro was acknowledged³⁴, by 1997, the boom was over, with producers in other countries being able to supply at lower cost (W. E. Murray, 2004, p. 252). A more recent example was the Niue Fish Processing factory which opened in 2004. This was a joint venture by Reef Shipping, a New Zealand company that provides the monthly shipping service to and from Niue, and the Government of Niue (MFAT, 2008). However, when I visited Niue in 2010, I noticed that the factory had closed. I asked a number of informants why this project had failed and received a wide

³⁴ Two informants in Tuvalu told me that Niue taro is one of the best the South Pacific in terms of flavour and overall quality.

range of opinions as to the causes, the most credible being that fishing fleets had changed from processing onshore to processing in “mother” ships that sail with the fishing fleet, thereby avoiding the need for fishing boats to take the catch to the shore base. One other project that also started in 2004 was the noni³⁵ juice plantation near the village of Vaiea at the southern end of Niue (MFAT, 2008). Unlike the fish factory, however, noni juice production continues which is mainly due to the availability of labour from Tuvalu according to several informants because, in the words of one informant, Niueans “do not like manual labour as it is seen as demeaning” (female, >60, September 2010). According to the 2011 census, 24 Tuvaluans live in Niue and I was told that they mainly live in the village of Vaiea (Government of Niue, 2011, p. 29). Some informants suggested that Tuvaluan immigrants are using Niue as a means to obtain Niue citizenship after three years and then migrate to New Zealand, but this clearly is not always the case as I was told³⁶ of one Tuvaluan who had lived in Niue for 15 years and represented the village of Vaiea in the Fono Ekepule.

In the 1980s, tourism as a potential source of employment and income was identified, which according to John Connell (2007, p. 11) was as a consequence of “the same kind of neo-liberal ‘prescriptive unreality’ that has necessitated agricultural development being fostered over many years...” During the period 1981 to 1987, tourist arrivals increased from 746 to 2040 and in 1987, the net local income (after deducting the imported goods and other expenditure relating to tourism) was over \$210,000 which compared favourably with visible exports which totalled just over \$120,000 (Milne, 1992, p. 567). Growth continued at a slower rate – in 2007, tourist numbers were 3,500 (MFAT, 2011), well short of the 5,000 visitors which was the target in the Tourism and Private Sector Development Programme of 1997 funded by the World Trade Organisation and the UNDP (B. King, McVey, & Simmons, 2000, p. 410). In 2009, the New Zealand Minister of Foreign Affairs and Trade commissioned Trevor Hall to prepare a report, the objective of which was to provide a plan to develop tourism “as a sustainable industry in Niue’s economic future” (Hall, 2009, p. 3). The report, commonly referred to in Niue as the Hall Report, commented that the target of 5,000 tourist mentioned above was not met for a number of interrelated and complex reasons including the air service being limited to one flight a week, lack of tourist accommodation and lack of trained and motivated people. The recommendations of the Hall Report (2009) followed what can be described as a neo-liberal agenda being wide-ranging and covering issues such as the need for a substantial expansion of the main hotel, labour and taxation reform, reform of property rights and increased flights. Some proposals were radical, including changing immigration law to enable New Zealand citizens to live and work in Niue, changing property rights to enable the government to demolish derelict buildings belonging to long-absent owners without consent and reducing the working week to 25 hours for government employees providing non-essential services. As could be expected, reaction to the Hall Report in Niue has been mixed and one elderly

³⁵ Noni (*Morinda citrifolia*) has become a popular dietary supplement (West, Jensen, Westendorf, & L.D.White, 2006).

³⁶ I met this informant, a Tuvaluan man in his 40s, during a field visit to Tuvalu and he was referring to his uncle. This articulate and well educated informant was visiting his home country.

informant was totally opposed as he believed that increased tourism could “turn Niue into another Fiji” (male, >70, March 2011). Other informants were more moderate and the main objection appeared to be lack of consultation, a point on which during an interview in March 2011, the New Zealand High Commissioner emphatically disagreed. Regardless of the mixed reaction in Niue, the recommendations of the Hall Report have been supported by the New Zealand government. I have not been able to establish to what extent this support is shared by the Government of Niue, particularly in regard to potentially unpopular proposals such as removing restrictions on New Zealand citizens living and working in Niue and reduction in government employee working hours³⁷. However, I understand that the proposals that focus directly on development of the tourism sector have been accepted by the Government of Niue and \$15 million over three years has been committed with a focus on tourism infrastructure including a major expansion of the Matavai Resort, the only hotel in Niue³⁸ (New Zealand Government, 2011).

The role of tourism in the Niue economy is significant. Tourism is the main source of economic development and employment after the government sector (Connell, 2007, p. 11), as evidenced by the private sector participants in my research all relying on tourism for income to some degree. Whether tourism can maintain this role without continued government support is a matter of conjecture; in a commentary on tourism prospects in Niue in 2007, Connell was sceptical, noting that there is a “lack of obvious tourist attractions and diversity” and expressed the view that in the case of Niue, “successful tourism remains as elusive as ever; a panacea for development has proved illusory” (2007, p. 11).

The reality is that while there was political independence from 1974, economic dependence on New Zealand has steadily increased and in economic terms, Niue cannot be regarded as a sustainable community as the high standard of living does not reflect a robust economy based on export income. This is not a new situation: in 1984, Bertram and Watters (1984, p. 183) observed that there had never been any process of export income-led growth in Niue. The economic dependence on ODA, mainly from New Zealand, was foreseen by both parties during independence negotiations. However, whether it was foreseen that the level of dependency would increase is another question. In 1976-77, overseas development assistance (ODA) mainly from New Zealand totalled \$2.2 million or \$708 per capita³⁹ which, in 2012 dollar terms, can be expressed as \$32.5 million total and \$5,000 per capita (Fisk, 1978, p. 2). In 2010/11, the total was \$18.72 million and while the total was less than in 1976/77, the amount per capita has nearly trebled to \$13,400 (MFAT, 2014d). Not surprisingly, this is of concern in Niue and New Zealand particularly as this high level of assistance to Niue has seemingly had little effect in stemming the outward flow of people. A consequence

³⁷ On 25 January 2014, In *Tagata o te Moana* on Radio New Zealand National Radio it was reported that the Premier of Niue, Toke Talagi, had announced that all public servants (other than those required to provide essential services) will be employed on a four day per week basis. However, they will continue to be paid the same weekly wage as for the current five days per week, thereby fulfilling an election promise to increase public service salaries by 20%.

³⁸ Until Cyclone Heta in 2004, there was also the Niue Hotel but this was reduced to rubble during the cyclone.

³⁹ Based on the then population of about 4,000.

of the lack of any significant export industry and the associated employment since independence has been the growth of the public sector which in 2011 accounted for the employment of around 400 people (MFAT, 2014d). In some respects, Niue can be described as possessing the elements of a “MIRAB” (Migration, Remittances, Aid and Bureaucracy) economy like other small Pacific states but given some evidence that remittances from Niueans working overseas are not a significant contributor to the economy, the Niue economy could be better described as “MIAB” – Migration, Aid and Bureaucracy. (Bertram & Watters, 1985; Connell, 2008, p. 1030).

Undoubtedly, the political and cultural influences are major factors in enabling Niueans to enjoy the benefits of a modern lifestyle while retaining those traditional aspects that they value most. However, this would not be possible without the social and physical infrastructure that provides a range of livelihood services to support this modern lifestyle and the economic system that enables these services to be paid for. In the following parts of this section, the social and physical infrastructure and the services these provide are discussed. I commence with energy supply which while not a service as such enables virtually all those services including health, education, water supply, transport and communications and without which, the modern lifestyle could not be maintained.

4.6.4 Livelihood services

(a) Energy supply

Energy supply is not a service as such but without access to an energy supply, most of the services that underpin the modern lifestyle described above would not be available. For example, without diesel fuel, 85% of the electricity now consumed could not be generated which in turn would mean that those services that rely on electricity⁴⁰ would not be available, including the pumped water supply, household and commercial refrigeration and communications. As a further example, the motor vehicles on which people rely to travel to and from work, to buy food and household goods and to maintain social interaction rely on petrol and diesel supplies.

The use of woodfuel for cooking continues into the contemporary era albeit on a small scale. In 2011, 24 households, or 5%, used woody biomass as the main cooking fuel (Government of Niue, 2011, p. 94). As I have observed first hand, the umu continues to be used to cook food for special occasions. Otherwise, electricity and LPG has largely displaced woodfuel for cooking (Government of Niue, 2011, p. 94). Even before the development programme of the 1960s and early 1970s, fuel imports in form of petrol, diesel and kerosene had increased as a percentage of total imports in “real” dollar terms and by 1971, fuel imports

⁴⁰ In this discussion, electricity is categorised as “energy supply” although correctly it is an “energy carrier” in that it transports energy from a source which in the case of Niue is mainly diesel oil, to an energy user, such as a refrigerator. However, the reality is that to most people, electricity is seen as energy supply and to all intents and purposes, this is what it is.

accounted for 15% of total imports. Since independence, Niue has become increasingly reliant on imported oil-based fuels including diesel, petrol, LPG and kerosene and in 2011 fuel imports cost just over \$4 million, which constituted just under 29% of total imports (Government of Niue, 2012c, p. 21). According to Isaka et al (2013a, p. 3), in 2009, diesel imports constituted about 60% of fuel imports with electricity generation accounting for just over 62% of diesel imports⁴¹. There was a sharp increase in diesel imports during the period 2004 to 2007 due to fuel used to generate electricity at the Niue Fish Processing factory which was not connected to the main electricity distribution system and also from fishing vessels refuelling. As noted above, the factory closed in 2007, and a considerable drop in diesel fuel imports resulted (Lenzen et al., 2014, p. 32).

As noted in the previous section of this chapter, the infrastructure programme that commenced in the mid-1960s included the expansion of electrification. This continued after independence with financial support from New Zealand and following completion in 1978, virtually every household was connected to the distribution system, a situation that continues to the present day⁴² (Department of Island Territories, 1974; Government of Niue, 1979; 2011, p. 93). In 2001, 2.94 GWh of electricity was consumed which equated to 1,700 kWh per capita; in 2011 (the most recent year for which I have been able to find published data), consumption⁴³ had increased to approximately 3.6 GWh or 2,400 kWh per capita (Crawley, 2014, p. 86). The reason (or reasons) for this significant increase can be attributed to two factors: firstly, increased use of household appliances; for example, while in 2002, 78% of households had refrigerators (Wade, 2005a, p. 14), in 2011, this had increased to over 90% (Government of Niue, 2011, p. 103). Secondly, and possibly more significant, is the additional consumption that can be attributed to the increased number of tourist arrivals (Crawley, 2014, pp. 34,86).

Electricity is supplied by a state owned enterprise, the Niue Power Corporation (NPC), from a power station located about 3 km from the capital, Alofi, and which houses four 500 kW diesel generators, as shown in Figure 17 below. In addition to the diesel generators, there are two photovoltaic (PV) generation⁴⁴ arrays with a combined generation capacity of 50 kWp⁴⁵ of electricity, one of which is located at the Hospital and the other at the High School. As discussed below, a further 275 kWp of PV generation capacity has recently been installed. Even with this additional PV generation capacity, electricity generation will rely on diesel fuel

⁴¹ I note that the figures in Isaka et al (2013a, p. 3) for electricity generation diesel fuel consumption in 2009 do not reconcile with the figure for electricity generation of 3.9 GWh in SPC (2012a, p. 3). If the typical energy conversion figure quoted in Wade (2005a, p. iv) for a large diesel engine of 0.33 litres per kWh is applied, the diesel fuel required will be in the order of 1.287 million litres which is close to the total diesel import figure in Isaka et al (2013, p. 3). A possible explanation is the timing of diesel fuel imports which may not correspond with electricity production data.

⁴² According to the census, 472 of the 477 households in Niue are connected to the NPC system.

⁴³ Note that this is the consumption figure and is less than the generation figure due to losses that occur in the generation and distribution systems.

⁴⁴ Refer to Chapter 1 for a brief discussion of photovoltaic (PV) generation technology.

⁴⁵ PV arrays are rated in terms of the maximum output when exposed to full sunlight. This is often shown as kW peak or kWp. Obviously if cloudy or if the sun is at an angle to the array panels, the actual output will be less than the rated or peak output.

for at least 85% of total generation output (NPC, 2013). The electricity is distributed by a mainly underground 11 kV main installed around the perimeter of Niue.

Figure 17 – Niue: NPC Power Station



Source: Author

From all accounts, the supply is normally reliable with few power outages, an impression backed up by data from 2010 showing that the total time the supply was interrupted over that year was 414 minutes or just under seven hours (SPC, 2012a, p. 14). While the good level of reliability of the electricity supply was taken for granted, I was told of some dissatisfaction regarding price. One informant expressed disappointment to me that his power bill had not decreased after installing a solar hot water unit, but it transpired that he did not have a hot water supply of any kind beforehand (male, >60, March 2011). In spite of concern over the cost of power, there was little or no appreciation of available power saving measures such as compact fluorescent lamps (CFLs). At an energy efficiency workshop⁴⁶ in which I participated in March 2011, most participants expressed unfavourable opinions regarding CFLs: too expensive, poor quality light and the time delay before the lamp provided good light⁴⁷. In spite of concerns regarding price, according to a key

⁴⁶ The workshop took place on 24 March 2011 at the Government Building.

⁴⁷ My co-presenter and I both pointed out that new models of CFL available incorporated improvements that overcame the issues of poor light quality and time delays and that at current electricity prices, the cost of a CFL used in a living area will typically be recovered from electricity cost savings within four months.

informant who works in the electricity sector, the reality is that electricity is supplied at less than the cost of production even at the highest tariff⁴⁸ of 70 cents/kWh.

As I discussed earlier in this chapter, ownership of electrical appliances in Niue households is high and has resulted in people becoming heavily reliant on electricity for their day to day lives: for example, household diets have changed to include dairy products and meat, which together with the traditional fish, rely on refrigeration for safe storage. The extent of this reliance and the vulnerability that this creates was demonstrated when, as described in Chapter 1, in 2006, three of the four generators at the power station were destroyed and the power station building badly damaged (Empower Consultants, 2006, p. 1). Concerted action by both the Niue and New Zealand governments and a New Zealand company specialising in diesel generators limited the power outage to a week by setting up a temporary power house which is shown in Figure 18.

Figure 18 – Niue: Temporary Power House (following 2006 fire)



Source: Author

Hospital and telecommunication services were kept in operation as these institutions have standby generator plant for such an eventuality. Fortuitously, the now-closed fish factory was still in operation and the management made the factory's cold and cool rooms available for householders to store perishable

⁴⁸ A sliding tariff applies for households: the tariff is 50 c/kWh for the first 100 kWh per month, 60 c/kWh for 101 to 300 kWh/month and 70 c/kWh for 301 kWh/month and above. A flat rate of 70 c/kWh applies to commercial/industrial and government consumers (SPC, 2012a).

foods. The short-lived crisis demonstrated the vulnerability that Niue shares with developed communities in general owing to the heavy reliance on electricity. A longer power outage could have had serious consequences, particularly as water supply is heavily reliant on electric motor driven pumps. Even the week-long power outage would have caused serious problems with perishable foods had the fish factory's cold and cool rooms not been available.

With the assistance of overseas donors, measures are being taken to reduce the dependency on imported energy, particularly in respect to electricity generation. In 2007, the European Union (EU) (2007) as part of EDF⁴⁹ committed €3.5 million (\$4.72 million⁵⁰) to development programmes in Niue of which €2,550,000 (\$4 million⁵¹) was for renewable energy and energy efficiency projects with the objective of reducing diesel imports for generation by 20% (EU, 2007, p. 22).

Figure 19 – PV Array at the Niue Hospital



Source: Author

Energy efficiency programmes funded by the EU have included the subsidised supply of solar water heaters and gas (LPG) cookers, the latter being more energy efficient than electric cookers⁵². According to the EDF

⁴⁹ 9th European Development Fund

⁵⁰ Conversion from Euro to New Zealand dollars (NZD) are approximate and based on the average rate of exchange of NZD = €0.6355 from July 2012 to June 2013 inclusive (from <http://www.rbnz.govt.nz/statistics/tables/b1/> on 30/08/2013)

⁵¹ *ibid*

⁵² Discussions with the EU programme coordinator took place in September 2010 and March 2011.

coordinator based in Niue, by 2010, photovoltaic (PV) generation totalling 51 kWp output had been installed using the EDF9 and as part of EDF10⁵³, a further 75 kW has recently been installed (May 2014)(NPC, 2013). The 30 kWp PV array at the Hospital is shown in Figure 19 above. In addition to the EDF 9 and 10 projects, a 200 kWp PV generation plant, located adjacent to the NPC power station, was commissioned in early 2014 and is shown in Figure 20 below. This project was funded by the Japanese government as part of the Pacific Environment Community (PEC) fund⁵⁴ at a cost of around \$US4 million (\$4.86 million⁵⁵) (Pacific Islands Forum, 2012).

Figure 20 – 200 kWp PV Array at the Niue Power Station



Source: Warren Crawley

⁵³ 10th European Development Fund

⁵⁴ In May of 2009 Pacific Islands Forum Leaders met with the Government of Japan at the 5th Pacific Island Leaders Meeting (PALM 5) in Hokkaido, Japan. At the PALM 5 Summit, Leaders issued the “Islanders’ Hokkaido Declaration” which reaffirmed Leaders’ commitment to collaborate and cooperate on a wide range of issues (MOFA, 2009) . A significant part of the Declaration was the launch of the PEC Fund, under which Japan provided a ¥6.8billion (approximately US\$66 million) contribution to Forum Island Countries (FIC) to tackle environmental issues. Each FIC is provided with an indicative allocation of USD\$4million to support projects with a focus on the provision of solar power generation systems and sea water desalination plants or a combination of both.(MOFA, 2009).

⁵⁵Conversion from \$US to New Zealand dollars (NZD) are approximate and based on the average rate of exchange of NZD = USD0.8221 from July 2012 to June 2013 inclusive (from <http://www.rbnz.govt.nz/statistics/tables/b1/> on 30/08/2013)

The completion of the EDF10 and the Japanese-funded project has resulted in a total PV generation output in the order of 326 kW and according to the Niue Power Corporation, this is expected to meet about 14% of Niue's annual electricity consumption and save about 150,000 litres of diesel (NPC, 2013). In terms of total diesel imports, this represents a saving of about 12.5% based on a total of 1.2 million litres imported in 2009 (SPC, 2012a, p. 3).

The virtual total reliance on PV generation, which as noted by Dornan (2012) is a high-cost option, illustrates the problem confronting Niue due to the lack of alternatives to diesel generation. According to Dornan and Jotzo (2012), low-cost renewable energy sources such as hydro-generation, geothermal energy or abundant biomass are not available. Wind generation – also classed by Dornan as a high-cost option – has been considered but to date has not been implemented. A report on the Niue power generation system in 2006 noted that the European Union had offered to fund the installation of two 75 kW wind turbines (Empower Consultants, 2006, p. 2) but according to an informant involved in energy infrastructure planning, the Niue government were reluctant to accept this offer owing to concerns regarding the ability of wind turbines to withstand the very strong winds experienced during cyclones and also the high level of specialist maintenance required (male, >50, March 2010)⁵⁶. The reliance on PV generation as the sole source of renewable energy generation is also of concern as there is potential for technical problems in a grid-connected system as is the case in Niue. Electrical system instability can occur when the output of the PV system is subject to sudden change, such as clouds passing over the PV array. In a system where the output is small compared with the base generation – such as diesel generation – this is unlikely to be an issue. Analysis by Crawley indicated that following the commissioning of the 200 kW PEC project, system instability had become a distinct possibility (2014, p. 141). From discussions with an MFAT informant in late 2014, I understand that stability problems had occurred and that assistance had been offered by MFAT to help resolve these problems.

(b) Health services

Health services are delivered from a hospital built in 2006, replacing the Lord Liverpool hospital that was destroyed during Cyclone Heta early in 2004 (Tait, 2004). The hospital is located close to the airport and according to two appropriately qualified informants, provides in-patient, general practitioner (GP), dental services and maternity services (female, >40, March 2011; male, >50, March 2011/September 2010). There is a 24 hour emergency service including ambulance with a trained paramedic. Based on interviews and visits to the hospital during field visits, my impression was that health services are good albeit limited in scope. At the time of my last visit (March 2011), there were three GPs from various parts of the Pacific but in the past, GPs have included Filipinos, New Zealanders and Ukrainians. Of the three GPs, one was trained

⁵⁶ See also Crawley (2014, p. 72).

in surgery and one in anaesthetics which enabled the Hospital to carry out a range of procedures, assisted from time to time by visits by specialists from New Zealand which increases the range of treatment provided. For example in March/April 2010, a physician carried out diabetes and cardiac clinics, an orthopaedic surgeon operated on 128 people and an ophthalmologist conducted eye clinics (Government of Niue, 2010b). However, complex cases require patients to travel to New Zealand for treatment and I was told by one informant that her husband had just gone to New Zealand for six months for such treatment (female, >40, March 2010). Treatment in New Zealand is funded by the Niue government. Finding and retaining medical staff is a constant challenge and from time to time, services have to be suspended. For example, I was told that for much of 2010, expectant mothers had to travel to New Zealand to give birth owing to the lack of appropriately qualified staff. In spite of these problems however, my impression from visiting the Hospital was that the services provided would be the envy of many New Zealand rural communities. Treatment – including dental – is free to Niue residents and even for non-residents, charges for GP and dental treatment are much less than in New Zealand as I found from personal experience.

I did not ask informants specifically about their health status or experience with the health service but during conversation, a number of people expressed satisfaction with the health care generally. From discussions with hospital management and staff, it was clear that Niue is a healthy place to live with low incidence of infectious disease, low infant mortality and high take-up of immunisation, generally confirming World Health Organisation data (WHO, 2013a). In common with most South Pacific countries, the incidence of diabetes is increasing plus some cardio-vascular disease although I was told that the incidence is apparently lower than other Pacific islands. One (appropriately qualified) informant speculated that the water supply which is high in calcium and magnesium as well as being free of pathogens could contribute to the relatively low rate of heart problems and certainly contributes to the virtual absence of osteoporosis (female, >40, March 2011).

The hospital is heavily reliant on electricity to maintain services. Without electricity, there would be no lighting and refrigerators used to store medicines and vaccines would not operate. Surgery would cease except under dire circumstances as anaesthetic machines and patient ventilators rely on electricity. This reliance is recognised and the hospital is provided with a standby diesel generator to ensure that services can be maintained in the event of an interruption to the NPC supply. However, as with NPC's generators, the hospital generator still relies on imported diesel fuel.

(c) Education

Universal free education is provided from a primary school and a secondary school both located in Alofi (EU, 2007, p. 9) and a school bus service provides transport between the schools and the villages. There is also a "satellite" of the University of the South Pacific (USP) providing a transition course for students from the secondary school intending to attend the USP in Fiji. Scholarships are available for tertiary study in New

Zealand and at the USP (EU, 2007, p. 9). Most Niuean informants had attended primary school in Niue. In the case of secondary education, a number of informants had attended school in New Zealand possibly due to access beyond third form (year 9) being limited in the 1970s. The education system is based on the New Zealand system and extends through to Year 13 ("old" Form 7) using the NCEA and informants generally appeared satisfied with the service provided.

In respect to informants' own levels of education, I did not seek detailed information on this topic but often people volunteered information unprompted. Of 10 key informants (this excludes the three government officials), six had received secondary or tertiary education in New Zealand, three to degree level, and four had received tertiary education in the form of courses (vocational or otherwise) in New Zealand or Fiji and in one case at master's level at USP⁵⁷. I was told that USP courses have become increasingly popular as there is now a good range of courses offered and there are now a variety of scholarships available and unlike scholarships involving study in New Zealand, there is no requirement to return to work in Niue for a period after graduation (male, >50, March 2011). Data in the 2011 census shows that 27% of the population having tertiary qualifications⁵⁸ (Government of Niue, 2011, p. 43) and while this suggests that my informants may not represent a typical cross-section of the population in terms of educational achievement, it does support the clear impression I was given by informants that access to a good education is available to Niueans.

Unlike the health services provided from the hospital, the two schools could continue to operate without electricity to some degree. However, a modern education service relies on visual aids, computers and access to the internet, all of which require electricity.

(d) Water supply

There is a strong link between the electrification programme and water supply. At independence, the threat of drought remained serious although as described earlier in this chapter, a number of bores had been installed, two with diesel pumps, two with windmills and the remainder fitted with hand pumps. Since the completion of the electricity distribution system, 20 electrically driven pumps have been installed in bores strategically located around the island (SOPAC, 2007a, p. 31). Water is pumped from the bores to village water storage tanks (one of which can be seen in Figure 14) from where the water is piped to most if not all houses and is of good quality (SOPAC, 2007a, p. 43). As a consequence, people in Niue have access to an ample supply of underground water (SOPAC, 2007a, p. 16). Any concerns expressed by informants on the

⁵⁷ This informant told me that as well as his studies towards a master's degree, his wife completed a bachelor's degree at USP two or three years ago, two daughters both have degrees from New Zealand and USP and are both working in Niue, one other daughter is now studying at USP while his one son dropped out of university in New Zealand as he can make more money in IT in Sydney.

⁵⁸ These include trade certificates, under-graduate diplomas, graduate diplomas and post-graduate diplomas.

issue of water supply were only in the context of the impact of drought on bush gardens. A number of informants referred to the rainwater harvesting project promoted by the Global Climate Change Project and funded by GEF and the Australian Government (SPC, 2013). The project will provide each of the 477 households in Niue with a 5,000 litre rainwater storage tank with the objective of “ensuring a reliable supply of potable water during extreme events”. The attitude of the informants was cautiously favourable as the benefits of having a reserve of water should the pumped supply be disrupted and also to use for bush gardens during drought were clear. One informant employed in the health sector expressed concern, however, that the tank supply should not be seen as a replacement for the pumped supply because of the potential for the tank water to be contaminated and also the health benefits from drinking the high mineral content water from the underground supply would be lost (female, >40, March 2011). Another informant somewhat sceptically commented that he “will believe it when I see it” as he had heard similar projects proposed in the past which had come to nothing (male, >70, March 2011).

(e) Transport services

As with water supply, transport in Niue is virtually 100% reliant on imported energy in the form of petrol, diesel and kerosene. The major infrastructure development programme completed immediately prior to independence included a network of all-weather roads and now people rely heavily on their cars for transport to and from places of work, to the shopping centre, to bush gardens, to the Hospital if needed and to socialise. Most government and commercial activity is located around the centre of Alofi or the new Government Building located near the airport and only a small number of people live in easy walking distance of their place of work. As a consequence, Niue has a very high level of car ownership and with most of the key informants' households owning two or more cars. This is supported by the 2011 census which recorded a total of 927 vehicles which, based on a total number of households of 477, equates to just under two vehicles per household (Government of Niue, 2011, p. 101). Based on my observations, cars are mostly second-hand of Japanese manufacture, imported via New Zealand. The only public transport provided are the school buses that bring children to and from the two schools. Two rental car companies operate in Niue, a service mainly used by visitors. During visits to Niue over several years, I have only seen a small number of motorbikes or scooters and only a few bicycles and most of those were ridden by palagi.

As well as the road network, the infrastructure programme included the construction of an airport suitable for medium sized jet aircraft, such as the Airbus A320 currently used by Air New Zealand on the Niue service. The air service to New Zealand provides Niueans with the essential connectivity to the outside world by reducing the sense of isolation that prevailed when ships provided the only form of transport. This is demonstrated on “plane days” which are a major event in Niue. These are the days the flights from New Zealand arrive and depart and the airport parking area is full of cars bringing people to farewell or meet relatives or friends departing to or arriving from New Zealand. Flights have in the past few years has been

limited to one flight a week, arriving and departing on Friday. However, an additional mid-week flight departing from New Zealand was introduced each fortnight for the period May to September 2013 inclusive mainly aimed at the tourism market. When last visiting in Niue in March 2011, I noted that the airport terminal had been upgraded and was told that this was funded by New Zealand ODA as part of the tourism project discussed earlier in this chapter.

The monthly shipping service provided by Reef Shipping no longer caters for passengers but provides a vital cargo service enabling regular supplies of food, building materials and fuel. If the ship is delayed, then some goods can become scarce. At the time of my March 2011 visit, the ship had been delayed three weeks and I was told that sugar and flour supplies were becoming short⁵⁹.

Figure 21 – “Ship day” in Niue



Source: Author

Weather can be a factor in ship delays because the ship has to stand a few hundred metres out from the wharf at Alofi while containers are off-loaded into a barge which transports the container to the wharf where it is transferred from the barge to a truck. Watching this process on one occasion during a moderate swell gave me an appreciation of the hazards involved – Figure 21 above shows the ship unloading on a relative calm day.

⁵⁹ During one of my earlier visit to Niue, a crisis occurred that was regarded by the local people of even greater seriousness as the supply of beer had run out.

(f) Communication infrastructure

While air transport and shipping provide physical connectivity with the outside world, telecommunication services are also important in reducing the sense of isolation. The services include telephone, radio, television and the internet, all of which depend on connection via satellite for overseas reception and transmission. These services rely on electricity for operation at both the central point of supply in the form of the satellite receiving station and at people's homes. Based on my own experience, domestic and international telephone services are reasonable in terms of availability and reliability although international calls are expensive. I also understand that a mobile telephone network has been re-established following an absence of some years after the old analogue network broke down. All my key informants have access to the internet and email services through computers at their place of work or increasingly commonly, at home. Recently, internet services were established across the island including wireless "hubs" at the larger villages. Informants expressed little or no dissatisfaction with the above services although one person complained that the internet was slow and unreliable (male, >50, March 2011). I was told that a new fibre optic cable had recently been installed⁶⁰ around the island and this was expected to improve both speed and reliability. The Broadcasting Corporation of Niue operates the radio station and the television station in Niue and broadcasts local and overseas produced programmes. News broadcasts include local news and international news from Radio New Zealand International and TV One. With the good internet access, radio and television, Niueans have a remarkable level of connectivity with the outside world given the small population and remote location.

4.7 CHAPTER SUMMARY AND DISCUSSION

In a little over 150 years, Niue has been transformed from a traditional island society, mostly isolated from the outside world, to a modern society with many of the characteristics of a developed country. Undoubtedly, the transformation process was largely imposed from outside, initially by the LMS and then by the New Zealand government as the colonial authority. To some degree, this situation continues with the heavy reliance on ODA from New Zealand: for example, the funding of the current tourism project by New Zealand required the government of Niue to agree to a number of changes including reducing hours worked by government employees (Hall, 2009)⁶¹.

Until the 1830s, the Niue society remained isolated from the outside world with the exception of what appears to have been hostile incursions from other South Pacific islands. As a result of this isolation, it is likely that little or no significant change occurred in terms of livelihoods, these being largely dependent on natural and

⁶⁰ I have been since told that this may not be the case but have been unable to confirm either way.

⁶¹ Not surprisingly, this has caused some resentment in Niue, an example being the Premier of Niue saying to a TV One reporter that New Zealand is obliged under the Niue Constitution Act 1974 to provide financial assistance to Niue and (paraphrasing) it is up to Niue how the financial assistance is used without interference from New Zealand (TV One News, 27 October 2013).

human capital within strong social and quasi-political frameworks. Natural capital in the form of woodfuel met energy supply needs and use was limited mainly to the cooking of food. Energy supply therefore could be described as playing a small but essential part in people's livelihoods. In terms of sustainability, the success of the pre-historic – or pre-palagi – society has to be acknowledged, given that it lasted for an estimated 1,300 to 1,400 years and there is no reason to believe that this situation could not have continued. This sustainability can be attributed to a number of factors, the main of which was the availability of adequate natural capital on which people relied on as a key and essential livelihood resource, including woodfuel together with human capital in the form of traditional knowledge on how to use these resources. Social capital is also likely to have been strong, maintained by the strict hierarchal structures within the various extended families or *magafaoa*. Other factors would have included the ability of the early settlers to cope with and then adapt to the livelihood obstacles that Niue would have presented: drought, tropical storms and shallow soils particularly given the reliance on root vegetables such as taro as an important food source throughout the tropical South Pacific. While undoubtedly a sustainable society, it would be wrong however to assume that life in pre-historic Niue was tranquil with not only hostile invaders to deal with from time to time but also internal conflict between the *magafaoa*.

The arrival of the LMS missionaries from 1830 onwards marked the beginning of the first phase of transformation of Niue society. The contribution of energy supply to this transformation was in direct terms limited: woodfuel remained the main source of household energy with possibly some use of oil lamps, and from a day to day livelihoods aspect, there was little change from the traditional era. Steam shipping services made an appearance, albeit briefly, towards the end of the trader and missionary era. Indirectly the new energy technologies developed during "northern" industrialisation and discussed in Chapter 2 had an impact through the availability of manufactured goods ranging from metal pots and pans to clothing. This was just one symptom of the 19th century globalisation, when the markets and resources of the South Pacific – along with other mainly tropical countries – were incorporated into the global economy that had developed as a consequence of industrialisation in northern Europe and North America (Firth, 2000, p. 184). Given that energy supply and the associated energy technologies were a critical if not causative factor in "northern" industrialisation, there a strong indirect link between the globalisation that transformed Niue in the second half of the 19th century and energy supply.

In the case of Niue, while this globalisation resulted in a degree of commercialisation, the main "export" in the absence of significant exploitable natural or mineral resources was labour to work in plantations in Fiji, Samoa and Queensland. The income earned from working overseas brought benefits in the form of new foods and consumer goods but, together with the activities of traders and the LMS, also resulted in the exposure of Niue to the outside world bringing new diseases and disruption to traditional lifestyles. However,

many aspects of day to day life did not change a great deal from that of the traditional era with people relying mainly on bush gardens, fishing for food and woodfuel as the main source of household energy.

Until the 1950s, the colonial era was marked by little change in people's day to day lives. This included energy, with most people continuing to use woodfuel for cooking although from all accounts, kerosene lamps had become in common use by the 1950s. There were some motor vehicles including a number of trucks and a small number of cars used by the colonial officials, such as the Resident Commissioner, and by the Chief Missionary, but from all accounts most people had limited access to motorised transport. By the 1920s, there was at least one diesel generator providing electricity to the radio telegraphy station. Steam or motor ships provided a monthly passenger and cargo service which will have improved connectivity and reduced the sense of isolation, and also provided a reliable means to export bananas, copra and other crops. The shipping service will also have increased the flow of imports thereby contributing to increased consumption.

The killing of the New Zealand Resident Commissioner, C. H. W. Lawson, in 1953 and severe cyclones in 1959 and 1960 alerted the New Zealand government to their responsibilities for Niue and the welfare of its people. These events, probably encouraged by the anti-colonial sentiment of the time, led to the development programme that included improved health and education services and major upgrades to infrastructure, including energy supply. Until the 1950s, most households relied almost entirely on natural capital in the form of woodfuel for their energy needs. By independence in 1974, electrification was well underway, regular air services had been introduced and most villages connected by an all-weather road network. A consequence of the development programme of the 1960s and 1970s is the relatively high standard of living enjoyed in contemporary Niue where most households have a similar range of electrical appliances to those of a typical New Zealand household, a good quality water supply, a high level of car ownership, adequate health and education services and modern communication systems. This standard of living relies to a large degree on ODA, a situation that shows no sign of changing in spite of attempts by the New Zealand and Niue governments to create opportunities to increase self-sufficiency. How successful the tourism development project will be remains uncertain but while it may reduce the level of ODA required for Niue to remain a stable society, I have not met anyone who believes that it will eliminate Niue's dependence on ODA.

Significant contributors to the merchandise trade deficit are fuel imports that make up in the order of 29% of the value of imports. As discussed previously in this chapter, the relatively high standard of living relies on a reliable and affordable energy supply. This energy supply has on one hand enabled the achievement of the high standard of living but is a major contributor to the economic imbalance that confronts Niue. To some degree this is recognised by the Niue government and its international partners. As noted above, the PV generation projects funded by the EU and the Japanese government will reduce Niue's dependency on

imported fuels by about 15% but this still leaves a balance of 85% of the current level to be imported. This remaining high level of dependency creates vulnerability as the consequences of disruption would be severe, the extent of which will be addressed in Chapter 7. Of concern is that there appears to be an absence of a fully developed strategy to reduce this dependency on imported fuels. There is recognition, however, of the need for such a strategy and the Niue National Strategic Plan 2009 included the development of a "Strategic Energy Policy" by 2010 together with a renewable energy electricity generation target of 20% of total generation by 2013 (Government of Niue, 2009a, p. 18). The second of those goals has been achieved at least partially with the EU and Japanese funded PV generation projects.

To conclude, contemporary Niue has the physical and social infrastructure that enables the provision of the livelihood services that characterise a modern society and although the transformation process that has resulted in this situation commenced 180 years ago, the major changes have occurred over the past 40 years. The problem confronting Niue – and New Zealand, given the constitutional relationship that exists with Niue – is that Niue does not have the resources necessary for an economy to support the livelihood services needed for the lifestyle that is currently enjoyed and is therefore heavily reliant on ODA, a situation that is unlikely to change in the foreseeable future. Energy has contributed to the transformation process and as discussed in the chapter, is essential if livelihood services are to be maintained at the current levels. Unfortunately, energy in the form of imported fuels contributes to Niue's large trade imbalance and thereby the dependency on ODA. This reliance on imported energy will be examined in detail in Chapter 6 and in Chapter 7, the impact of a disruption to energy supply will be analysed.

As discussed in Chapter 1, Tuvalu is also reliant on imported fuels and Chapter 5 that follows reviews the transformation of Tuvalu from traditional to contemporary society with particular reference to the part that energy played in the transformation process.

CHAPTER 5: TRANSFORMATION OF A SMALL ISLAND SOCIETY FROM “PRE-PALAGI” TO MODERNITY: PART 2- TUVALU.

5.1 INTRODUCTION

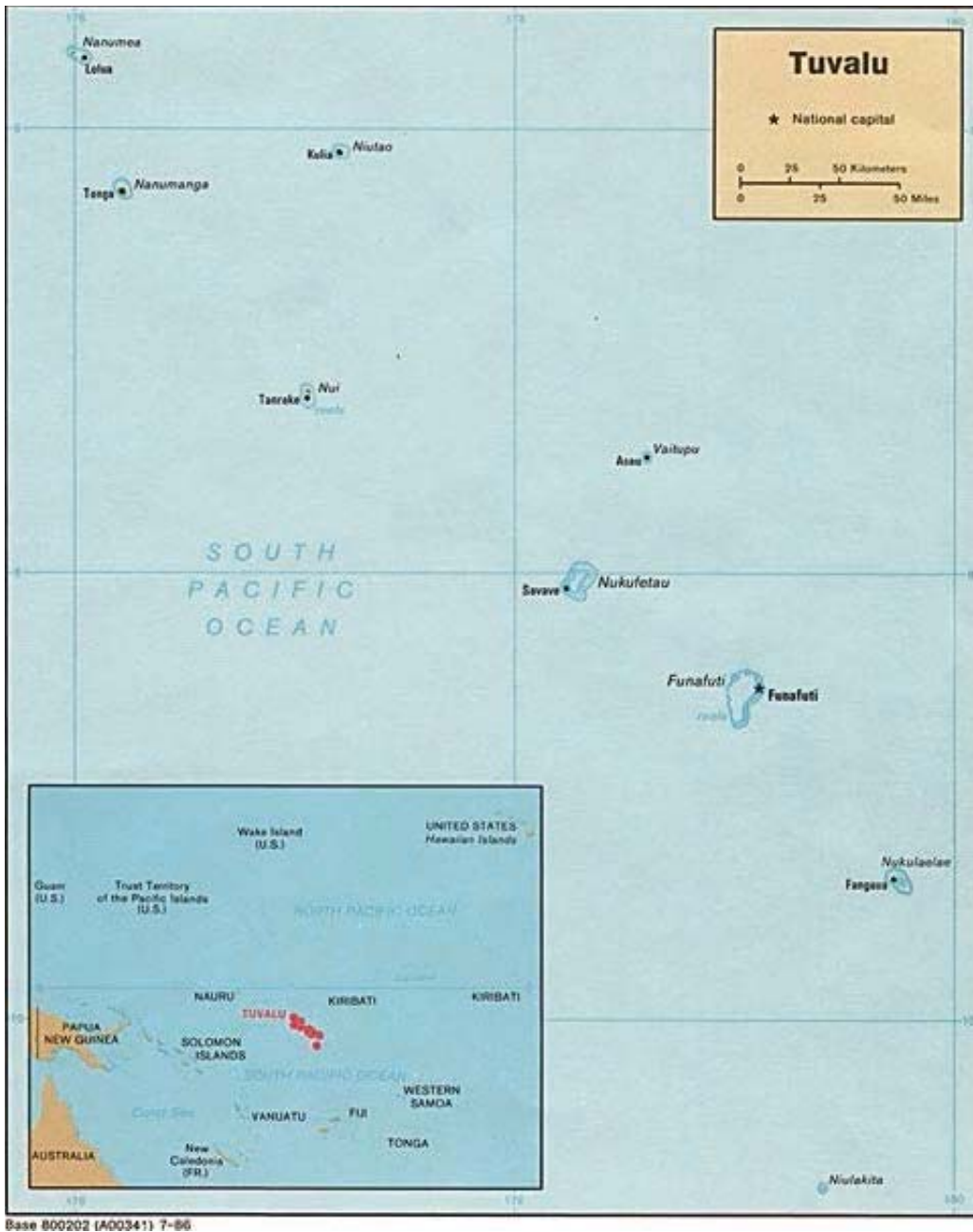
This chapter sets out as a narrative the transformation of Tuvalu from a self-sufficient traditional island community to a society with many of the characteristics of modernity and dependent on imported goods, notably energy. As for Niue in the previous chapter, the objective is to gain an understanding as firstly to why and how this occurred and secondly the extent to which energy supply influenced the process of transformation. This chapter is therefore Part 2 of the process commenced in Chapter 4 aimed at addressing the first research question.

Tuvalu has a relatively modest GDP per capita of \$A3,273 (2011) and is classified by the United Nations as a “least developed country” (LDC) (UNCTAD, 2013, p. 170; World Bank, 2012). While categorised as having an “upper middle income”, Tuvalu’s status as an LDC recognises “the almost total lack of exploitable resources, very limited potential for economic development and vulnerability to external economic and environmental shocks” (UNCTAD, 2013, p. 170). A brief country profile that outlines the current political and economic situation follows this introduction after which Tuvalu’s development from a traditional island society through to today’s society is reviewed with the objective of understanding how the current situation has evolved, what is planned to ensure that Tuvalu can continue as a cohesive and viable community and the part that energy supply has played and continues to play in this development. For the purposes of this discussion, Tuvalu’s history in terms of known human occupation closely matches that of Niue in the previous chapter and can conveniently be divided into four eras: traditional or pre-palagi society from circa 1400 to circa 1820; trader and missionary that includes the period when Tuvalu was effectively governed by the London Missionary Society from circa 1820 to 1892; colonial when Tuvalu was governed by Great Britain from 1892 to 1978 and contemporary from independence in 1978 to the present day. This chapter concludes with a summary and discussion that reviews each stage of transformation and examines the role of energy in the transformation process. Throughout this chapter, I use the contemporary names for Tuvalu and the other countries or islands that made up the Gilbert and Ellice Islands Colony: Tuvalu rather than the Ellice Islands, Kiribati rather than the Gilbert Islands and Banaba rather than Ocean Island.

A similar structure is adopted in this chapter to that used in Chapter 4. The review of each of the historical eras starts with an outline of the socio-political factors that were the primary societal influences and were the main drivers of transformation. The review is followed by a review of people’s day to day lives and the activities they pursued as a means of living. The focus then shifts to those factors or livelihood services that supported those livelihood activities, the general nature of these livelihood services having been discussed in Chapter 3.

For each era, the part that energy supply is specifically addressed, noting that this ranges from meeting basic day to day needs through to supporting the complex mix of activities that makes up contemporary livelihoods.

Figure 22 - Map of Tuvalu



Source: Isaka et al (2013b, p. 1)

As discussed in Chapter 3, the information on which this chapter is based was obtained from both secondary and primary sources. In the cases of the traditional society and trader and missionary eras, I rely totally on secondary sources ranging from histories based on legend through to contemporary accounts from European visitors during the mid and late 19th century. Similarly, much of the discussion on the colonial era is based on secondary sources including descriptions of life in Tuvalu in general literature such as MacDonald (1971, 1975), Keith and Anne Chambers (2001) and Laracy (1983) and official publications produced by the British Colonial Office (1961, 1968). One difficulty I encountered was that during the colonial era, Tuvalu was administered as part of the Gilbert and Ellice Islands Protectorate or Colony and for this reason, statistical and economic data for Tuvalu as a separate entity is not always available, particularly given that Tuvalu was very much the minor party in terms of population when compared with Kiribati. As was the case with Niue, the information from secondary sources was supplemented through conversations during field visits with a number of informants who could recall life in Tuvalu in the late stages of the colonial era. Most of these informants spent their childhood on the Outer Islands and were able to provide a picture of the way of life in what was and, to a large degree, remains, a rural livelihood based on subsistence agriculture and fishing.

The discussion on the contemporary era relies equally on both primary and secondary sources. As noted in Chapter 3, primary sources comprised 20 informants, 14 of which are categorised as “key informants” and were interviewed in the semi-structured format. All but one interview took place in Tuvalu, the exception being an interview that took place in New Zealand. The ages of key informants were more widely spread than was the case with Niue with 50% aged below 40. While I had no intention to deliberately “recruit” younger informants, as can be seen from Table 3.4, the informant age profile corresponds to the general age profile of the population of Tuvalu to some degree. Most key informants had management or technical roles.

As with Niue, when referring to informants, I avoid detailed descriptions because except where the informant was interviewed in his or her official capacity, all interviews were conducted on the basis of strict anonymity and in a small community such as Funafuti, care has to be taken not to include information that could lead to identification of an informant. However, to provide some context, where appropriate, I identify the sex of the informant, the approximate age and the date of the interview or conversation – for example, a male informant of 45 interviewed during March 2013 is identified as follows “(male, > 40, March 2013)”.

5.2 POLITICAL AND ECONOMIC PROFILE

Tuvalu is a parliamentary democracy with the head of state being Queen Elizabeth II. The national legislature is a 15 member unicameral parliament, or Fale i Fono with representatives appointed from eight of the nine islands the exception being the smallest island of Niulakita. From 1892 to 1978, Tuvalu was

governed by Great Britain and known as the Ellice Islands (Government of Tuvalu, 2012a). For most of this period, the Ellice Islands and the neighbouring Gilbert Islands – now Kiribati – were administered by Britain as a single unit (Isala, 1983, p. 153). Following extended negotiations with the British Government, who initially wanted the Gilbert and Ellice Islands to remain a single political unit, Tuvalu finally became an independent nation on 1 October 1978 (Isala, 1983, p. 176). The capital is the atoll of Funafuti, the main island of which is Fogafale.

According to the World Bank (2012), the gross domestic product (GDP) was \$US35.78 million in 2011 and, based on the 2012 population of 10,590 and an exchange rate of \$US1.03 to \$A1.00⁶², this equates to a GDP per capita of \$A3,273⁶³ (Tuvalu Central Statistics Department, 2013). Tuvalu has a large merchandise trade deficit - imports in 2007 were to be just under \$ A18.4 million while exports amounted to just over \$A109,000. Over the previous five years imports had ranged between \$A20 million and \$A6 million while exports had ranged from \$A17,000 to \$A250,000 (Tuvalu Central Statistics Department, 2008). Of the \$A18.4 million imports in 2007, fuel imports cost just over \$A2,959,000 or 16% of total imports (Tuvalu Central Statistics Department, 2008, p. 13)

The Government of Tuvalu is vocal in its concern over the impact of climate change, a valid concern given that across all nine islands of Tuvalu, the highest point above sea level is less than five metres (Government of Tuvalu, 2012b, p. 1; 2011a, p. 11; PCCSP, 2011, p. 4). In his statement to the United Nations General Assembly in September 2000 on the Admission of Tuvalu to the United Nations, the late Prime Minister of Tuvalu, the Honourable Ionatana Ionatana, expressed these concerns with particular reference to rising sea levels,

Tuvalu has an almost total lack of exploitable resources and is generally regarded as having very little potential for economic development (Tisdell & Fairbairn, 1983, p. 25). There is little private sector activity in the economy with over two-thirds of employment being in the government sector (MFAT, 2014c). Given this lack of exploitable resources, Tuvalu is reliant on other sources of income to counter the large trade imbalance and these include remittances from Tuvaluans working overseas as seafarers (mainly in German ships) that totalled over \$US2 million in 2007, and ODA from a range of countries and agencies including New Zealand, Australia, Japan, Taiwan, the European Union and the World Bank (MFAT, 2014c). Other sources are earnings from the Tuvalu Trust Fund, set up by Australia, New Zealand and the United Kingdom in 1987, revenue from the sale of the internet domain name “.tv” and fishing licence fees mainly from Taiwan and Japan (MFAT, 2014c). Lack of employment opportunities in the Outer Islands coupled with limited

⁶² Average for 2011 from Reserve Bank of New Zealand Statistics <http://www.rbnz.govt.nz/statistics/exandint/b1/download.html>

⁶³ Except where otherwise stated, I use Australian dollars (\$) in this chapter for the reason that this is the official currency of Tuvalu.

infrastructure and poor transport links has resulted in continuing migration to Funafuti and depopulation of the Outer Islands (Tuvalu Central Statistics Department, 2013, p. 6). In summary, Tuvalu can be described as possessing the elements of a “MIRAB” economy in that it is dependent on migration (Mi), aid (A) in the form of ODA from a number of countries, remittances (R), mainly from seafarers, and bureaucracy (B) with two-thirds of the population working for the government. (Bertram & Watters, 1985, p. 497)

5.3 THE PRE-PALAGI ERA CIRCA 1400 TO 1820

The definition of the pre-palagi society era is less clear cut than was the case with Niue. The permanent habitation of the nine islands is thought to have taken place over a period from the 14th to 17th centuries while contact with New England whalers in the late 18th century and with traders from the mid-19th century meant that Tuvaluans were exposed to outside influences for an extended period before the London Missionary Society commenced an organised process of conversion to Christianity. Compared with Niue, the history is somewhat more complex, where the transformation from an isolated traditional society to a society governed by the LMS took place over about 30 years. The complexity is due in part to Tuvalu being made up of nine islands, but in terms of day to day life, however, the structure of society was similar across all nine islands as was the way of life (Laracy, 1983; Roberts, 1958). This is not surprising given that the early settlers came from traditional Polynesian island societies and that the way of life was governed by an island environment which was common to the tropical South Pacific.

In spite of a number of visits by Europeans, the earliest recorded being that of the Spanish explorer Francisco Antonia Maurelle who visited Nanumea in 1781, first-hand accounts of life in traditional Tuvalu are limited. An account of visits to Funafuti and Nukufetau in 1841 by Charles Wilkes in Laracy (1983, p. 190) is not that informative in respect to day to day life and although there are reports of visits by whalers, there appear to be no written accounts of these visits (Laracy, 1983, p. 190; Roberts, 1958, p. 394). The description of traditional society relies to a large degree on description of life in early Tuvalu in “Tuvalu: a History” (Laracy, 1983). However, a visit by Caroline Martha David in 1897 provides some useful guides in respect to the traditional lifestyle even though by that time, some aspects of traditional life would have been changed through the influence of the missionaries (David, 1913).

Based on legends and the language spoken by most Tuvaluans, it is considered most likely that the first inhabitants of Tuvalu came from Samoa and Tonga as part of a “western backwash” over a period from the 14th to 17th centuries during which people migrated from the central parts of Polynesia in westerly direction which was opposite to the easterly flow of migration that had occurred in earlier times (Macdonald, 1982, p. 3). However, it was suggested by T. O’Brian (1983, p. 16) that linguistic studies indicated much earlier settlement dating back some 2,000 years; this earlier date was supported by Chambers and Chambers based on carbon dating of material excavated in Vaitupu in 1984 (2001, p. 61). Each island has its own

legends which indicate original settlement by people from Samoa or Tonga, either directly or via one of the other islands, the exception being the small island of Niulakita which was only spasmodically settled until 1950 when settled by people from Niutao (T. O'Brien, 1983, p. 15). The first settlers will have found a much harsher environment than those existing in Samoa and Tonga – poor and shallow soils, shortage of fresh water and vulnerability to drought – and adapted livelihoods and customs to suit (Bedford et al., 1980, p. 206; Koch, 1961, p. 11; Roberts, 1958, p. 394; Tisdell & Fairbairn, 1983, p. 7; Turbott, 1949, p. 36). These included the use of strict population control measures that kept family size generally to two children (Bedford et al., 1980, p. 207; Macdonald, 1982, p. 59). As a consequence, it is believed that the population of Tuvalu before 1900 was never more than 3,000 (Tafaaki, 1983, p. 26). This meant that the natural capital on which people relied on was not over-utilised. It was estimated that the early 19th century population was distributed through the islands as shown in Table 8 below.

Table 8: Tuvalu – Estimated Population by Island over the 19th Century

Island	Early 19 th century	1892
Niutao	450	615
Nanumea	650	690
Funafuti	280	231
Nukufetau	250	270
Nanumanga	335	373
Nui	250	387
Nukulaelae	300	95
Vaitupu	400	456
Niulakita	0	0
	2915	3117

Sources: Newton (1967, p. 203) and Bedford et al (1980, p. 204).

The leaders in the traditional Tuvaluan society were the chiefs or aliki, an inherited role which brought with it substantial power and responsibility (Tafaaki, 1983, p. 19). Typically, an aliki would be the leader of a community or clan of about 100 people which would include a number of families or sologa, each led by an elder (te sina o Fenua) (Tafaaki, 1983, p. 20). With island populations ranging from about 300 to 600 people, this suggests that there was between three and six clans on an island. Each family would have a specialised role within the clan such as house or canoe building, farming, fishing or warfare for defence (Tafaaki, 1983, p. 22). Spiritually, each island had its own one or more principal deities and a number of lesser deities (Kofe,

1983a, p. 29). Deities were mostly ancestors and generally, the original settlers of the island (Kofe, 1983a, p. 30). The deities were represented by the vaka-atua or priests who were members of particular families and exercised great power over people, including the aliki (Kofe, 1983a, p. 33).

As was the case in Niue, there were outbreaks of warfare between island clans over land and between the islands of Tuvalu. There were also incursions by warriors from other island groups from time to time (Koch, 1961, p. 193; Samuelu, 1983, p. 36). While it appears that these incursions were generally repelled, warriors from Kiribati conquered the island of Nui and as a consequence, the dialect spoken in Nui has links with the language spoken in Kiribati (Pape, 1983, p. 72; Roberts, 1958, p. 404).

Traditional society in Tuvalu relied on natural capital for food and shelter. The diet was mainly fish, coconut and pulaka, a tuberous root similar to taro, the pulaka being the staple and grown in pits (Koch, 1961, p. 73). The pulaka pits had – and apparently still have – particular value over and above other land, as the ability to grow large amounts of pulaka bestowed status on the grower (Samuelu, 1983, p. 36). Gathered food sources included the fruit of the pandanus and the felo tree, land crabs and wild birds (Koch, 1961, p. 13). Gathering and cultivating food would have been hard work, given the poor quality of the soils which necessitated the creation of the pulaka pits (Bedford et al., 1980, p. 206). Coconut water was the favoured drink supplemented with palm toddy, sap drawn from the coconut palm (Koch, 1961, p. 74; Turbott, 1949, p. 36). Protein was mainly in the form of fish as a staple and occasionally turtle meat which was highly valued (Roberts, 1958, p. 411). Koch (1961, p. 19) described in detail the wide range of fishing equipment and canoes used throughout the islands of Tuvalu. While the main role of canoes was for fishing, large sailing canoes were used in warfare between the islands and possibly for voyages to Samoa and other distant islands (Koch, 1961, p. 143). Clothing was matting made from various plant materials such as pandanus leaf (Laracy, 1983, p. 191). According to David (1913, p. 7), a typical traditional house was built using a timber pole frame clad with plaited palm-leaves and with pandanus. Traditional healers had an important and prestigious place in society, a situation that continues to the present day, particularly in the Outer Islands. Traditional medicine was a family-based skill, with knowledge being handed down from generation to generation (Tafaaki, 1983, p. 24).

Biomass in the form of woodfuel (coconut shell or wood) was the main source of energy and was used for cooking and possibly to provide some form of lighting. Food was cooked in a shallow umu or earth oven very similar to the Niuean umu and by using half coconut shells suspended over an open wood fire (Koch, 1961, pp. 68,70).

Although normally experiencing a regular and adequate rainfall, people in Tuvalu were (and still are) vulnerable to drought; for example, Nia (1983, p. 65) refers to a spell used in Niutao to generate rain during

a long drought. It is possible that the frequency and impact of drought may not have been as severe as Niue, for the reason that instead of draining through the porous rock and flowing out to sea as in Niue, water can collect in wells on top of the coralline base of the islands (Koch, 1961, p. 74).

In summary, therefore, the pre-palagi era in Tuvalu can be described as an example of a sustainable lifestyle in a relatively challenging environment. By the late 18th century, there were signs that this situation was going to change with awareness of the existence by Europeans of this group of islands dating back to sightings in 1567 and 1595 by the Spanish explorer Mendaña (Kofe, 1983b, p. 102). As noted earlier, Maurelle visited Nanumea in 1781 and contact with New England whalers occurred on a limited scale from late in the 18th century. These whalers were active in the South Pacific mainly as a consequence of the American War of Independence having reduced access to other whaling areas (Thurn, 1915, p. 311). As trade increased across the Pacific in the early 19th century, regular sightings of Tuvalu by Europeans occurred. In 1819, de Peyster on a voyage from Valparaiso to Calcutta, after being nearly wrecked on Funafuti, named the island group Ellice's Group, after Edward Ellice, an English member of parliament whose cargo he was carrying (Roberts, 1958, p. 394).

5.4 PALAGI AND PASTORS⁶⁴ – THE TRADER AND MISSIONARY ERA: 1820 TO 1901

From the 1820s onwards, traders were regularly visiting the islands of Tuvalu, introducing the islanders to the concept of trading products such as copra and handicrafts for manufactured goods (Tafaaki, 1983, p. 22). By the mid-1860s, most of the islands of Tuvalu had had a resident trader and not only did the traders introduce the islanders to Western goods but a number of them introduced the islanders to Christianity (Munro, 1987, p. 78). The introduction to Christianity appears to have been on a relatively informal basis and it was not until 1861 when Tuvalu came to the attention of the LMS that wholesale conversion to Christianity commenced, a process that had a considerable impact on the way of life. The commencement of the process of conversion to Christianity was accidental: a deacon from the Cook Islands, Elekana, was shipwrecked on Nukulaelae in 1861 and instructed the islanders on the Christian God, after which he travelled to Funafuti and repeated the exercise⁶⁵(Kofe, 1983b, p. 110). After four months, he travelled to Samoa to attend theological collage during which period he reported to the LMS on the need for missionaries in Tuvalu. As a result, the Reverend A. W. Murray took a team of Samoan teachers, including Elekana, to Tuvalu in 1865 (Kofe, 1983b, p. 110). This signalled the start of a new era for Tuvalu with profound impacts across the way of life.

⁶⁴ With acknowledgements to Kofe (1983b).

⁶⁵ I note that Chambers and Chambers (2001, p. 71) refer to the shipwreck story as apocryphal but do not suggest an alternative?

From the accounts of the activities of the LMS missionaries given in Kofe (1983b) it appears that as the islanders had already been introduced to Christianity by traders, they were happy to welcome the LMS and asked for teachers to instruct them more about Christianity. There were exceptions and reportedly, the people of Niutao, Nanumea and Nanumaga were unenthusiastic and it took some effort on the part of the LMS before all three islands joined the rest of Tuvalu in the acceptance of Christianity (Kofe, 1983b, p. 113). In the case of Nanumea, following the expulsion of the Reverend A. W. Murray from the island in 1872, the Royal Navy was prevailed on to help persuade Nanumeans to accept the LMS and HMS Moresby sailed to Nanumea where a cannon was fired but fortunately into the bush rather than the village, following which a Samoan pastor was allowed to land and commence conversion (K. Chambers & Chambers, 2001, p. 71). This early missionary work had a strong Samoan input with the teachers or pastors bringing a “modified Fa’a Samoa” (Macdonald, 1982, p. 41). Tuvalu was counted as a district of the Samoan Church with control left to Samoan pastors with an annual supervisory visit by a palagi missionary from Samoa. In the 1870s and 1880s this influence of the LMS had spread into the control of day to day life through local island governments to the extent that by 1890, the LMS had grown into a “virtually unchallenged power” throughout Tuvalu (Macdonald, 1982, p. 49). The power held by traditional chiefs, the aliki, had been greatly weakened by this stage and replaced by laws drawn up by the pastors (Macdonald, 1971, p. 12; Samuelu, 1983, p. 129). Furthermore, the church leader on an island assumed the status and powers of aliki for that island (Duckworth, 2002, p. 3). The islands were administered by local councils or faipule set up by the pastors and comprised deacons – local people appointed by the pastors – and leading members of the local church. The faipule, under the guidance of the pastors introduced and enforced laws that were primarily aimed at maintaining morality and respect for the missionaries (Hassall, Kaitani, Tipu, & Wainikesa, 2011, p. 66; Macdonald, 1971, p. 22). The laws enforced modest dress codes, Sabbath observance and monogamy and traditional birth control measures were proscribed (Kofe, 1983b, p. 112). Land disputes were resolved by the pastors acting as mediators and advisers (Samuelu, 1983, p. 36).

Otherwise, it is likely that in respect to day to day life, many aspects of traditional society remained unchanged. No doubt the LMS pastors were diligent in their pastoral activities but there is no evidence from the literature of an equivalent to George Lawes who, as described in Chapter 4, had such a dominant and influential role during the parallel missionary era in Niue. The pastors introduced basic education in the Samoan language, mainly to assist people with their religious studies (Macdonald, 1971, p. 12). From the accounts in David (1913), it appears that the LMS did not attempt to provide any form of health service similar to that provided by Lawes in Niue. David (1913, p. 18) lists a range of unpleasant ailments that she encountered during her three month stay in Funafuti, many of which were spread due to a lack of basic hygiene. Diseases such as influenza and dysentery were introduced from the early days of contact with Europeans and changes in lifestyle – for example, people living in insanitary conditions in cluttered villages

rather than the more open traditional style – resulted in increased morbidity and from early in the 19th century, to outbreaks of tuberculosis (Bedford et al., 1980, p. 210).

The contacts with North American whalers from late in the 18th century and with traders from the 1820s onwards meant both awareness of the outside world and the beginning of commerce with fish and coconuts being traded for iron tools and utensils and pigs and poultry (Macdonald, 1982, p. 24). Pig and chicken were added to the diet but fish remained the main source of protein with coconut, taro, pulaka, breadfruit, pandanus and banana being the main plant foods (David, 1913, p. 96). As also happened in Niue, Tuvalu had become part of the globalisation process and in the 1850s trade in coconut oil commenced, initially by itinerant ship captains later followed by Australian trading companies who used resident palagi traders whose role was to barter goods (such as metal fish hooks, knives and bottles) for coconut oil (Munro, 1987, p. 76; Roberts, 1958, p. 395). This also meant exposure to labour recruiters but from all accounts, recruitment was limited probably due to opposition from the missionaries and possibly also due to the small population spread over eight⁶⁶ islands meaning that Tuvalu was not an attractive proposition to the recruiters (Bedford et al., 1980, p. 214). As a consequence, the number of Tuvaluans working overseas between 1850 and 1900 was relatively small at about 500, the destinations mainly Fiji, Hawaii, Samoa and Australia (Bedford et al., 1980, p. 213). The success of the recruiters may also have been adversely affected by the activities of Peruvian slavers who abducted 420 people in 1863 from Nukulaelae and Funafuti and took them to work in guano mines in Peru (Kofe, 1983b, p. 107). The impact of the raids were devastating reducing the populations of Nukulaelae and Funafuti by 80% and 60% respectively and it was many years before the population recovered to re-raid levels (Bedford et al., 1980, p. 214). Such events and general concerns about the dubious activities of labour recruiters and traders resulted in four Royal Navy ships visiting Kiribati and Tuvalu to maintain the peace and to provide some protection to the islanders (Macdonald, 1971, p. 16).

From a day to day energy use perspective, not a great deal of change took place during the era as far as the general population was concerned. Woodfuel using the umu in either closed or open form was the main source of cooking fuel and from a description in David (1913, p. 86), even in the early days of the colonial era, metal pots or pans were not used with food mostly baked or roasted with coconut shells used for boiling. Kerosene lamps were used by the pastors and some better off households for lighting while others used crude coconut oil lamps made from a half coconut shell and a cloth wick (David, 1913, p. 27).

As can be seen from Table 9 above, the population increased from an estimated 2,915 early in the 19th century to 3,117 in 1892 just after the end of the Trader and Missionary era. It is probable that the population

⁶⁶ This excludes Niulakita which is understood not to have been populated during this era – refer Table 9.

increase would have been higher but for the impact of the raids in 1863 by Peruvian slavers on the populations of Funafuti and Nukulaelae which was still apparent nearly 30 years after the event.

Undoubtedly, the rule of the missionaries resulted in profound changes to many aspects of life in Tuvalu, the impacts of which continue to the present day. However, the period of direct rule was short. By 1886, the Australian and New Zealand governments became increasingly concerned at the loss of British influence in the Pacific. European and North American industrialisation resulted in increased trans-Pacific trade and a perceived need by the main trading nations – Britain, France, United States and Germany – to protect their various interests (Samuelu, 1983, p. 127). The Australian and New Zealand governments saw a threat from both Germany and the United States and put pressure on the British Colonial Office to take some action. This led to Britain and Germany agreeing on respective “spheres of influence” in the Pacific, mainly to counter increasing incursions from United States interests (Macdonald, 1982, p. 66). Following further pressure from the Australians, in 1892 – and with some reluctance – the Colonial Office declared the Gilbert Islands a protectorate followed by the Ellice Islands later in the same year (Macdonald, 1982, p. 70).

5.5 THE COLONIAL ERA: NEGLECT, WAR AND TRANSFORMATION - 1892 TO 1974

Britain was a reluctant coloniser and having taken possession, was probably uncertain about what to do with the Gilbert and Ellice Islands, two remote groups of islands with very little in the way of exploitable resources. To some degree, this could explain the lack of social and economic development during the period 1892 to 1941. The significance of 1941 is that following the occupation of Kiribati by the Japanese, Tuvalu found itself on the front line in the Pacific War. From late 1942 until 1945, Funafuti, Nukufetau and Nanumea were occupied by the American army and while of short duration, the environmental impact remains to the present day. Following the Second World War, there was growing recognition by Britain by 1945 that the colonial policies – or perhaps in the case of the Gilbert and Ellice Islands Colony a lack of policy – up until then had not worked and a change of direction was required (Macdonald, 1971, p. 104). The result was an increased effort towards social and economic development in preparation for eventual independence.

5.5.1 A “Neglected Backwater” – 1892 to 1941

At the beginning of the colonial era, Tuvalu was administered by a Resident Commissioner in Kiribati who was responsible to the High Commissioner for the Western Pacific based in Fiji who in turn reported to the Colonial Office in London (British Library, 2012; Thurn, 1915, p. 318). While notionally separate, the Gilbert and Ellice Islands were administered as a single unit, the Gilbert and Ellice Islands Protectorate, a situation that was formalised in 1916 when the Gilbert and Ellice Islands Colony (referred to below as “the Colony”) was formed (British Library, 2012; Macdonald, 1975, pp. 1, 26). The headquarters for the Resident Commissioner was initially in Kiribati but in 1907, was moved to Banaba, some 240 miles (380 kilometres)

from Kiribati, the move being a result of the discovery of extensive quantities of phosphate ores on the island and the perceived need by the British government to supervise the activities of the phosphate industry on the island including the setting up of funds for the ultimate resettlement of the Banabans (Macdonald, 1971, pp. 54, 59, 70). The move of the Resident Commissioner to Banaba resulted in considerable difficulties in communications between the headquarters and the other islands in the colony – which also included Tokelau⁶⁷, the Line Islands and the Phoenix Islands at that time – the outcome being Kiribati and Tuvalu remaining “a neglected backwater of the (British) Empire” until the Second World War (Macdonald, 1971, p. 54).

The Order in Council establishing the Colony in 1916 conferred upon the High Commissioner responsibility for the administration of justice, the raising of revenue, and generally keeping the peace, order and good government of the Colony, this power being exercised by the Resident Commissioner (British Library, 2012). The Order also stipulated that native laws and customs should be respected where possible (British Library, 2012). The Protectorate and later the Colony were divided into Districts, the number of which varied over time according to perceived administrative need, and each District was under the jurisdiction of a District Officer. In 1909, the position of District Officer responsible for the administration of the Ellice Islands District was established and based in Funafuti (Teo, 1983, p. 132).

Initially, the colonial authorities largely retained the laws drawn up by the LMS translated from Samoan into English and enacted as the Native Laws of the Ellice Islands Protectorate 1894 (Hassall et al., 2011, p. 67). The maintenance of law and order on each island was the responsibility of the High Chief or *tapu*, assisted by councillors or *kaupule*⁶⁸, a number of police, a magistrate and a scribe (Teo, 1983, p. 130). The power of the church through the pastors remained dominant and in 1917 after the status changed from a protectorate to a colony, a revised set of laws were promulgated by the Resident Commissioner (Teo, 1983, p. 131). These laws abolished the office of *tapu* and reduced the numbers of *kaupule* and police while increasing oversight by the Resident Commissioner and the District Officer with the overall intention being to reduce the power of the LMS (Hassall et al., 2011, p. 68).

The revised Native Laws of 1917 theoretically provided for increased autonomy at island level but the office of the Resident Commissioner retained the right to prepare and enforce whatever regulations they saw fit, resulting in “authoritarian and paternalistic administrative policies” (Hassall et al., 2011, p. 70). In spite of the intention to reduce the power of the LMS, with the Resident Commissioner being based in Tarawa and

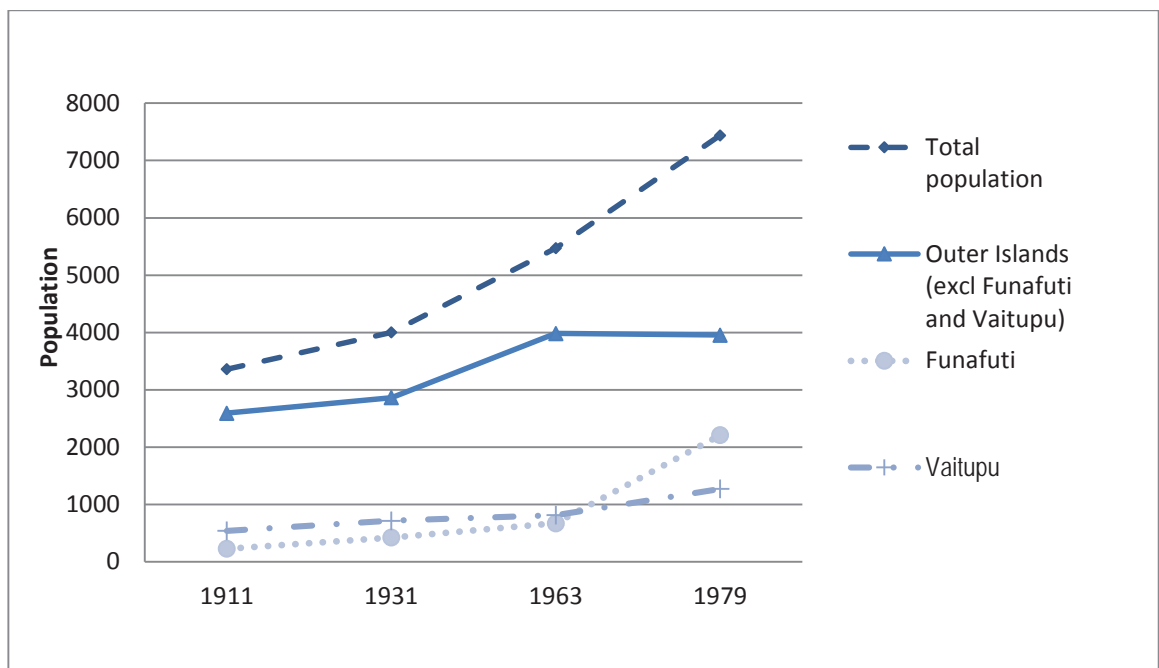
⁶⁷ Tokelau was placed under the jurisdiction of New Zealand in 1925 (Colonial Office, 1961, p. 81). Tokelau remains a “non-self-governing” territory administered by New Zealand (MFAT, 2014b).

⁶⁸ This appears to have evolved from the original Samoan “*faipule*”.

later Banaba, visits by colonial officials to Tuvalu were infrequent and the LMS pastors continued to have considerable influence (Hassall et al., 2011, p. 70).

The Native Laws Ordinance of 1917 established Native Governments with responsibility for implementing Native Laws and Regulations through Native Councils put in place on each island. The Native Governments became responsible for many aspects of day to day life including, over time, justice (magistrates and police), taxes, health, housing, communication, public works and the postal service including the wireless systems (British Library, 2012). A Native Land Commission was established in 1919 to administer land ownership and disputes (British Library, 2012). The laws remained largely based on those drawn up by the missionaries and while the dominance of the church may have been reduced, the influence remained strong including sanctions in law against immoral behaviour (Duckworth, 2002, p. 3; Teo, 1983, p. 130). As shown in Figure 23, there was a steady increase in population of the period 1911 to 1979.

Figure 23 - Tuvalu: Estimated Population by Island 1911 to 1979



Sources: Veltman (1980) and Laracy (1983)

Some efforts were made by the colonial authorities early in the era to provide some basic health and education services. Outbreaks of tuberculosis, yaws and filariasis led to the appointment of a medical officer in Funafuti in 1904 (Macdonald, 1971, p. 74). Up until then, some medical services were provided by the LMS but these appear to have been limited based on the accounts of Caroline Martha David (1913) of her

experiences in Funafuti in 1897 where much of her time was taken in providing basic medical care. In 1913, a hospital was established in Funafuti, mainly in the charge of "Native Medical Practitioners" who were trained at the Fiji School of Medicine (Teo, 1983, p. 134).

Education initially remained the preserve of the LMS whose priority was religious-based education (Macdonald, 1971, p. 135; Teo, 1983). In 1922, a school was opened in Kiribati to provide the people of the Gilbert and Ellice Islands Colony with basic education sufficient to enable entry into the government service (Macdonald, 1971, p. 75; Teo, 1983, p. 135). Following representations from Tuvalu parents and the raising of £2,625, a school was established in Funafuti in 1923 but was soon moved to Vaitupu due a lack of food on Funafuti to sustain the school (Macdonald, 1971, p. 76; Teo, 1983, p. 136). The school was directed by a New Zealander, D. G. Kennedy, who took an enlightened approach to education which unfortunately alarmed the Resident Commissioner, Arthur Grimble, who in 1931 expressed the view that providing young boys with an education beyond that necessary for village life "threatens to produce a class of youths both economically useless and socially dangerous...." (Macdonald, 1971, p. 78; Teo, 1983, p. 137).

Life until the Second World War continued much as it had done before the colonial era with "little development" in either of the island groups that made up the Colony (Macdonald, 1975, p. 2). The lifestyle was largely subsistence – cultivating pulaka, pawpaw and bananas, fishing and pig raising (Colonial Office, 1968, p. 31). Following the discovery of high grade phosphate rock on Banaba in 1903, mining commenced and Banaba was annexed by Britain and became part of the Gilbert and Ellice Islands Protectorate (Faanui, 1983, p. 122). From the beginning of mining operations, Tuvaluans were recruited to work in Banaba and later in Nauru (Faanui, 1983, p. 122). From the accounts in Faanui (1983), while providing income for household material needs and contributions to the Ekalesia, the life working in the mines was hard and unpleasant. Providing labour for the phosphate industry on Banaba was the main source of income for Tuvaluans other than copra production and remained important until 1979 when mining ceased (Faanui, 1983, p. 123). The income enabled some purchase of consumer goods and funded the construction of island water cisterns and churches as well the activities of the LMS (Faanui, 1983, p. 123; Koch, 1961, p. 12). The numbers of people working on Banaba varied considerably over the period: initially, the colonial authorities restricted recruitment owing to concerns about population depletion on some islands and also the willingness of people to work on Banaba depended on the price of copra – the higher the price, the greater the reluctance (Shlomowitz & Munro, 1992, p. 110). While exports of phosphates from Banaba provided some income for the Colony as a whole and certainly to Tuvaluans in the form of income from employment on Banaba, the contribution to the Colony was less than the expenditure by the Colonial government and Macdonald (1971, p. 102) was of the view that the phosphate was exported to the three main beneficiaries, Australia, New Zealand and Britain at well below the true value.

One step forward was the establishment of the cooperative society or fusi in Vaitupu in 1926 by Kennedy whose influence went beyond the education sector. The purpose of the fusi was two-fold: to help people to obtain better prices for copra from the trading companies while also acting as a retail outlet through the fusi stores (Teo, 1983, p. 136). The fusi were later extended throughout the Colony and continue in Tuvalu to the present day (Teo, 1983, p. 137).

In terms of energy supply and use, there is very little information in the literature. Based on discussions with informants familiar with the late stages of the colonial era – the 1960s and 1970s – it is likely that very little will have changed from the trader and missionary era for much of the colonial era. Woodfuel using the umu in either closed or open form was the main source of cooking fuel. Possibly, the use of kerosene lamps may have increased.

By the late 1930s there was change in the offing with growing realisation in Britain that policy changes were required in the administration of colonies throughout the Empire, including the Gilbert and Ellice Islands Colony (Macdonald, 1971, p. 103). Any plans to implement these changes were postponed by the outbreak of the Second World War. In the case of the Gilbert and Ellice Islands Colony, however, the War had an impact that could have not been foreseen with the occupation of Kiribati and Banaba by Japanese armed forces in 1942 and the response of the United States that followed (Macdonald, 1971, p. 114; Telavi, 1983, p. 140).

5.5.2 War – 1942 to 1945

Following the Japanese invasion, from late 1942 until 1945, Funafuti, Nukufetau and Nanumea were occupied by the United States Army and while of short duration, the impact remains to the present day. Tuvalu became a forward base to attack the Japanese and airstrips were constructed on each of the three islands, resulting in the destruction of pulaka and taro pits and coconut groves (K. Chambers & Chambers, 2001, p. 80; Telavi, 1983, p. 142). The most obvious and lasting physical impact was the construction of the air strip on Funafuti which is now the airport for Tuvalu. According to Telavi (1983, p. 142), the destruction of pulaka pits in Funafuti resulted in pulaka no longer being a staple. The construction also resulted in the unsightly and rubbish-filled “borrow” pits where coral was dug out to provide material for the airstrip, an unfortunate reminder of the Second World War that remains to the present day. The impact of the American occupation on communities where “a kerosene lamp, a bicycle, or a sewing machine were luxuries” can only be imagined (Macdonald, 1982, p. 143). While the occupation by the United States Army was brief, it was dramatic in that it introduced Tuvalu to modern technology and awareness of a different lifestyle (Macdonald, 1971, p. 116; Telavi, 1983, p. 141). An outward sign were the “American” style houses built using abandoned materials with walls and iron roofs (McCreary & Boardman, 1965, p. 28). Unfortunately, some Tuvaluans

were trapped in Banaba following the Japanese invasion and suffered ill treatment and hardship as a consequence (Faanui, 1983, p. 124).

5.5.3 The First Signs of Change – 1950s and 1960s

Following the end of the Second World War, the British government recognised that a change in approach to this remote colony was required (Macdonald, 1971, p. 104). In a major change of policy direction, the British government devolved more responsibility for policy development and implementation to colonial administrations including the Gilbert and Ellice Islands Colony (Macdonald, 1971, p. 120). The administration headquarters for the Colony was relocated from Banaba to Tarawa in Kiribati in 1947 and after a slow start, there were improvements in education and health services (Macdonald, 1971, p. 118; Sapoaga, 1983, p. 146). Political reforms took place in 1948, 1955 and 1967, all of which were aimed at improving the effectiveness of local government. These reforms appear to have had mixed success mainly because the combined influence of the colonial authorities and the church had displaced traditional leaders and systems (Hassall et al., 2011, p. 71). However, in spite of its faults, at independence, the 1967 Local Government Ordinance became the Tuvalu Local Government Ordinance 1978 and remained in place until amended in 1985 (Hassall et al., 2011, p. 72). In 1965, Island Councils were established on each island consisting of elected councillors and a government appointed Executive Officer and with the responsibility for the well-being and development of the island including the passing of by-laws, part of a process in which the Colonial authorities were transferring powers of government to elected representatives (Sapoaga, 1983, p. 148).

In Funafuti, the impact the occupation by the United States Army was enhanced by other influences of “European” lifestyles mainly from expatriates working in Tuvalu, such as meteorological staff and their families. Extensive use of transistor radios picking up Samoan and Tonga radio stations was observed by visitors in the 1960s (McCreary & Boardman, 1965, p. 33). In terms of day to day lives, by 1970 significant changes had taken place in the Colony⁶⁹ with the improved education and health services discussed below. Imported foodstuffs, kerosene lamps, agricultural tools and kitchen utensils were available and widely used (Macdonald, 1971, p. 171). Of these, foodstuffs – rice, flour, sugar, tinned meat and fish, biscuits and powdered milk – accounted for 33% of the Colony's imports by value in 1967 (Colonial Office, 1968, p. 22). To what extent this represents a universal change in diet rather than indicative of the situation in Funafuti remains a question as a number of informants who lived in the Outer Islands in the 1970s suggested otherwise. One informant who lived on Niutao told me that his family grew all their food and caught fish and only occasionally could afford to buy luxuries – biscuits, rice, flour and tea – when they were able to sell copra (male, >50, September 2009). Another informant who grew up in Nukufetau recalled a diet that only included fish every two or three days and was otherwise limited to breadfruit, taro and coconut. His first

⁶⁹ Unfortunately, most of the available economic and social data for the pre-independence period is for the Gilbert and Ellice Islands Colony as a whole.

experience of meat as a regular part of the diet did not occur until he went to the Motufoua secondary school in Vaitupu (male, >40, September 2009). Contact with the outside world improved in 1964 with weekly or fortnightly air services between Funafuti, Suva and Tarawa (Colonial Office, 1968, p. 5). Shipping services operated between the islands of the Colony but it appears that other than occasional voyages to and from Fiji, shipping services between Tuvalu and the outside world were via Tarawa (Colonial Office, 1968, p. 61).

Macdonald (1971, p. 171) commented that the adoption of "the trappings of European civilisation represents change only at a superficial level". In spite of improved health services, some diseases remained a problem notably TB, diarrhoea and filariasis (Colonial Office, 1968, p. 44). Furthermore, there was a wide gap between those living on the outer islands of the Colony and those resident in the "relatively urbanised Tarawa" (Macdonald, 1971, p. 173). The only commercial crop grown in the Colony was coconut and copra played a major part in the Tuvalu economy and as a source of income for households (Colonial Office, 1968, p. 25).

There is no evidence of significant economic development in Tuvalu during the colonial era – at least, until after the Second World War. Even late in the era, there was no infrastructure development programme in Tuvalu similar to that implemented in Niue with the focus of the Colonial Authority being on developing Tarawa in Kiribati as the headquarters of the Colony (Sapoaga, 1983, p. 146). In respect to trade, I have found little information and what information is available is for the Gilbert and Ellice Island Colony in which Tuvalu was secondary player to Kiribati.

In terms of energy supply, for the average Tuvaluan there was little change over much of the colonial era. From discussions with several informants who could recall the 1960s and 1970s, woodfuel remained the main energy source for cooking. Kerosene lamps had become more common but coconut stems were used to provide lighting, particularly outside. When asked how people managed without refrigeration, it was explained to me that baking fish in the umu enabled keeping for two or three days and longer if salted (male, >40, March 2013; female, >40, September 2009; male, >50, September 2009). At independence, electricity was only supplied to a number of government facilities from local diesel generators (male, >50, March 2013). Indirectly, services that rely on energy supply improved in the 1960s, notably transport with the introduction of regular air services

Until the 1950s, island schools in Tuvalu were operated by the LMS but from 1953, the administration established government schools on each island that operated in parallel with the mission schools until 1963 when mission and government schools were combined and universal primary education offered (Macdonald, 1971, p. 164; Sapoaga, 1983, p. 149). Secondary education in Tuvalu, though, suffered a setback in 1953 when the Ellice Island school closed down and pupils were transferred to the main school for the Colony in

Tarawa although the Motufoua School on Vaitupu remained open but only for children of church members (Sapoaga, 1983, p. 149). Teacher and nursing training facilities and a new hospital were established in Tarawa and these together with the secondary school attracted Tuvaluans to Tarawa for schooling and training and for government employment (Macdonald, 1971, p. 119; Sapoaga, 1983, p. 147). After separation from Kiribati in 1975, the government took measures to repatriate services from Kiribati to Tuvalu. These included negotiations with the Ekalesia that resulted in the Motufoua School becoming a joint operation between the government and the Ekalesia and entry was no longer restricted to church members. However, entry was by examination and limited in number (Sapoaga, 1983, p. 150). The government instituted training programmes in Fiji for teachers and nurses to ensure that at independence staff were available for schools and the new Princess Margaret Hospital in Funafuti that was built with funding from New Zealand and formally opened as part of Independence celebrations in 1978 (Sapoaga, 1983, p. 151).

Of particular concern to the Colonial authorities was the prospect of over-population placing stress on the limited resources of the islands (Colonial Office, 1968, p. 10). While the main concern was over-population in parts of Kiribati, there was also concern in respect to Tuvalu. As shown in Figure 23, the population had increased from 3,117 in 1892 to 7,439 in 1979, the year following independence. The change in the population of Funafuti was far greater with the population increasing from 228 in 1911 to 2,210 in 1979, a nearly 10-fold increase (Connell & Lea, 2001, p. 35). This can be largely attributed to Funafuti's role as the headquarters for the Ellice Island district, a role that dates back to 1909 and which resulted in increased employment opportunities in the government sector in particular (Connell & Lea, 2001, p. 35; Teo, 1983, p. 129).

Following the end of the Second World War, phosphate production at Banaba increased substantially, again providing employment for Tuvaluans and revenue for the Colony as a whole, some of which was used for economic and social development (Macdonald, 1971, p. 125). Eventually, the phosphate resource was depleted to the extent that mining became uneconomic and in 1979, the last Tuvaluan labourers left Banaba (Faanui, 1983, p. 125).

5.5.4 Towards Secession and Independence

As I discussed in Chapter 2, there was a strong move internationally towards decolonisation encouraged by the United States and adopted by the newly formed United Nations that as part of its charter, was committed to encouraging decolonisation (Sapoaga, 1983, p. 146). In response, in 1963, Britain set up an Advisory Council for the Colony as a first step in preparing for independence (Isala, 1983, p. 153). As independence approached, the preference of the British government that Tuvalu and Kiribati remained unified became a matter of serious concern on the part of both communities. The focus of development was on Kiribati and Tarawa in particular, a cause of resentment on the part of the Tuvaluans, while the success of Tuvaluans in

gaining employment and influence in the Colony's government⁷⁰ was resented by the i-Kiribati (Macdonald, 1971, pp. 223, 248; Tagupa, 1983, p. 130). As a consequence, the progress towards independence was slow, but eventually, the British government agreed in 1974 that a referendum be held in Tuvalu to decide the issue. In the referendum, Tuvaluans voted overwhelmingly for separation and in 1975, as a first step toward independence, Tuvalu was given the legal status of a separate British dependency (Isala, 1983, p. 158). This was followed by an increasing level of self-government, ultimately leading to independence on 1 October 1978 (Isala, 1983, p. 176).

5.6 CONTEMPORARY TUVALU - 1978 TO THE PRESENT DAY

At independence in 1978, the Independence Constitution of Tuvalu was enacted by the Tuvalu Independence Order 1978. The Constitution established a Westminster-style unicameral parliamentary system with Queen Elizabeth the Second as Queen of Tuvalu represented in Tuvalu by the Governor-General. The Constitution was amended in 1986 on the grounds that it was "time that the people of Tuvalu reconsidered it in the light of their history" ("Constitution of Tuvalu," 1986). However, the amended constitution did not alter the fundamental principles of the Independence Constitution in terms of the role of the Queen as head of state and system of government (Powles, 1992, p. 81). At present, the Fale i Fono, the parliament has 15 members made up of two members from seven islands and one member from Nukulaelae.

The smallest island of Niulakita has no direct representative but is represented by the members from the neighbouring island of Niutao (Government of Tuvalu, 2012a). The church, Ekalesia Kelisiano Tuvalu, the descendant of the LMS, retains considerable influence. According to the Ekalesia's website⁷¹, about 94% of Tuvaluans belong to the Ekalesia and certainly the absence of people on the streets of Funafuti at church service time on a Sunday morning supports this estimate. An informant explained that other religions active include the Seventh Day Adventists, Latter Day Saints, Jehovah's Witnesses, Baha'i and a family of Moslems (male, >40, September 2009; male, >50, March 2013).

As discussed above, the 1967 Local Government Ordinance introduced in the Colonial Era became the Tuvalu Local Government Ordinance 1978. In 1985, the Ordinance was amended to provide for recognition by island kaupule of the role of the Falekaupule or traditional elders on each island, the role being that given by local custom and tradition of the island. To some degree, this formalised what was happening in practice but was aimed at strengthening traditional governance, albeit in a small way (Hassall et al., 2011, p. 72). More revolutionary was the Falekaupule Act 1997 which, following extensive consultation, established the

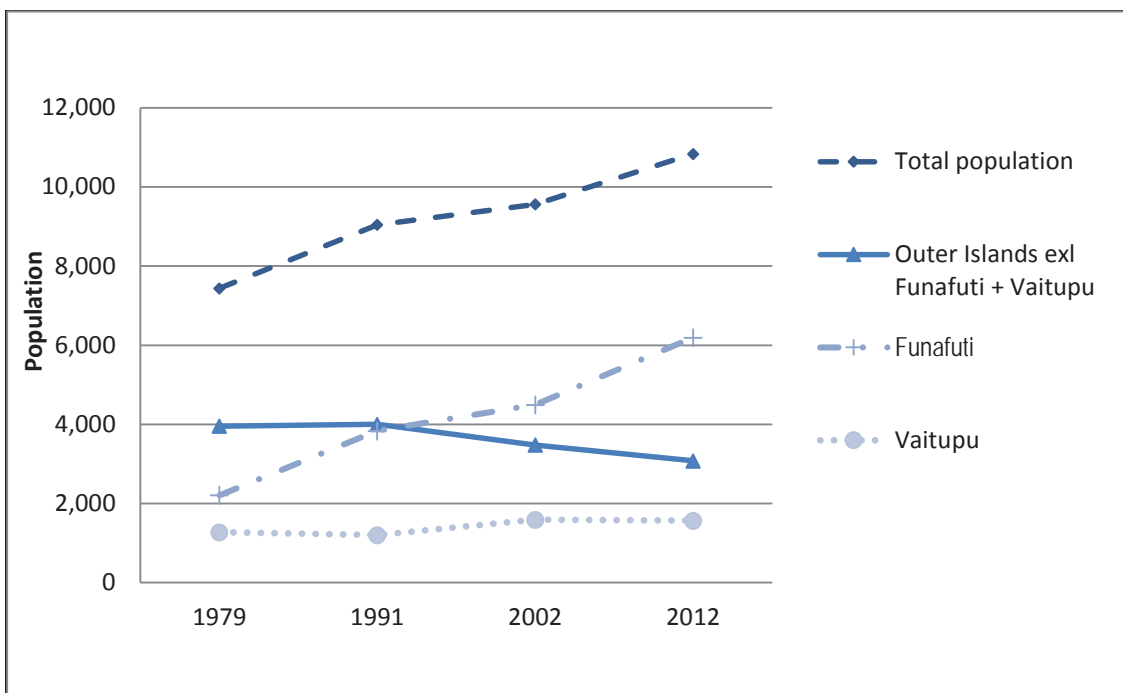
⁷⁰ In 1964, 13 of the 28 "key" posts in the Colony's civil service were held by Tuvaluans, despite the population of Kiribati being nearly six times that of Tuvalu (Macdonald, 1971, p. 211).

⁷¹ www.ektuvalu.com/

role of the Falekaupule as the primary social institution and sovereign power on each island with the kaupule comprising six elected councillors as the executive arm (Hassall et al., 2011, p. 73; Richardson, 2009, p. 122). The main objective of this reform was to empower local people by enabling participation in community planning and decision making through annual Falekaupule assemblies and thereby incorporate social-cultural and traditional values into the national development strategy (Hassall et al., 2011, p. 78). A Falekaupule Trust Fund was set up in 1999 using contributions from the islands, central government, NGOs and international donors and is designed to provide funding for projects on the islands (Hassall et al., 2011, p. 79; Richardson, 2009, p. 122).

A major policy issue for the Government of Tuvalu is migration from the Outer Islands to Funafuti, and according to one government informant, the Falekaupule Act was seen as the main instrument to create development on the Outer Islands and thereby slow the migratory flow (female, >40, September 2009). Success appears to have been limited as can be seen from Figure 24 below with the population of Funafuti increasing nearly three-fold during the period 1979 to 2012 while that of the Outer Islands has steadily declined with the exception of Vaitupu where the population has remained stable.

Figure 24 - Tuvalu: Population by Island from 1979 to 2012



Sources: Laracy (1983, p. 187) and Tuvalu Statistics (2012)

5.6.1 Contemporary society

On arrival at Funafuti airport, one is confronted with a mixture of impressions. The airport runway occupies a significant proportion of the total land area of Fogafoale and is lined with houses on one side and the power station, the Public Works Department and pig pens on the other. Arrival formalities take place in a cramped and somewhat rundown airport terminal building and next door is the large fale where, according to informants, the parliament or fono meets about four times a year but is also used for various community meetings and social events. The hotel is a five minute walk from the airport through the large crowd that assembles at “plane time”. Next to the hotel is the modern three-storey Government Building, shown in Figure 25, the construction of which was funded by Taiwan. As one walks to the hotel, care is required to avoid puddles during the wet season and there is a need to keep an eye out for motorcycles – although these tend not to go very fast, probably owing to the condition of the roads. There are only a few cars, most of which appear to be large four-wheel drive vehicles⁷² lined up outside the Government Building.

Figure 25 – Tuvalu: View towards the Airport with Government Building in the Background



Source: Author

⁷² Commonly known as “sports utility vehicles” (SUVs).

Although reportedly there is a refuse collection system, there is quite a lot of litter apparent. A 10 minute walk from the hotel reveals the crowded nature of Funafuti where houses range from shacks built from waste building materials such as scraps of corrugated steel roofing through to well-constructed bungalows, mainly located alongside the south western section of the airport runway and most of these, I was told, are occupied by government ministers. However, the somewhat unprepossessing impression gained on arrival is counterbalanced by a pleasant atmosphere of sociability that becomes apparent after a day or two. Except when it is raining, at weekends and during early evenings, groups of young people play ball games alongside the Funafuti airport runway as shown Figure 26 below. People sit outside their houses and engage in conversation with passers-by, including palagi and even offering shelter to those caught in a downpour as I found on one occasion.

Figure 26 – Tuvalu: “Evening Sports” on the Airport Runway



Source: Author

Typically, based on my observations, most houses in Funafuti are constructed from various types of boarding including plywood and cement fibre with corrugated steel or aluminium roofs and are mostly single storey with a small number of two storey dwellings. According to an informant familiar with the Outer Islands, the majority of houses on these islands are of similar construction to those in Funafuti (male, >50, March 2013). Often, open sided “lean-to” structures with parasol roofs have been added to houses and these are

often fitted with pull-down canvas sides to provide a degree of shelter and privacy. The poor quality housing tends to be located at the two extremities of Fogafale and according to several informants, these houses are typically occupied by people who have migrated from the Outer Islands. This information is supported in the report by Simpson et al (2012, pp. 9,32) which found that while in the central district of Fogafale, 65% of the population are indigenous to Funafuti, this reduces to 22% in the northern district of the island.

Most informants originated from the Outer Islands and as a consequence, rent their houses because land is mostly owned by Funafuti families and under both custom and statute, sale of land is virtually impossible (Government of Tuvalu, 1962). According to two informants, this is a source of resentment with tenants believing that Funafuti landowners are unfairly profiting (female, >40, September 2009; male, >50, March 2013). It appears that this resentment might be reciprocated with natives of Funafuti reportedly unhappy at the “invasion” of people from the Outer Islands impacting on their way of life and environment (Connell & Lea, 2001, p. 43). Informants' household sizes ranged from three to 18 with a median of about seven; the larger households included extended family members who have also moved from the Outer Islands. A project carried out in Funafuti in 2012 revealed an ambivalent view on community cohesiveness in terms of working together towards common goals and ability to influence community direction through access to leaders (Simpson et al., 2012, p. 10). Possibly this reflects the diversity of the Funafuti community with the high proportion of people whose home islands are other than Funafuti.

From discussions with informants in Tuvalu, it was clear that their “home” islands (the island on which they were born or, in the case of younger informants born in Funafuti, the island from which their family came) were of great cultural importance (K. Chambers & Chambers, 2001, p. 229). Several informants told me that they visit their home islands once a year or once every two years, and most of those, particularly those over 50 years old, said that they intended to settle on their home island after retirement. One participant talked wistfully of the idyllic life he recalled from his childhood in Nanumea – peaceful, safe and able to spend the days fishing and growing crops (male, > 40, September 2009). Another informant, a Tuvaluan now resident in Suva and on a visit to Tuvalu in the course of his employment, told me of the importance to him of Nanumea, his home island (male, >40, March 2013). He told me that a Nanumea Community Association⁷³ had been formed with the objective of ensuring that island traditions and culture are retained and while mainly aimed at the Nanumea community in Funafuti, it now draws members from all over the world. While other island communities may not be as well organised as Nanumea, efforts to maintain the unique cultures of each island remain. For example, in my September 2009 visit, I was invited to watch young people singing and dancing to celebrate Niutao day and was told that the costumes, dances and songs were unique to Niutao (male, >50, September 2009). Closely connected to the home island and of importance is the

⁷³ For more information, refer the Association's website /www.nanumea.net/Nanufuti_Update.html

extended family. One key informant did note, though, that the extended family has less influence on people's lives than used to be the case with the head of the family now being elected and having limited advisory powers only (male, >50, March 2013).

Cultural change has also affected diet with rice having displaced taro or pulaka as a staple and according to informants, is generally eaten with locally grown vegetables, fish and meat. The purchase of rice and flour, both imported foodstuffs, accounted for 25.5% of household expenditure in 2010 (Government of Tuvalu, 2010, p. 23). This level of reliance on imported food suggests that the capacity of land in Tuvalu may be insufficient to support the current population in terms of the availability and fertility to grow food. According to informants, the vegetables grown include squash, breadfruit and leaf vegetables while meat includes chicken, turkey meat, lamb neck and pork. Two young informants described their diet of mainly vegetables and fish with raised eyebrows and a sigh as "boring" (females, >18, March 2013). In Funafuti, the vegetables are mostly grown in the garden set up and funded by the Government of Taiwan. I visited the garden shown in Figure 27 below (generally referred to as the "Taiwanese gardens") during both my field visits and noted that crops grown included lettuce, spinach, beans, okra, chilli, squash, cucumber and pawpaw.

Figure 27 – Tuvalu: The "Taiwanese Gardens"



Source: Author

The gardens, which are located on the eastern side of the airport runway, opens for sale of vegetables on each Saturday morning. As part of the Taiwanese gardens project, people were encouraged to grow their own vegetables and fruit and items such as bananas and pawpaw are grown with some success. However, the lack of space on this highly populated island means that the amount grown is quite limited and the 2010 Household Income and Expenditure Survey (HIES) recorded that just 12% of food was home produced in Funafuti compared with nearly 50% in the Outer Islands (Government of Tuvalu, 2010, p. 25). Fish is a staple, particularly in the Outer Islands but in Funafuti, it was clear from interviews that meat has displaced fish to some degree as the main source of protein, a point confirmed in the 2010 HIES (Government of Tuvalu, 2010, p. 23). Two informants told me that they often go fishing but mainly for relaxation (males, >50, March 2013). One informant told me that he was sent fish and other seafood by relatives living in the Outer Islands (male, >40, March 2013). The relatives also send coconuts which are used as pig food and as cooking fuel. In exchange, the relatives are sent "luxuries" including frozen chicken, biscuits and other "snack" food and in one case, wine (male, >40, March 2013). Pig raising is universal and I was told that owning pigs has become embedded in the culture and the ability to produce a pig when required for family and other major feasts was an imperative, even in poor households (female, >30, March 2013).

In terms of livelihoods, as noted in Chapter 3, of the 20 informants only three were employed in the private sector. None of my informants relied on subsistence agriculture or fishing other than in a recreational sense, a possible exception being pig raising noting that one informant had nine pigs (male, > 40, September 2013). My informants were resident in Funafuti, however, and from discussions with those informants with relatives living in the Outer Islands, it was clear that people in the Outer Islands rely heavily on subsistence agriculture and fishing for income and for food for the household. This information is confirmed by data in the 2010 HIES and in the ILO report (2010, p. 6). While reliance on fishing as a means of income is less in Funafuti than in the Outer Islands, it is nevertheless important and a survey carried out in 2011 revealed that about 13% of the community earn some income from selling fish while many families sell pig meat (Simpson et al., 2012, p. 21). For some years, employment as seafarers by overseas shipping companies has been a major source of income and four informants were ex-seafarers (male, >40, September 2009; two males, >50, March 2013; male, >40, March 2013) and two informants were married to seafarers (female, >30, September 2009; female, >20, March 2013). Of concern to the government is a decline in seafarer employment as remittances from seafarers have contributed to about 10% of GDP (MFAT, 2014c). The remittances from this employment have declined by 80% since 2001, the decline being attributed to the impact of the 2008 Global Financial Crisis on international trade (Sihotang, 2009). During my March 2013 visit, I was told that one of the two German shipping companies employing Tuvaluan seafarers planned to reduce recruitment staff in Tuvalu (male, >50, March 2013).

While extreme poverty may not exist in Tuvalu, in 2010 26% of the population were considered by the Government of Tuvalu as living below the “Basic Needs Poverty Line” (BNPL) (ESCAP, 2010, p. 4; PIFS, 2012). The Government of Tuvalu’s Progress Report on achievement of the Millennium Development Goals (MDG) included the following statement:

The causes of poverty in the PPA⁷⁴ consultations reflect the above definition and terminology of poverty in the local context. These are:

1. Limited access to quality basic services and infrastructure;
2. Limited income generation opportunities, particularly for women and youth and those with low qualifications;
3. Overcrowding and overpopulation of households and communities, particularly on Funafuti;
4. Weakening social support system;
5. Too many family, church, community and island contribution commitments; and
6. Idleness and ‘dependency attitude’ among families.

(Government of Tuvalu, 2011b, p. 17).

As noted earlier in this chapter, the poor quality of housing, particularly as one approaches the extremities of Fogafale, provides some visual evidence of poverty.

5.6.2 Economic development

As noted at the beginning of this chapter, Tuvalu has an almost total lack of exploitable resources and very little potential for standard models of economic development (Tisdell & Fairbairn, 1983, p. 25). Tuvalu is vulnerable to both external economic and environmental shocks and in recognition of this vulnerability while classified as having an “upper middle income”, Tuvalu has been designated by the United Nations as a Least Developed Country (MFAT, 2014c).

As was the case with Niue, Tuvalu gained independence at a time when the international trend was towards neoliberal economics – the “second wave of globalisation”, the first wave being the 19th century globalisation discussed in Chapter 2 (Firth, 2000, p. 181; W. E. Murray, 2001, p. 138). Overt examples of the impact of globalisation is pressure on Tuvalu by overseas donors to reduce dependency on ODA and these are discussed below. Less obvious are social consequences: Chambers and Chambers (2001, p. 230) attributed the replacement of traditional sharing obligations that benefited the community as a whole to market exchange including the setting up of small businesses to the “inroads of capitalism” and feared that this trend would result in social stratification.

⁷⁴ Participatory Poverty Assessment.

In October 1987, the Tuvalu Trust Fund (TTF) was set up by governments of New Zealand, Australia, the United Kingdom and Tuvalu in October 1987. The objective of the TTF was “to contribute to the long term financial viability of Tuvalu by providing an additional source of revenue for recurrent expenses of government” and through the 1990s, the TTF contributed about 20% of government recurrent revenue (Tisdell, 2002, p. 912). Unfortunately, the Tuvalu economy has suffered from the global financial crisis of 2008 in that in recent years the TTF not yielded any income and during my March 2013 visit, an economist, who was visiting Tuvalu as part of a mission by an international development agency, told me that the lack of income from the Trust Fund has had a serious impact on the economy. The role of the mission team was to assist the Tuvalu government with budget management; however, it was stressed to me that this was no reflection on the government’s financial management but rather a reflection of the times. To add to this adversity, as noted above, income in the form of remittances from seafarers working on overseas ships has reduced from \$A1.2 million in 2001 to \$A0.3 million in 2012 (ADB, 2013, p. 128).

Tuvalu’s exclusive economic zone (EEZ) is of great importance in terms of foreign exchange income. In 2012, Tuvalu received \$A9 million from fishing licence fees and has fishing licence agreements with Taiwan, Japan and New Zealand (MFAT, 2014c). The long term sustainability of tuna stocks – the main target product for foreign fishing fleets – is a concern as is the maintenance of inshore fisheries (Hunt, 2003, p. 84).

Sale of the right to the internet domain name “.tv” to a Californian company for approximately \$A60 million over 12 years including a yearly payment of approximately A\$2.2 million is expected to provide significant income over the years to come (MFAT, 2014c).

The “blueprint” for economic and social development is the National Strategy for Sustainable Development 2005 – 2015 or Te Tekakeega II (Government of Tuvalu, 2005). The document was published in 2005 following lengthy consultations and focuses on eight key areas: governance, the economy; the private sector and job creation; social services; outer islands and Falekaupule; education and training; infrastructure; and natural resources (Government of Tuvalu, 2005, p. 3). Te Tekakeega II – often referred to in official documents as TK II – and the planning tool developed in 2009, the Kakeega II Matrix, both recognise the critical and continuing role of overseas donors (Government of Tuvalu, 2005, 2009). Furthermore, the assistance programmes of donors reflect the objectives of TK II. For example, the focus of recent ADB assistance has been on institutional strengthening and financial management, a key strategy in TK II (Government of Tuvalu, 2005, p. 15). World Bank assistance includes the development of a new Development Policy Operation to assist Tuvalu to rebuild financial reserves and to improve the delivery of health and education (World Bank, 2013a). In terms of infrastructure, programmes include the redevelopment of Funafuti international airport with associated training and technical assistance funded by

the World Bank and substantial investments in renewable energy from a range of donors led by New Zealand and including the Abu Dhabi Fund for Development (ADFD), the World Bank and the European Union (Government of Tuvalu & TEC, 2013; PINA, 2013). The renewable energy projects are discussed in detail in the next section of this chapter.

In summary, the focus of TK II and Tuvalu's international partners is on improving the efficiency of the economy – and thereby people's livelihoods – through improved governance, increased private sector participation in the economy and improved infrastructure. Closely linked are those services that support livelihoods through social and physical infrastructure. These livelihood services on one hand ensure an effective and strong economy while on the other hand, require an economy that has sufficient strength to pay for and maintain those services.

5.6.3 Livelihood Services

As I discussed in Chapter 4, livelihood services are those services that are provided through social and physical infrastructure and support people's livelihood. These services exist within the political, social and economic framework on a basis of mutual dependency: for example, these services all require financial support from a functioning economy and the political support to put them place initially and to operate and maintain while without these services, a modern society cannot function effectively.

(a) Energy supply.

As I discussed in Chapter 4, most of the services that underpin the modern lifestyle described above either would not be available or would be much reduced in scope and effectiveness without energy.

Excluding the biomass resource (which is mainly in the form of woodfuel) and LPG used for cooking, energy consumption in 2009 totalled 168,000 GJ of which nearly 100% was in the form of imported petroleum fuels (SPC, 2012b, p. 3). These comprised 3.3 million litres of diesel oil, 800,000 litres of petrol and 300,000 litres of kerosene. Using an estimated population figure of 10,600⁷⁵, in energy terms this equates to 15.85 GJ per capita. To place this in context, this compares with approximately 50 GJ per capita and 200 GJ per capita for Niue and New Zealand respectively (MBIE, 2013, p. 3)(SPC, 2012a, p. 3). In terms of energy use trends over the past 30 years, as shown in Table 9 below, there was a rapid increase per capita from 1984 to 2003 Wade (2005b, p. 16) attributed this to a number of factors including more diesel used for electricity generation as consequence of increased installation of air conditioning in government and commercial buildings in Funafuti during the 1990s, kerosene replacing woodfuel as the main household cooking fuel and the installation of diesel generating plant on the Outer Islands in 2000/2001 (with the exception of Niulakita).

⁷⁵ Extrapolated from 2002 and 2012 census figures of 9,561 and 10,837 respectively (Tuvalu Central Statistics Department, 2013)

**Table 9: Tuvalu Imported Energy Consumption – 1984 to 2009
(excluding LPG)**

	Total consumption – GJ	Population	Consumption per capita – GJ
1984	47,100	8,364	5.63
1992	93,600	9,043	10.35
2003	142,500	9,300	15.32
2009	168,000	10,600	15.85

Sources: Wade (2005b) and SPC (2012b).

The data in Table 9 suggests that the trend for increased energy use may have slowed from 2003 to 2009. However, it should be noted that while kerosene imports are taken into account, owing to lack of data, LPG imports are not included. From discussions with informants, LPG appears to have displaced kerosene as a cooking fuel in recent years and it is likely that the figure of 168,000 GJ for 2009 understated imported energy use given that LPG is not included. Woodfuel remains an important component of the energy-mix in contemporary Tuvalu. Of the 20 Tuvaluan informants, 11 used woodfuel on a regular basis and not just for special occasions. By observation during walking around Funafuti, many houses have an outside cooking area which is open sided with a roof for shelter and cooking is carried out using a pot suspended over an open fire or some form of homemade simple metal stove. In one case I saw an ingenious stove constructed from an LPG cylinder cut in half with an opening in the side for feeding in fuel. Most informants told me that LPG is their preferred cooking fuel but several use woodfuel for “slow” cooking of taro and pig food. From time to time, the supply of LPG becomes short and during my September 2009 visit, the price of a 9 kg cylinder had increased from the normal \$A43-45 to \$A50 and two informants had switched to woodfuel until the supplies were back to normal (female, >30, September 2009; male, >50, September 2009).

Of the 3.3 million litres of diesel imported in 2009, the largest use was for electricity generation with 1.78 million litres (54%) being used for electricity generation with the remainder used for transport (Isaka, Mofor & Wade, 2013b, p. 3). Total transport fuel use – diesel, petrol and (aviation) kerosene – in 2009 was 2.13 million litres and will have included use by motor vehicles, ships, fishing boats and aircraft (Isaka et al, 2013b, p. 3). In 2007, fuel imports cost a little over \$A2,959,000 or 16% of total imports (Tuvalu Central Statistics Department, 2008, p. 13)

At independence in 1978, electricity supply was limited to a small number of government buildings and was by means of local diesel generator sets⁷⁶. In 1984, a central diesel power station, shown in Figure 28 below, was constructed⁷⁷ in Funafuti and electricity distributed throughout Fogaale to most households. The generation plant and the distribution system was largely replaced in 2006, the project being funded by Japan (Ridgway, 2006, p 13). In the Outer Islands, solar home systems were widely installed to provide lighting, funded by a variety of development agencies under the Lome II Pacific Regional Energy Programme's (PREP) photovoltaic (PV) programme and a total of 428 systems were operating by 1994 (Fifita, 1999, p. 13). In addition, from descriptions in Chambers and Chambers, it appears that in the Outer Islands, a number of small diesel or petrol generators were used to provide electricity for communal activities; mention is also made of refrigerators which obviously needed some form of energy supply although the extent and purpose – household or commercial use – is unclear (2001, pp. 156,239). Unfortunately, in the mid-1990s, the institutional structure around the PV programme collapsed, brought on by embezzlement of the cooperative's funds and in 2000, the systems were replaced with diesel generation on all islands except for Niulakita (Fifita, 1999; Wade, 2005b, p. 35).

Electricity generation and distribution are the responsibility of a state owned enterprise, the Tuvalu Electricity Corporation (TEC). In Funafuti, electricity is supplied from a central power station housing three 600 kW diesel generators. In addition to the diesel generators, there are three solar arrays capable of supplying 148 kWp in total into the island network (Government of Tuvalu, 2012b, p. 12). As two of the arrays have only recently been installed, generation data is not available. However, based on operating experience with the first of these arrays to be installed, I estimate that the solar arrays supply about 4 to 5% of the total electricity consumption⁷⁸. On seven of the Outer Islands, the generation plant comprises two or three diesel generators, the exception being the small island on Niulakita which, according to the General Manager of TEC⁷⁹, has no central electricity supply. In the case of Vaitupu, the Motufoua School is provided with a 46 kWp diesel/solar hybrid system⁸⁰ installed in 2009 with, according to a reliable informant, funding from the Italian Government (male, >50, March 2013). The Funafuti electricity supply is very reliable with the total time the supply was interrupted in 2009 being two hours (SPC, 2012b, p. 15). Two informants who had technical management roles in TEC could only recall one occasion since 2004 when supply was interrupted for several hours. While electricity is available 24 hours a day in Funafuti, in the Outer Islands electricity is

⁷⁶ Email dated 20/4/2009 from Mafalu Lotolua, General Manager of the Tuvalu Electricity Corporation.

⁷⁷ My attempts to find out which country funded the construction of the power station and distribution system, including a visit to the National Archives in Funafuti were unsuccessful. Conflicting information was received from informants, some saying New Zealand, others suggesting Australia.

⁷⁸ In 2010, the existing 40 kWp array generated 60,400 kWh which equates to 1,510 kWh per kW peak. Using this kWh per kWp installed ratio, electricity output from arrays of 148 kWp can be expected to generate approximately 223,480 kWh per annum; based on the 2010 total generation of 4,995,500 kWh, this represents about 4.5% (based on data in Master Plan for Renewable Energy and Energy Efficiency in Tuvalu (Government of Tuvalu, 2012b, p. 12).

⁷⁹ Interview in March 2013.

⁸⁰ The hybrid system comprises a diesel generator, a 46 kWp array and batteries.

nominally available from 18 hours each day but that from time to time this availability is reduced due to a shortage of diesel fuel (Kaly, 2013, p. 36).

Figure 28 – Tuvalu: The Fogafale Power Station with Airport Runway in Foreground



Source: Author

In 2010, electricity generation in Funafuti totalled 4,997,500 kWh (Government of Tuvalu, 2012b, p. 8) with the bulk of the electricity being consumed for refrigeration and air conditioning (Empower Consultants, 2009, p. 22). The largest single consumer of electricity is the Government Building on Funafuti – where much of this is for air conditioning – which uses about 8% of total consumption followed by the Princess Margaret hospital. Other major users include the Tuvalu Cooperative Society which stores frozen food imports in refrigerated containers and in freezers in the fusi – retail outlets – located around Funafuti and the desalination plant (Government of Tuvalu, 2012b, p. 18). Approximately 75% of the electricity supplied to domestic consumers is used for refrigeration (Empower Consultants, 2009, p. 22). The peak demand period in Funafuti is during the weekday period 8 am to 4 pm which is likely to be due to building air conditioning and possibly increased refrigeration load as the day warms up (Empower Consultants, 2009, p. 7).

About 95% of households in Funafuti are connected to an electricity grid, this dropping to 93.7% in the Outer Islands (SPC, 2012b, p. 4). The households of all the Tuvalu-based informants were connected to the grid and their households owned refrigerators and freezers (separate or combined), television and DVD players, a Sky decoder in the case of about 50% of informants, washing machines, fans and electric irons. Some informants also had rice cookers and electric kettles. One informant had an air conditioning unit but from discussions with other informants, this appeared to be an exception. All these informants were resident in Funafuti and, except for two informants who were students, could be classed as “middle income” given that they were all in full-time employment so it is likely that poorer households may not have the same range of appliances. During one visit, I was invited into a house occupied by a widow who I was informed had very limited financial resources and noted that other than a LPG burner, the only appliance was a refrigerator-freezer and I was told that this is considered to be essential owing to the reliance on perishable foodstuffs, particularly in the case of someone that is unable to catch fish or grow food. Based on discussions with informants who were familiar with the Outer Islands as a result of their employment by TEC, appliance ownership in the Outer Islands was understood to be less than that in Funafuti, one reason being given that unlike Funafuti, electricity is not available for 24 hours each day. This information was supported by a survey carried out in 2013 on four of the eight Outer Islands which indicated that about 75% households have a similar range of appliances to those on Funafuti and that this percentage would be higher in respect to freezers and washing machines if 24 hour power was available (Kaly, 2013, p. 58).

There has been a steady growth in electricity generation in Funafuti over the past 15 years. In 1999, generation totalled 3,170,000 kWh (Wade, 2005b, p. 8) and as noted above, this had increased to 4,997,500 kWh in 2010 (Government of Tuvalu, 2012b, p. 8). On a per capita basis, generation increased from approximately 750 kWh in 1999 (Wade, 2005b, p. 8) to 970 kWh in 2010⁸¹, an increase of 30% (Government of Tuvalu, 2012b, p. 8). A possible reason for this increase is increased ownership of household appliances; for example, a survey in 2003, indicated that about 50% of households owned refrigerators and freezers (separate or combined) (Wade, 2005b, p. 22) while from my discussions with informants and from observation, ownership of these appliance is likely to have increased to 80% of households or greater. As is often the case in developing countries, electricity in Tuvalu is supplied at below the cost of generation. The current household tariff for Funafuti⁸² ranges from \$A0.30 for the first 50 kWh per month to \$A0.56 for kWh for units above 100 kWh and a flat rate of \$A0.56 for commercial and government users (Isaka et al., 2013b, p. 5) whereas Empower Consultants estimated that based on a diesel price of \$A1.40, the generation fuel cost was at least \$A0.55 per kWh (Empower Consultants, 2009, p. 18). Given that the generation cost excludes operating and maintenance costs, I estimate the total cost of supply will be significantly higher than

⁸¹ Based on an estimated 2010 population for Funafuti of 5,156 (Government of Tuvalu, 2012b, p. 8).

⁸² The tariff in the Outer Islands is 1 cent less in each tariff band. The extra 1 cent for Funafuti is to allow for street lighting electricity consumption.

\$A0.55; one informant who I consider was well informed on this issue, suggested that the real cost of supply was in the order of \$A2 per kWh (male, >40, March 2013).

Total electricity generation in 2010 on the Outer Islands⁸³ was 940,000 kWh or an annual average of 142 kWh per capita (Government of Tuvalu, 2012b, p. 9). This compares with an about seven times higher per capita generation in 2010 of 969 kWh in Funafuti. This is no doubt due in part to the much higher proportion of commercial and government buildings, mostly air conditioned, in Funafuti than is the case in the Outer Islands (Government of Tuvalu, 2012b, p. 9). A fairer comparison is to compare residential electricity consumption on Funafuti with that of the Outer Islands and, according to Empower Consultants (2009, p. 19), in 2009 residential electricity consumption in Funafuti accounted for 37% of total consumption. Applying this to the total generation figure of 4,997,500 kWh, total residential generation becomes 1,850,000 kWh or 359 kWh per capita which is still over three times that of the Outer Islands. Possible explanations for this are the higher ownership of household appliances in Funafuti and access to 24 hour electricity compared with a maximum of 18 hours a day on the Outer Islands.

The need to reduce dependency on imported energy in the form of petroleum fuels has been recognised by the Government of Tuvalu for some years. Given that electricity generation is the single biggest user of imported fuels in the form of diesel, as part of the aim to meet the target of 100% renewable energy, the Government of Tuvalu has set up a Renewable Energy and Energy Efficiency Unit (REEEU) within TEC. The stated objective of the REEEU is to limit diesel consumption by identifying and developing alternative forms of generation and encouraging energy efficiency (Ridgway Capital Projects, 2008, p. 6). With the assistance of the New Zealand Aid Programme, the Government of Tuvalu and TEC have prepared a "Master Plan for Renewable Electricity and Energy Efficiency in Tuvalu - Enetise Tutumau 2012-2020" which has two goals:

- To generate electricity with 100% renewable energy by 2020
- To increase energy efficiency on Funafuti by 30%.

Enetise Tutumau proposed that the first goal be achieved through a combination of renewable energy technologies: solar (PV), wind and bio-diesel (Government of Tuvalu, 2012b, p. 3). However, there is a clear preference for the use of PV technology over wind (Government of Tuvalu, (2012b), p. 4). From discussions with informants from TEC, this is due to concerns about the maintainability of wind turbines in a tropical marine environment with the risk of occasional cyclones. Bio-diesel is seen as making up less than 10% of generation. These goals are by any measure extremely ambitious. However, the government has done an

⁸³ This excludes Niulakita which is not provided an electricity distribution system.

excellent job in obtaining the support of international donors to assist in implementing the Master Plan by providing financial and technical assistance. Current and proposed projects include:

- Funafuti PV generation -Stage 1: this is to be funded by the New Zealand Aid Programme and the Abu Dhabi Fund for Development (ADFD) and comprises the installation of solar arrays with a combined output of about 500⁸⁴ kWp. The electricity generated will be delivered into the Funafuti distribution system and I estimate that when combined with the output from the existing PV arrays, the PV systems will contribute about 17% of electricity generated⁸⁵ (Kaly, 2013, p. 4; Pipeline Magazine, 2014).
- Outer Islands hybrid PV/diesel generation – Nanumaga, Nanumea, Niutao and Vaitupu: this project will be funded by the New Zealand Aid Programme. Each island installation will comprise PV arrays operating in parallel with a diesel generator and with battery storage. The batteries will store surplus PV generation during the day so that electricity is available at night or during cloudy conditions when lack of sun prevents PV generation. Battery capacity will be equivalent to between three and five days normal usage. The diesel generator will provide electricity during extended periods of cloudy weather. Electricity will become available on a 24 hours basis compared with the current 18 hours or less; diesel fuel consumption is expected to be less than 10% of current consumption (Kaly, 2013, p. 4).
- Outer Islands hybrid PV/diesel generation - Nui, Nukulaelae, Niulakita; this project will be funded by the European Union. I have not been able to find any published information on the proposed project but from discussions with TEC, I understand that the concept will be similar to that adopted for the New Zealand funded project: PV arrays operating in parallel with a diesel generator and with battery storage.
- Energy Sector Development Project (ESDP) –This project will be funded by the World Bank and is at an early stage. It is a portfolio of activities, including improving the efficiency of the existing TEC electricity system, expanding renewable energy electricity generation in Funafuti, an energy efficiency programme, a study on the viability of coconut oil production in the Outer Islands for the use as a bio-fuel for diesel generation and the development of a strategy to optimise the integration and performance of future generation systems (Government of Tuvalu & TEC, 2013, p. 4). The energy efficiency component is of particular importance because the Enertise Tutumau has the goal of a 30% improvement in energy efficiency by 2020. The energy efficiency component also includes an “evaluation of the potential use of electric motorcycles, scooters and bicycles for individual transportation”(Government of Tuvalu & TEC, 2013, p. 5)

⁸⁴ I have been advised informally by a reliable informant that that the output from the ADFD funded and New Zealand funded components will be 350 kWp and 150 kWp respectively. This compares with the earlier information in Kaly (2013, p. 4) where a total of 533 kWp was to be funded by the New Zealand Aid Programme. Additional PV generation may be funded by New Zealand following further studies by the World Bank ESDP – see above; this study will also consider system stability issues.

⁸⁵ This is calculated using an output of 1510 kWh per annum for each kWp installed – see earlier footnote on this topic.

In summary, the programme reflects well on the government and TEC and their joint ability to mobilise international donors. There are challenges particularly in Funafuti where the lack of land available for PV arrays or wind turbines will make the Enetise Tutumau goal of 5 MW installed renewable energy generation capacity difficult to achieve (Government of Tuvalu, 2012b, p. 5). In order to install the PV arrays needed to meet this goal, extensive use of roofs will be required involving government, commercial and residential buildings with the likelihood that many buildings will need to be strengthened (Government of Tuvalu, (2012b, p. A4) and a structural evaluation is included in the ESDP (Government of Tuvalu & TEC, 2013, p. 5) . Furthermore, the generation system proposed and outlined in Enetise Tutumau is extremely complex involving decentralised battery and inverter “sub-stations” located around Funafuti (Government of Tuvalu, 2012b, p. B3).

Enertise Tutumau is an electricity master plan and therefore other users of imported fuel receive little attention – although the energy efficiency programme component of the ESDP includes a study on the potential use of electric bicycles, scooters and motorcycles (Government of Tuvalu & TEC, 2013, p. 5). The proposed study on the viability of coconut oil production in the Outer Islands as part of the World Bank funded ESDP is of interest as not only would the use of coconut oil reduce further the need to import diesel, but it could also provide a source of employment in the production of copra (Woods, Hemstock, & Burnyeat, 2006, p. 488).

Attempts have been made by an NGO, Alofa Tuvalu, to encourage the use of biomass fuels, in particular biogas and biodiesel. In my March 2013 visit, I met with a keen supporter of Alofa Tuvalu, who discussed the success and failures of the NGO's programme to date. Unfortunately, ill health on the part of the NGO founder, Gilliane Le Gallic, a French film maker, has impeded progress in recent months. While a number of projects have failed for both technical and non-technical reasons, a household scale biogas project that commenced in Nanumea involving two bio-digesters has been expanded with 12 digesters in operation in April 2014 in Nanumea and Nanumanga (Alofa Tuvalu, 2014, p. 6). The bio-digesters are drum-type and use pig dung and vegetable waste for the feedstock. The biogas is piped to communal gas burners. Given the large number and concentration of pig pens in Funafuti, the potential for biogas generation appears high and during a walk on the eastern side of the runway, I came across a large derelict biogas digester that according to a sign alongside had been built as part of an Australia-Tuvalu “Model Pig Pen Project”. I asked a number of informants why this project had failed and received a number of explanations including that the biogas technology was too complex, people were reluctant to maintain the effluent pumps because it involved direct contact with pig manure and the need to use fresh water to wash the pig pens. However, the experience in Nanumea suggests that these issues could be overcome with government and donor support

particularly if a small-scale approach is adopted which does not involve pumps or other mechanical components.

The importance of energy supply and the need to reduce the existing dependency on imported fuel, becomes apparent when considering those livelihood services that rely on energy for effective delivery. These services are discussed below.

(b) Health services

A reliable supply of electricity is essential in the delivery of a modern health service. Health services throughout Tuvalu may not be up to the level expected in a developed country but nevertheless, the requirement for a reliable electricity supply exists. Refrigeration, which relies on electricity, is essential for the storage of drugs and vaccines. Also requiring electricity is the range of bio-medical equipment that is an important part of a modern hospital (including diagnostic equipment such as X-ray machines, laboratory equipment, anaesthetic machines and patient ventilators).

Health services are provided from the Princess Margaret Hospital on Funafuti which opened in 1978 (Sapoaga, 1983, p. 151) supplemented by health clinics on each island staffed by nurses (ADB, 2006, p. 106). Serious cases that cannot be dealt with at the Princess Margaret Hospital are evacuated by air to Fiji or New Zealand with New Zealand and Australian funding (ADB, 2006, p. 107). The hospital has a standby diesel generator, in respect to which I have received completely contradictory comments from two informants on the maintenance and condition.

Earlier problems with infectious diseases have been largely replaced with health problems associated with poor nutrition and poor sanitation and water quality (ADB, 2006, p. 107). From a discussion in March 2013 with a representative of an international development agency, health issues are typical of Pacific Islands with non-communicable diseases (NCD) such as diabetes and cardiovascular disease being dominant (Connell, 2003, p. 93). This is confirmed in the WHO health profile for Tuvalu (WHO, 2013c).

The incidence of tuberculosis is high relative to other countries in the region but the rate is declining (WHO, 2013c). Life expectancy in Tuvalu in 2011 was 64 years compared with the regional average of 76 and, as discussed below, lack of access to health care may be a contributing factor (WHO, 2013c). I did not ask people about their health status but generally people appeared satisfied with the health care service. This was in spite of the limited health services available in Funafuti and even more limited in the Outer Islands as I will describe below.

A major problem is recruitment and retention of medical practitioners, particularly surgeons. In a discussion with an MFAT development programme manager, I was told that resolving this issue is a priority for both AusAid⁸⁶ and the New Zealand Aid Programme which funded the employment of a medical practitioner with surgical capability in 2012. When I visited the Princess Margaret Hospital in 2009, a senior nurse told me that no surgery was being carried out at the hospital at that time and for any condition requiring surgery other than a simple cut or fracture, the patient would have to travel to Fiji for treatment under an arrangement between the governments of Tuvalu and Fiji. In terms of facilities, the Hospital does not compare well with the Hospital in Niue. While the wards are well designed and well maintained, other parts of the Hospital were not in such good condition mainly due to the age of the Hospital and the need for upgrade work⁸⁷.

Medical care in the Outer Islands is provided by nurses based at Health Posts and, without doctors, only limited health care can be provided. In the event of a requirement for medical care beyond the capability of the health post nurses, initially advice is sought by telephone or radio from doctors at the Princess Margaret Hospital, otherwise, the patient has to travel to Funafuti (ADB, 2006, p. 107). Given the somewhat irregular and unreliable nature of interisland travel, this can impact adversely on the outcome for the patient (Panapa, 2012, p. 23). In situations of severe emergency, patrol boats are used to bring patients to Funafuti (ADB, 2006, p. 107). Given the problem that people have accessing adequate medical treatment, it is not surprising that people in Tuvalu still turn to traditional healers and masseurs for treatment (Panapa, 2012, p. 17).

(c) Education

The reliance on energy in enabling the delivery of modern education service is less clear cut than is the case with health services. Arguably, the most significant role of energy supply in education is by enabling modern communication systems, notably the internet both for access to information and for distance learning, this being of particular relevance to small and remote island communities.

Universal free and compulsory education is provided from the age of six to 15 in Tuvalu. Entry to the government run Motufoua secondary school on Vaitupu is by examination with the Fetuvalu School in Funafuti operated by the Congregational Church of Tuvalu – the Ekalesia – offering an alternative although with a slightly higher fee (ADB, 2006, p. 105). Secondary students study towards the Fiji Junior Certificate and can go on to study for either the Pacific Secondary School Certificate at Motufoua or the Cambridge International Examination at Fetuvalu.

⁸⁶ Australian Agency for International Development.

⁸⁷ For example, while the wards rely on natural ventilation, offices and some treatment areas require air conditioning and during my visit, I estimated that about 80% of air conditioning units were not functioning due to lack of maintenance.

As in Niue, the University of the South Pacific has established a satellite institution – the University of the South Pacific Extension Campus (USPEC) – which offers post-secondary school foundation courses for those intending to undertake tertiary studies, either by distance-learning or in Fiji, Australia or New Zealand, generally funded through government scholarships. Distance-learning is provided via the internet from the main USP campus in Suva (ADB, 2006, p. 105). Other tertiary institutions include the Technical Education Centre (TEC) which provides training in the building trades and the Tuvalu Maritime Training Institute (TMTI) which provides training of seafarers (CEDOL, 2014). In terms of economic benefit, the setting up of the TMTI in 1979 has been a success providing seafarers for international shipping companies, recently mainly German (Borovnik, 2009, p. 144).

Most informants had received primary education in Tuvalu at a school on their home island. In the case of secondary education, there was a mix with some having attended Motufoua and others Fetuvalu. Two informants received schooling in Fiji. All informants appeared satisfied with the education that they had received. In respect to tertiary education, I did not seek detailed information on this topic but often people volunteered information unprompted. The majority of informants had or were in the process of obtaining tertiary qualifications ranging from one informant with a degree from Oxford through to two young informants studying accountancy at the USPEC in Funafuti. Education is clearly valued and two mature informants were studying towards degrees from USP funded by scholarships from Korea and Australia. Two informants told me that they regularly tell their teenage children that they must obtain good qualifications before they try and get work in New Zealand or Australia. As was the case in Niue, I was told that scholarships for study at the USP are readily available and, to a lesser degree, at universities in Australia and New Zealand. It is likely that my informants were not truly representative of the total population: according to the International Council for Open and Distance Education (2014), while primary and secondary education is free and compulsory up to the age of 15, there were a number of deficiencies in the delivery of education, declining outcomes in achievement and poor rates of attendance at secondary school.

(c) Water supply

Typically, water supply systems rely on stored rain water. Groundwater is available on all islands but is of variable quality and seldom used for drinking water because of concerns about contamination from pit latrines and septic tanks. In Funafuti, groundwater is only used for feeding pigs, washing pig pens and flushing toilets while in other islands, groundwater may also be used for washing clothes and bathing and for drinking during droughts. However, in periods of drought, excessive drawing water from wells has resulted in the water becoming salty which can affect surrounding vegetation (SOPAC, 2007f, p. 20). As a consequence, the main source of water for drinking and washing is rain water stored in household and community tanks. In Funafuti, water storage is supplemented by desalination plants (ADB, 2006, p. 110).

Drought is a serious threat. Following an extended dry period, a crisis can occur as in 2011 when severe water restrictions had to be imposed on Funafuti and some Outer Islands (Banyan, 2011). An international relief programme was implemented including air lifting water to Tuvalu followed by the provision of additional desalination plants to supplement the existing plant that was already running at capacity (BBC News, 2011). Since the emergency, the existing desalination plant has been upgraded in conjunction with a 42 kWp PV array, and, according to informants, this was funded by the Russian Federation. A new desalination plant in conjunction with a 66 kWp PV array has been installed at the Public Works Department in Funafuti (Government of Tuvalu, 2012b, p. 12). In both cases, while the PV arrays were installed as part of the desalination plant, when the electricity generated is not required for desalination, it automatically feeds into the Funafuti distribution system and makes up part of the total PV generation capacity of 148 kWp noted earlier in this chapter. Conversely, during periods of cloudy weather when there is a low level of PV generation, the desalination plants are supplied with electricity from the diesel generators at the main power station.

The need to have adequate water storage is well understood and was stressed to me by a number of informants, all of whom had installed rain water storage tanks by their houses. However, based on my observation when walking around Fogafale, space restrictions around some of the poorer houses were such that the installation of a water tank would be very difficult if not impossible. While the water from the water tanks and the desalination plant is suitable for cooking and washing, it requires boiling to ensure potability and as a consequence shops are well stocked with bottled water imported from Fiji. Even during the wet season the need to conserve water is appreciated by some: during my March 2013 visit I saw a man taking advantage of a downpour by standing under the edge of a roof and using the torrent of water for his evening shower.

(d) Sanitation

Sanitation is very poor and while the risk to health is relatively low on the Outer Islands with a low population density, the risk is serious in Funafuti (ADB, 2006, p. 111). There is no reticulated sewage system in Tuvalu and most households have their own facility, the quality and efficacy of which varies considerably. Septic tanks and pit latrines are the most common systems in use but are often poorly constructed and maintained and as noted above, leakage from inadequately treated effluent from the tanks can contaminate groundwater and lagoons (ADB, 2006, p. 111; Connell, 2003, p. 92; SOPAC, 2007f, p. 33).

(e) Transport services

Motorcycles are the most common form of local transport and there are a small number of cars. All Tuvalu-based key informants used motorcycles on a daily basis, except one who was provided with a car by his employer. The motorcycles were considered essential by all informants and one of the last things they would

give up if fuel became very expensive. Inter-island travel is by the government operated shipping service but this service tends to be unreliable (Resture, 2010, p. 3). For a short period from 1981 to 1983, a seaplane service operated between Funafuti and the six Outer Islands with lagoons but the operating costs were too high for the service to continue (Resture, 2010, p. 77). Reef Shipping currently provides a monthly freight service from Suva (Reef Shipping, 2012). I was told (but was unable to confirm) that the government inter-island ship makes an occasional voyage to and from Fiji. Otherwise, the main and vital passenger link with the outside world is the twice-weekly⁸⁸ Fiji Airways (formerly Air Pacific) service between Suva and Funafuti using a 42 seat aircraft; Figure 29 shows the airport on “plane day”. The importance of this service is recognised in the World Bank funded “Tuvalu Aviation Investment Project” (TvAIP). The total cost of this loan project is expected to be in the order of \$US18 million and includes upgrading of the runway, improvements to the terminal, upgrading of navigational aids and improvements to the Funafuti road network (Government of Tuvalu & TEC, 2013, p. 2).

Figure 29 – Tuvalu: “Plane Day” at Funafuti International Airport



Source: Author

(f) Communication infrastructure

Funafuti is provided with landline and mobile phone services. Most informants told me that they have access to the internet either from home or from their place of work. My experience of the internet service provided

⁸⁸ I have recently been advised by an MFAT informant that this will be increased to three flights a week.

at the hotel is generally good with sufficient bandwidth for “Skype” phone calls and listening to the RNZ National Radio. There is no local television service but as noted above, a number of informant subscribe to a satellite television service. There is a local radio station, Radio Tuvalu, which broadcasts in English and Tuvaluan and I was told is an important source of information; there is also a government-owned weekly newspaper (Government of Tuvalu, 2011a, p. 12).

I was not able to obtain detailed information on the communication services provided in the Outer Islands other than that telephone services with Funafuti are available at post offices (Government of Tuvalu, 2011a, p. 12). However, in a discussion with a senior government official in September 2009, I was informed that internet services had been (or were being) provided in the Outer Islands as part of the overall Outer Island development programme, one particular benefit being identified as enabling seafarers’ wives to keep in regular email contact with their husbands. During my March 2013 visit, I was told that a computer with internet access had been set up in the Kaupule office on each island⁸⁹.

5.7 CHAPTER SUMMARY AND DISCUSSION

The transformation of Tuvalu from a traditional island society to a modern society followed a similar path to that of Niue and energy had a significant part in this transformation. As with Niue, energy supply did not cause or drive the transformation. Rather, the transformation was imposed from outside and was driven by political or quasi-political motives, initially the LMS and the desire to impose their beliefs and values on the people of Tuvalu and later, the British government as part of a strategy to maintain its dominant role in the South-West Pacific. 19th century globalisation was also a critical factor in that it brought the concepts of trade and payment for labour, concepts that did not exist beforehand. While these “drivers” caused the transformation, it can be argued that energy supply provided the “fuel”.

In pre-palagi Tuvalu, natural capital met food needs and also provided energy in the form of woodfuel. However, life was harsh with limited land area and poor and shallow soils with an ever-present risk of drought, a situation that was dealt with by the imposition of strict population control measures to ensure that the natural capital resources on which life depended were maintained at replenishment level. Social capital was strong, with day to day life controlled by chiefs or aliki who exercised considerable power over their community or clan. Unlike Niue, Tuvaluans appear to have welcomed early visitors from the outside world with regular contact with palagi commenced late in the 18th century with visits by New England whalers. From the 1820s onwards, traders regularly visited Tuvalu and by the 1860s, most islands had a resident trader. However, other than the introduction of the concept of trade, to manufactured goods and to some new food sources (including pigs and chickens), day to day life will have carried on largely unchanged with

⁸⁹ I assume that this does not apply to Niulakita.

reliance on natural and human capital continuing including woodfuel as the main source of energy. Significant change occurred in the 1860s with the arrival of the LMS missionaries, an event that resulted in transformation of Tuvalu society with the missionaries displacing the aliki as rulers and imposing new laws that changed many aspect of the traditional way of life. While there were some benefits from the rule of the LMS and other impacts of globalisation – a reduction in conflict between the clans, the introduction of new food sources and manufactured goods – there were negatives, including exposure to new diseases and notably the activities of the Peruvian slavers which resulted in a large reduction of the populations of Funafuti and Nukulaelae. In terms of energy use, there was little change, with woodfuel remaining the main source of household energy.

For much of the colonial era, there was little change in day to day lives. Woodfuel continued to be the main source of energy supply. Otherwise, the influence of energy was subtle and indirect: for example, shipping services and later the introduction of regular air services, both of which relied on energy supply. Occupation by American forces during the Second World War introduced Tuvaluans – at least those living on the three occupied islands – to a range of new technologies and it must have created some discontent after their departure when life returned to normal. In terms of transformation, no real change took place until the 1970s when Tuvalu separated from Kiribati as until then, any development in terms of infrastructure took place in Kiribati, the exception being the upgrading of the airstrip in Funafuti in 1963 permitting regular air services. As a consequence, at independence in 1978, electricity supply was limited to a number of government buildings, mainly on Funafuti, with woodfuel being the main energy source together with kerosene lamps for lighting.

Since independence in 1978, there have been advances in infrastructure, both social and physical. Health and education services can be described as reasonable in terms of access, but there is significant disparity between Funafuti and the Outer Islands. Migration from the Outer Islands to Funafuti has resulted in serious overpopulation in Funafuti with overt signs of poverty and poor housing. Electrification is over 90% although the quality of supply is inferior in the Outer Islands to that in Funafuti. Water supply continues to be a problem in dry years, mitigated to some extent through the construction of desalination plants on Funafuti. Poor sanitation is a serious problem, particularly on Funafuti due to the very high population density. At household level, LPG has replaced woodfuel to a large extent although woodfuel is still used for “slow” cooking. Most households in Funafuti have refrigerators/freezers and washing machines and while less on the Outer Islands, ownership of refrigerators or freezers is still high at around 75%. Motorcycles are extensively used on Funafuti– I saw very few bicycles during my visits.

In summary, most Tuvaluan and particularly those in Funafuti have a reasonable standard of living although there is a significant minority who, according to the government, live below the Basic Needs Poverty Line.

A consequence of achieving a reasonable standard of living is increased energy consumption, particularly in Funafuti. Changes in diet have meant an increased need for refrigeration and transport is mainly by motorcycle. The provision of health services and – albeit to a lesser degree – education services relies on electricity. Transport of people and goods between Funafuti and the Outer Islands rely on shipping services and have become increasingly important in enabling access for people in the Outer Islands to health and education services. Increasing consumption of imported foods has increased the reliance on regular international shipping services. The twice-weekly⁹⁰ air service between Funafuti and Suva is a vital link with the outside world and I am told that it is regularly fully booked with Tuvaluan seafarers travelling to either join a ship or return from a voyage, Tuvaluans travelling overseas for education or specialist healthcare, government officials and consultants from international development agencies.

The Government of Tuvalu is aware of the dependency of the modern lifestyle and the associated livelihoods on energy supply. The government is also acutely conscious that most of this energy supply is imported and a large contributor to the merchandise trade imbalance and also has created a significant vulnerability to any curtailment of energy imports. As discussed above, the government has prepared *Enetise Tutumau* which has the commendable objective of electricity generation from 100% renewable energy sources by 2020. Furthermore, *Enetise Tutumau* is enabling a focussed and coordinated approach to implementation by international donors in the provision of technical and financial assistance. A concern I have is that *Enetise Tutumau* is an electricity master plan and does not address other energy supply issues, including cooking and transport fuels. Another concern is that the recommendations in *Enetise Tutumau* rely heavily on PV electricity generation with the possibility of some wind generation, both of which are high-cost generation options (Dornan, 2012). As discussed earlier in this chapter, in Funafuti, there is very little land available for PV arrays or wind turbines and as a result, in order to meet the electricity demand, there would be a need to use roofs of residential buildings as well as government buildings, with the likelihood that many of the roofs would require strengthening. The need to resort to a solution that is likely to be expensive to construct and difficult to operate and maintain reflects the problem confronting Tuvalu in that as is the case in Niue, there is lack of more affordable renewable energy resources such as hydro and geothermal generation (Dornan, 2012; Wade, 2005a, p. 16; 2005b, p. 29).

To some degree, my concerns expressed above regarding *Enetise Tutumau* being solely an electricity master plan and the reliance on PV generation as the solution are mitigated by the scope of work to be covered by the World Bank ESDP. As discussed earlier in this chapter, the ESDP comprises a portfolio of activities and the inclusion of a study on the proposal to expand Funafuti PV generation may identify a less complex solution than that described in *Enetise Tutumau*. Also, the proposed evaluation of electric

⁹⁰ I have been recently told (August 2014) by a New Zealand Aid Programme officer that the service will soon be increased to three flights each week.

motorcycles, scooters and bicycles extends the scope of ESDP to at least partly address the issue of transport energy needs. Particularly encouraging is the inclusion in ESDP of a study on the viability of coconut oil production on the Outer Islands for the use as a bio-fuel for diesel generation as this will highlight the potential that biomass energy offers. As noted in Chapter 1, biomass comprises material of plant and animal origins and in the context of Niue and Tuvalu, includes wood and associated material such as coconuts, crop residues, household waste and animal waste (Sims & El Bassam, 2003, p. 2). An advantage of biomass is that not only can it provide fuel flexibility but also is a renewable energy source that can be stored (Sims & El Bassam, 2003, p. 1). Most importantly, it can be produced domestically. Dornan (2012) dismissed biomass as an option for Tuvalu on the basis that there is a “lack of biomass in Tuvalu” but a study undertaken by Woods et al (2006) while acknowledging the challenges of limited land area, poor quality soils and complex land ownership arrangements, concluded that biomass in the forms of crop residues, animal dung and coconut oil could make a considerable contribution towards reducing dependency on imported fuels (Woods et al., 2006, p. 486). The success of the Alofa Tuvalu biogas project in Nanumea and Nanumanga using pig manure in small drum digesters raises the prospect of wider application, particularly in Funafuti which ultimately could reduce the use of LPG by providing a clean and inexpensive cooking fuel. In addition, the digester effluent or slurry provides a good and safe organic fertiliser (Cole and Dias, 2012, p. 8).

To summarise, life in contemporary Tuvalu is supported by physical and social infrastructure that provides the necessary livelihood services that enable the maintenance of a reasonable standard of living. Unlike Niue, Tuvalu comprises nine widely dispersed small islands, with over 50% of the population living in Funafuti, creating one of the most densely populated areas in the South Pacific. Furthermore, there is a disparity between Funafuti and the eight Outer Islands in terms of services available and employment opportunities resulting in continuing migration to Funafuti. As with Niue, while the transformation process from traditional to contemporary society commenced 200 years ago, most of the change has taken place in the past 30 years. The lack of resources in Tuvalu means that in order to maintain a reasonable standard of living, Tuvalu is reliant on ODA to assist in meeting the large trade imbalance to which fuel imports make a significant contribution while being necessary to enable provision of livelihood services. This reliance on imported energy will be examined in detail in Chapter 6 and in Chapter 7, the impact of a disruption to energy supply will be analysed.

CHAPTER 6: USING THE SUSTAINABLE LIVELIHOODS APPROACH AS A METHOD OF ANALYSIS.

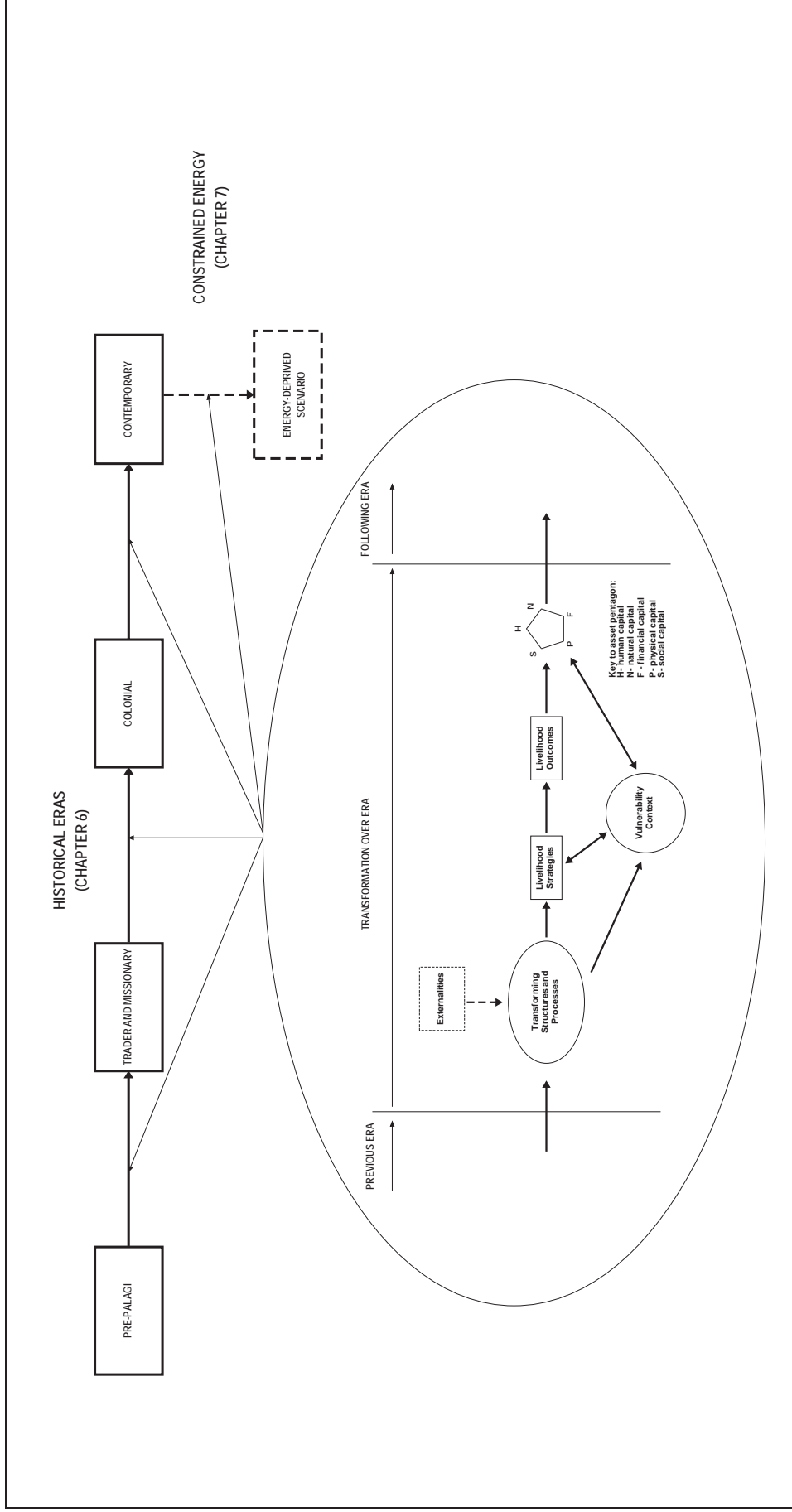
6.1 INTRODUCTION

In this chapter, the sustainable livelihoods approach is used to analyse livelihoods in Niue and Tuvalu over the four historical eras and to develop a series of livelihood profiles. Chapters 4 and 5 provide a historical narrative of the transformation of these two societies including the part that energy played in the transformation. The narrative is descriptive, however, and as such does not attempt to evaluate the extent of energy's contribution to transformation. This chapter is aimed at achieving a more complete understanding of energy's role in transformation by adopting an analytical process of that examines the components of people's livelihoods and, as such, is a continuation of the process of addressing the first research question.

As discussed in Chapter 3, the sustainable livelihoods approach provides a means to examine the impacts of influences such as energy across the spectrum of people's livelihoods rather than just by sector by sector. In this chapter, the methodology outlined in Chapter 3 is applied to analyse the transformation process and thereby gain an understanding of the extent that energy influenced transformation both directly and indirectly.

The DFID sustainable livelihoods framework is used as the model for analysis, the rationale being that the framework provides a tool that enables the impact of an externality such as energy supply to be evaluated not only in terms of the component directly impacted but also the indirect impacts on other components. For each country, livelihood profiles are developed for each of the four historical eras described in Chapters 4 and 5, namely the pre-palagi, the trader and missionary, the colonial and the contemporary eras. In the cases of the pre-palagi and trader and missionary eras, the assessment is a "snapshot" towards the end of the era. However, the assessment of the colonial era is of the early 1950s which is immediately before the development activities that were commenced by the colonial authorities as precursors to eventual (and inevitable) independence, the rationale for this approach is that this is more representative of livelihoods in the colonial era than if the assessment was of livelihoods in the 1970s immediately prior to independence. Central to the analysis is the transformation that took place through the historical eras and is continuing today in the contemporary era. The process of analysis, the development of which was discussed in Chapter 3 and illustrated graphically in Figure 11 and reproduced below as Figure 30, is discussed under two headings: the first being transformation and livelihood assets followed by the vulnerability context. The outputs from the analysis are represented as a series of livelihood pentagons and vulnerability profiles. Figure 30 shows the process in the form of a flow chart.

Figure 30– Process of Analysis



The process as illustrated is somewhat simplistic in that in reality there is feedback between the various components. For example, in a society where human capital increases through education, this could feed back to the transforming structures and processes as people become better educated and more aware of their political and human rights. However, in this analysis the primary objective is to understand how energy influenced the transformation process over a given era and the consequences in terms of changes to livelihood assets and vulnerability.

In the first part of the analysis, the overall process of transformation that took place in the two countries is examined for each era and starts by considering the three livelihood components listed below. A homogenous society is assumed but it is acknowledged that inequalities exist, particularly in Tuvalu, with a level of poverty and also disparities between people living in Funafuti and the Outer Islands in terms of access to services and employment.

- Transforming structures and processes - defined by DFID (1999b, p. 2.4) as “the institutions, organisations, policies and legislation that shape livelihoods”.
- Livelihood strategies - defined by DFID (1999b, p. 2.5) as “the overarching term used to denote the range and combination of activities and choices that people make/undertake in order to achieve their livelihood goals (including productive activities, investment strategies, reproductive choices, etc.)”.
- Livelihood outcomes - defined by DFID (1999b, p.2.6) as “the achievements or outputs of livelihood strategies”.

Livelihood assets for each era in the two countries are then analysed. As described by DFID (1999b, p. 2.3), the sustainable livelihood approach is founded on the concept that people require a range of assets to achieve positive outcomes, as represented by the asset pentagon in the DFID sustainable livelihoods framework (DFID, 1999b, p. 2.1). In the second part of the analysis, the vulnerability context is examined. As defined by DFID (1999b, p. 2.2), the vulnerability context “frames the external environment in which people exist” and can both destroy and create assets (DFID, 1999b, p. 2.3).

The following section describes the first part of the analysis: transformation and livelihood assets.

6.2 TRANSFORMATION AND LIVELIHOOD ASSETS

This section commences with the analysis of the transforming structures and processes for each era and is set out as a series of tables. Transforming structures and processes had a direct influence on the livelihood strategies that people adopted and the resultant livelihood outcomes, and which are shown graphically in a series of figures.

The changing transforming structures and processes over the four historical eras are notable in two respects: firstly, the increasing complexity of the structures and processes over time and secondly, the extent to which external factors – globalisation, evangelisation, colonisation and post-Second World War development in particular – transformed livelihoods in both countries. Similarly, the range and complexity of livelihood strategies increases over the four eras and in the figures that follow, guided by the DFID Sustainable Livelihoods Guidance Sheets (1999b), I have grouped livelihood strategies into four broad categories:

- Basic needs, which are essentially aimed at ensuring food security.
- Society, which covers the range of factors that determine how people live including governance, health care, education, housing and community organisation.
- Income, which covers employment and sources of income.
- Connectivity – an all-embracing term covering transport and communication services.

The figures also show outcomes and the linkages between strategies and outcomes which I have grouped into seven categories, again guided by the DFID Sustainable Livelihoods Guidance Sheets (1999b):

- Food security.
- Access to land and fisheries.
- Physical security – includes both external and internal risks.
- Sense of inclusiveness and human rights.
- Good health.
- Employment opportunities.
- Cash income.

In addition to the links between strategies and outcomes, there are “secondary” links between outcomes and these are shown as a broken line. For example, good health can impact on cash income by enabling a person to work while access to cash income can improve food security by enabling purchase of food.

The analysis moves to the development of a series of livelihood asset profiles to be shown graphically for each country and each era based on the DFID asset pentagon. As discussed in detail in Chapter 3, the sustainable livelihoods approach is asset based and the DFID framework is built around the asset pentagon with the five livelihood capitals: human capital, natural capital, financial capital, physical capital and social capital. Also discussed in Chapter 3 were the definitions of these capitals and the elements that contribute to each capital. Table 10 below summarises these elements together with examples.

Table 10: Livelihood Capitals

HUMAN CAPITAL	Examples
"skills, knowledge, ability to labour and good health"	
Knowledge – traditional and "formal"	Methods for growing of crops and for fishing, traditional medicine/healing; formal education through schools and tertiary institutions.
Pool of people with appropriate skills and knowledge and "ability to labour".	Ranges from skilled technicians/professionals to unskilled/semi-skilled.
Good health	Access to an effective health care
NATURAL CAPITAL	
"natural resource stocks from which resource flows and services useful for livelihoods are derived"	
Land	For agriculture/horticulture and for housing.
Fisheries	For seafood gathering, fishing
Forests	For wood for construction and for food (eg coconuts)
Indigenous energy sources- biomass, wind, sun, ocean.	Cooking fuel, electricity generation.
Access to water	Water for drinking water agriculture/horticulture.
PHYSICAL CAPITAL	
"the basic infrastructure and producer goods needed to support livelihoods"	
Affordable transport	Cars, motorcycles, bicycles, air services, shipping services, roads, airports.
Shelter	Housing.
Water supply	Piped supply, water tanks, desalination plant..
Sanitation and waste disposal	Sewerage, septic tanks, rubbish collections
Home appliances	Refrigerators, cooking appliances
Energy supply	Electricity, LPG, transport fuels
Communication systems	Telephone, internet, radio, TV
FINANCIAL CAPITAL ⁹¹	
"the financial resources that people use to achieve livelihood objectives"	
Cash inflows	Wages/salaries, payment for services, remittances, rents, welfare payments
SOCIAL CAPITAL	
"the social resources upon which people draw in pursuit of their livelihood objectives"	
Networks	Working together to achieve common goals through social, community or political action.
Relationships	Extended family or community-based relationships.
Memberships	Membership of formal or semi-formal groups or organisations with common goals/objectives rules and sanctions.
International links	Supportive political or economic relationships with other countries.

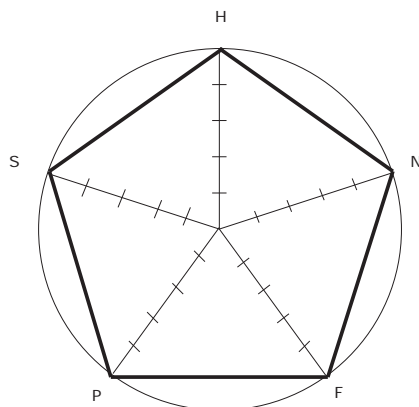
Based on DFID (1999b)

⁹¹ The "savings and tangible assets" element has been omitted as obtaining information on this element from informants was regarded as overly intrusive and of little relevance to the objectives of my research.

In order to illustrate the link between energy and livelihood assets in the various eras, I have developed a parallel series of “energy pentagons” which show the significance of energy in supporting each of the five capitals.

In an ideal situation, the asset pentagon will be as shown in Figure 31 where all five capitals are strong. Such an situation indicates that the vulnerability of such a community is reduced in that should an event occur that adversely impacts on one capital, the strength of the other capitals, while affected, means that the community is better able to withstand such an event – in other words, the resilience of the community is increased (DFID, 1999b, p. 2.3).

Figure 31 – The Resilient Livelihood Asset Pentagon



- H: Human capital
- N: Natural capital
- F: Financial capital
- P: Physical capital
- S: Social capital

A methodology has been developed to assign a value to each capital and the process of this analysis is set out in Appendix 2 for each of the four historical eras in Niue and Tuvalu. The valuation process which is described in detail below uses the literature and judgement based on both learnings from the field visits to Niue and Tuvalu and experience gained from energy-related projects in the South Pacific and elsewhere notably Indonesia and Yemen. The purpose of the pentagons is to provide an illustration of the asset profile in each era and the relative transformation that took place over time rather than provide absolute values. The valuation is made against an ideal but the ideal has to be realistic – for example, it is unrealistic to suggest an ideal where specialist medical care is available “in-country” in either Niue or Tuvalu given the population sizes. Of greater relevance is access to the capital even if this means travel to another country

in the region – noting that as discussed in Chapters 4 and 5, both countries receive funding support for such travel from the New Zealand Aid Programme and possibly from other international development agencies.

The livelihood energy pentagons were developed using a similar process to that used for determining livelihood asset values. The livelihoods energy pentagon is intended to be primarily illustrative of the role of energy in each of the capitals during the four eras. Unlike the asset pentagon, the energy pentagon is indicative of the relationship between energy and each of the capitals and there is no “ideal” pentagon as such. It is important to note that the value attributed to an energy factor is not directly related to the value of the corresponding capital. For example, in the case of physical capital in the contemporary eras in both countries, the energy pentagon gives a higher value for physical capital energy than for physical capital in the asset pentagon because firstly, physical capital includes energy supply and secondly, physical capital assets such as household appliances and motor vehicles rely on energy supply.

The process, which is set out in detail in Appendix 2, was carried out as follows:

1. Each of the five capitals is divided into elements as shown in Table 10 above.
2. Each element is evaluated and allocated an asset value in terms of the contribution of that element to the capital. The value is out of 10 with 10 indicating high value and zero no value. In some cases, while the asset value may appear high in terms of quality, the abundance may be limited or the ability of the community to access the element may be restricted or constrained and in such cases, the asset value is reduced. The valuation is intended to provide an indication of the capital values and in the discussion that follows, the values are classified as follows:

Value range	Classification
9 – 10	Very strong
7 – 8	Strong
5 – 6	Moderate
3 – 4	Weak
1 – 2	Very weak

3. The arithmetic averages of the elements of a capital are calculated and these are used to develop asset pentagons for each of the four historical eras.
4. An energy factor is allocated to each capital to indicate the magnitude of the link between the capital and energy. The capital can be a source of energy or a user of energy or a combination of the two. A factor of 10 indicates a strong link while 0 indicates little or no link. The energy factors are shown in the form of a livelihoods energy pentagon for each era.

When using Table 10 in the analysis set out in Appendix 2, it was necessary to take into account what can be described as the “norm” for the era under consideration. For example, a house in the pre-palagi era in Niue is believed to have comprised a pole-framed structure with thatched roof and walls using coconut palm fronds (Loeb, 1926, p. 90) and while this met the needs of people at the time, a house of this construction would not be considered adequate in terms of physical capital by contemporary standards. Similarly, the traditional knowledge of the pre-palagi and, to a large degree, also of the trader and missionary era enabled people to meet much of their livelihood needs in terms of human capital, a situation that no longer applies to the same extent in the contemporary societies of both countries.

As discussed in Chapter 3, there are linkages between the capitals in that a change in one capital may affect one or more of the other capitals. Similarly, a change in energy supply that impacts on one capital may also impact on other capitals. An example is the transport element of physical capital which relies on another element of physical capital in the form of imported fuels and as will be seen in the discussion below, in contemporary Niue and Tuvalu, any change to access to motorised transport – cars, motorcycles, trucks, planes and ships – will impact on all five capitals to some extent.

The discussion that follows discusses the outcomes of the analysis for each country over the four historical eras commencing with the components of livelihood transformation – transforming structures and processes, livelihood strategies and livelihood outcome – followed by livelihood assets.

6.2.1 Pre-palagi Era

As discussed in Chapters 4 and 5, the timing of the pre-palagi eras in each of the two countries is different. In the case of Niue, the pre-palagi era is defined as the period from the likely date of initial settlement of around 500 AD to 1830 when contact with the LMS missionaries commenced, albeit initially unwelcome (Talagi, 1982, p. 111). In Tuvalu, settlement is considered most likely to have commenced around 1400 with contact with palagi whalers commencing in the late 18th century, followed by traders in the 1820s and the LMS missionaries in 1860 (Roberts, 1958, p. 394; Tafaaki, 1983, p. 22) .

(a) Livelihood transformation

No doubt some transformation of society in Niue and Tuvalu will have occurred over the duration of the pre-palagi era. However, information on the extent and nature of this transformation is not available and any discussion would be based on speculation. As shown in Table 11 below, quasi-political structures did exist in the form of the magafaoa in Niue and the ‘clans’ in Tuvalu but were aimed more at retaining the status quo rather than achieving change (Percy Smith, 1983, p. 178; Tafaaki, 1983, p. 19). Any change was probably due to conquest either by another magafaoa or clan or by warriors from other South Pacific islands.

Table 11: Transforming Structures and Processes – Pre-palagi Era

COUNTRY	STRUCTURES	PROCESSES	EXTERNALITIES
<p>NIUE (Ref Chapter 4:4.3)</p>	<ul style="list-style-type: none"> Extended family or magafaoa patu Kingly system in place at times in an attempt to limit conflict. 	<ul style="list-style-type: none"> Rules and societal norms imposed by family chiefs or takitaki magafaoa with strict hierarchal/ class structure. Magafaoa access to land and fisheries subject to dispute and often resolved by physical conflict. 	<p>Incursions by warriors from Samoa, Tonga and Southern Cook Islands.</p>
<p>TUVALU (Ref Chapter 5:5.3)</p>	<p>Community or clan comprising a number of families under overall control of hereditary chief or ailiki.</p>	<ul style="list-style-type: none"> Rules and societal norms imposed by ailiki with strict hierarchal/class structure with roles and duties of families within community defined by tradition. Population strictly controlled to ensure sustainable access to resources. Community access to land subject to dispute and often resolved by physical conflict 	<p>Incursions by warriors from Samoa, Tonga and Kiribati.</p>

Livelihood strategies and outcomes as detailed in Figures 32 and 33 below were relatively simple with a focus on survival. Energy's role was limited to the gathering and use of woodfuel but nevertheless was a critical part of food security as without the ability to cook food, survival would have not been possible. Food supply would have been paramount and measures to ensure security of supply included repulsing attempts by warriors from other local families or clans and other South Pacific islands to expropriate resources. Spiritual or religious needs were met through the worship of local deities and in event of drought, these local deities were called upon for assistance, sometimes through the agency of a priest or shaman (Loeb, 1924, p. 396; Nia, 1983, p. 65). Traditional knowledge contributed to basic healthcare, arguably the most effective aspect of this being the policy in Niue to discourage visitors who may bring unwelcome disease (Etuata & Tanaki, 1982, p. 101; Fisk, 1978, p. 1; Percy Smith, 1983, pp. 6, 22). In Tuvalu, restrictions on family size were imposed in order to limit the population and the resultant stress on the limited land resources (Bedford et al., 1980, p. 207; Macdonald, 1982, p. 59). To summarise, livelihood strategies were aimed at maintaining a living society through the preservation of the status quo.

(b) Livelihood Assets

Niue

Details of the analysis are shown in Table 21 in Appendix 2 and the results are summarised below and illustrated in Figure 34. Human and natural capitals were strong in pre-palagi Niue. This is to be expected given that in the absence of financial and physical capital, people were heavily reliant on both these capitals to maintain the living society. However, both these capitals included weak elements. In the case of human capital, the weakest element was the lack of health care and while traditional healers existed, the effectiveness of their cures appears questionable (Loeb, 1924, pp. 397,399). Formal education services were non-existent but traditional knowledge is likely to have been strong and appropriate for the reason that if this were not the case, the community would not have remained in existence for several centuries. An example of the successful application of this knowledge was the policy of keeping visitors away to avoid the introduction of disease. Natural capital met all food needs but with some weaknesses that reduced the overall value, including, in particular, water supply which, as noted in Chapter 4, was completely reliant on adequate rainfall and as a consequence, when droughts occurred, the consequences were disastrous. The other weakness influencing the natural capital value – although to a much lesser degree – was the poor and rocky soils that posed a challenge to the growing of food crops. Financial capital was non-existent as there was no contact with palagi traders and therefore no commercial activity or need for it. Physical capital was limited to housing which as described in Chapter 4, was very basic. Social capital was strong in terms of the community as a whole but given the hierarchical nature of the magafaoa, there would have been little individual “political” freedom as such.

Figure 32 – Livelihood Strategies and Outcomes: Pre-palagi Era- Niue

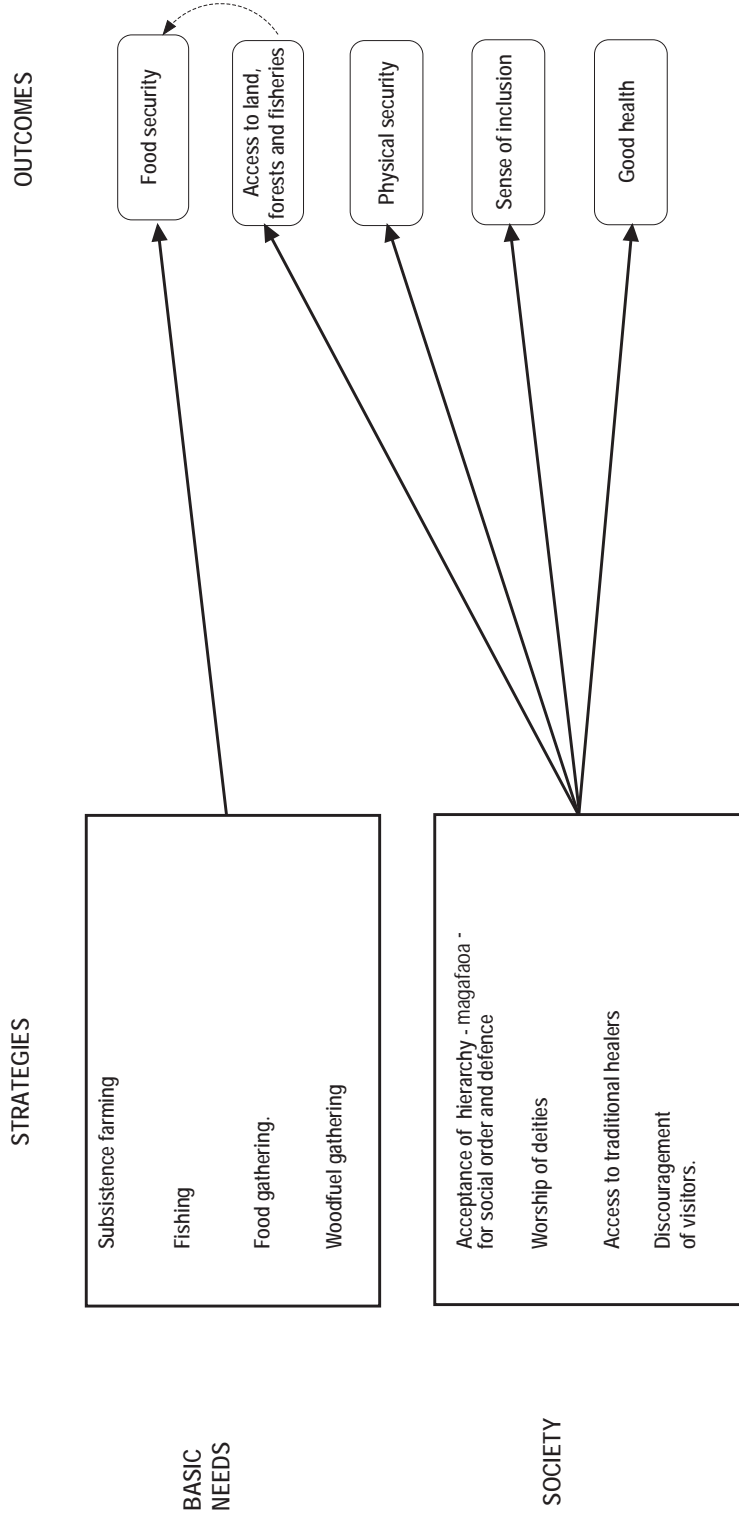


Figure 33 – Livelihood Strategies and Outcomes: Pre-palagi Era- Tuvalu

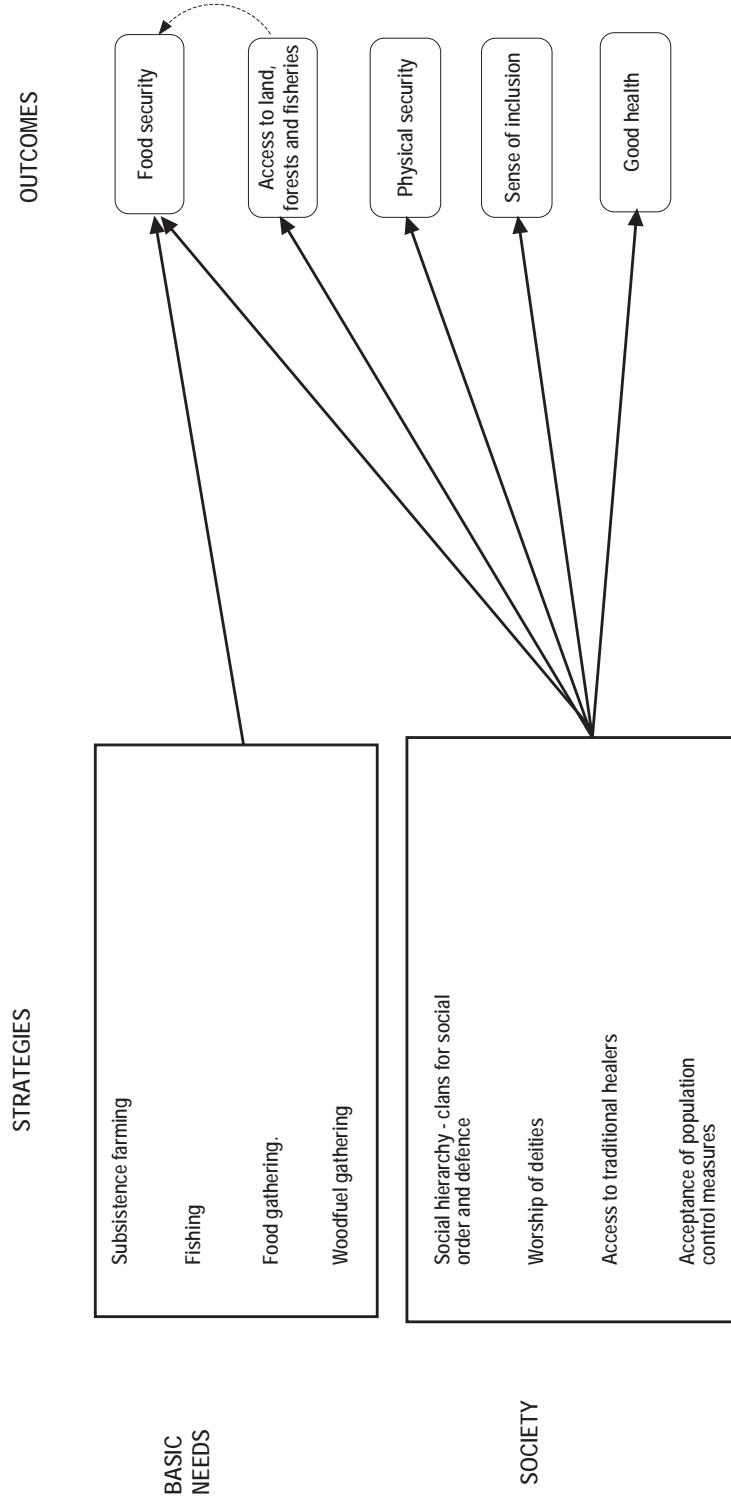
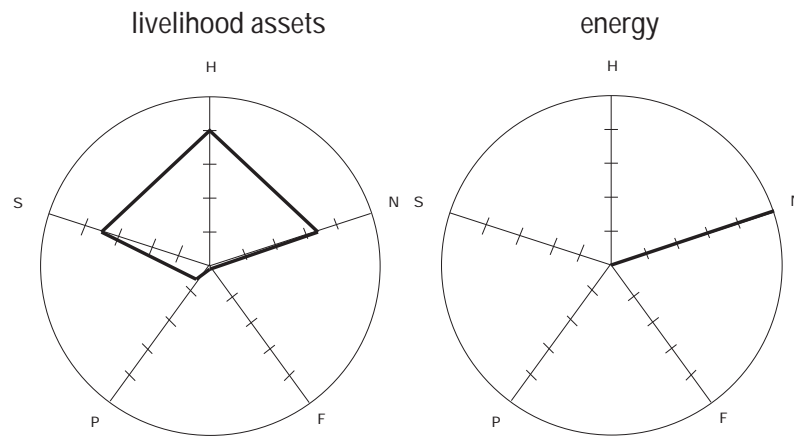


Figure 34 – Livelihood Pentagons: Pre-palagi era Niue



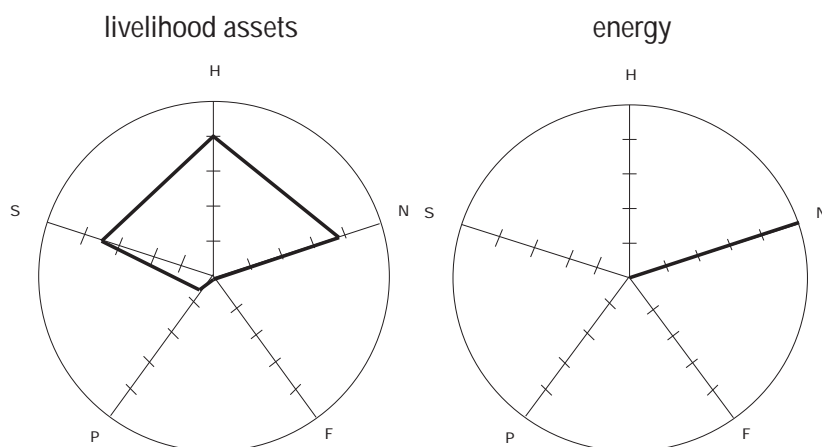
In terms of energy supply and usage, natural capital in the form of woodfuel had a vital role in pre-palagi Niue as a cooking fuel although, as noted in Chapter 4, it may have been used to provide some form of lighting at night and also for warmth during the cooler nights that can occur during the middle of the year. It is possible that natural capital energy in the form of solar radiation and wind might have been used for drying food or propelling canoes but I have not been able to find any reference in the literature to these applications. There was no energy in the form of physical capital, nor did energy have a role in the remaining three capitals. Consequently, the energy pentagon for pre-palagi Niue as shown in Figure 34 is very simple, comprising natural capital energy only, illustrating that all the energy needs were met from natural capital.

Tuvalu

Details of the analysis are shown in Table 25 in Appendix 2 and the results are summarised below and illustrated in Figure 35. The livelihood pentagons for pre-palagi era Tuvalu are very similar to those for Niue which is not surprising given that the societies were similar culturally and also in terms of climate and soil conditions.

Human, physical and social capitals were very similar to those of Niue while financial capital was also non-existent. Natural capital was marginally higher, reflecting what appears to have been a slightly better access to fresh water through the existence of some wells and water holes. However, poor soil conditions also prevail in Tuvalu. The access to natural capital may have been adversely affected had not strict population controls been in place (Bedford et al., 1980, p. 207; Macdonald, 1982, p. 59). Energy supply was met totally through natural capital in the form of woodfuel used for cooking.

Figure 35 – Livelihood Pentagons: Pre-palagi Era Tuvalu



6.2.2 The Trader and Missionary Era

As with the pre-palagi era, there were many similarities in the transformation process during the missionary and trader eras in Niue and Tuvalu. Arguably, the most significant difference is that the early Tuvaluans were willing to welcome visitors to their islands whereas in the case with the Niue, the opposite applied (Etuata & Tanaki, 1982, p. 101). As a consequence – and possibly also due to Tuvalu being on a busier shipping route – visits by palagi commenced earlier in Tuvalu with trade having commenced on a regular basis by the 1850s. As a result, traders were resident on some islands before the arrival of the LMS whereas in Niue, traders arrived after the LMS and although this is not entirely clear from the literature, it appears likely that the activities of the traders were supported by the LMS.

(a) Livelihood Transformation

The simple transformation structure and processes that existed in the pre-palagi era were subjected to major change during the trader and missionary era. As discussed in Chapters 4 and 5 and summarised in Table 12 below, the arrival of the LMS missionaries eventually resulted in the displacement of the takitaki magafaoa in Niue and the aliki in Tuvalu as rulers and the replacement with structures set up and controlled by the missionaries (Duckworth, 2002, p. 3; Talagi, 1982, p. 119). In both countries, laws were put in place by the missionaries which were largely aimed at controlling people's behaviour but also had benefit in eliminating physical conflict as a means of resolving disputes over land. The concept of trade was introduced with the arrival of the traders which, in the case of Tuvalu, predated that of the LMS. Trade not only introduced selling produce and handcrafts for money but also enabled the purchase of manufactured goods.

A demand for labour in plantations in the South Pacific led to young people from both Niue and Tuvalu to travel overseas and on return, use the cash income earned to purchase goods and materials. This commercial activity can be attributed to the “first phase of Globalisation” and which as discussed in Chapter 2, was a direct consequence of “northern” industrialisation and indirectly the new energy technologies that enabled industrialisation.

The impacts on livelihoods in the trader and missionary era in terms of livelihood strategies and outcomes are represented graphically in Figures 36 and 37 for Niue and Tuvalu respectively. In both countries, the simplicity of livelihoods in the pre-palagi era was replaced with a relatively complex framework. Woodfuel continued as the main energy source in its role as cooking fuel and as such remained an essential component of food security.

Otherwise, changes in energy supply had not yet had any significant direct impact on livelihoods other than the introduction of some steam ship services facilitating the importing and exporting of goods and providing passenger services. The rule of missionaries resulted in changes that necessitated a number of additional livelihood strategies. Conversion to Christianity replaced worship of local deities and rule of the missionaries may have been onerous in terms of imposed controls over personal behaviour. However, conflict as a means of settling disputes over land was replaced by negotiation and the absolute rule of the takitaki magafaoa and the aliki ceased. Other changes resulted from exposure to globalisation – for example, the ability to provide one’s labour for cash income and using that cash to buy goods – thereby increasing both financial and physical capital.

The links between outcomes also demonstrate the increased complexity of livelihoods in the era. It is noted that the figures in Appendix 2 do not attempt to measure the extent to which a strategy contributes to a change in an outcome; for example, while it is assumed that the basic education provided by the missionaries in both countries probably helped enhance employment prospects through the knowledge gained, it is difficult to judge how significant this was. Similarly, it is assumed that in Niue at least, the basic health care may have on occasions improved people’s ability to work and earn income.

Table 12: Transforming Structures and Processes – Trader and Missionary Era

COUNTRY	STRUCTURES	PROCESSES	EXTERNALITIES
<p>NIUE (Ref Chapter 4: 4.4).</p>	<ul style="list-style-type: none"> Village and central fono set up by LMS (who retained overall control). Magafaoa remain important but with reduced power. 	<ul style="list-style-type: none"> Written laws and justice/enforcement system put in place by the LMS mainly aimed at aimed at controlling people's behaviour. Law and order enforced by police force and administered by magistrates appointed by the LMS. Warfare as a means to resolve land disputes replaced by consultation. Basic education and health services introduced by LMS. Commercial activity introduced by LMS. 	<ul style="list-style-type: none"> Evangelisation – arrival of the LMS missionaries. The "First Phase" of Globalisation: <ul style="list-style-type: none"> Commencement of trade (encouraged by LMS missionaries) and travel by Niueans to work for wages overseas; Concern in Niue at increasing "great power rivalry" in the South Pacific. Concern at activities of labour recruiters and Peruvian slavers resulting in Royal Navy ships patrolling the region.
<p>TUVALU (Ref Chapter 5:5.4)</p>	<ul style="list-style-type: none"> Island councils or faipule set up by LMS pastors (Duckworth, 2002, p. 3). Role of aliki greatly reduced. 	<ul style="list-style-type: none"> Written laws put in place by the LMS pastors mainly aimed at aimed at controlling people's behaviour. Law and order enforced by police force and administered by LMS pastors. Warfare as a means to resolve land disputes replaced by mediation. Commercial activity commenced mid-19th century with traders eventually resident on most islands. Basic education introduced by LMS. 	<ul style="list-style-type: none"> The "First Phase" of Globalisation: <ul style="list-style-type: none"> Arrival of traders and commencement of trade; some travel by Tuvaluans to work for wages overseas. Concern at activities of labour recruiters and Peruvian slavers resulting in Royal Navy ships patrolling the region. Evangelisation – arrival of the LMS missionaries.

Figure 36 – Livelihood Strategies and Outcomes: Trader and Missionary Era – Niue

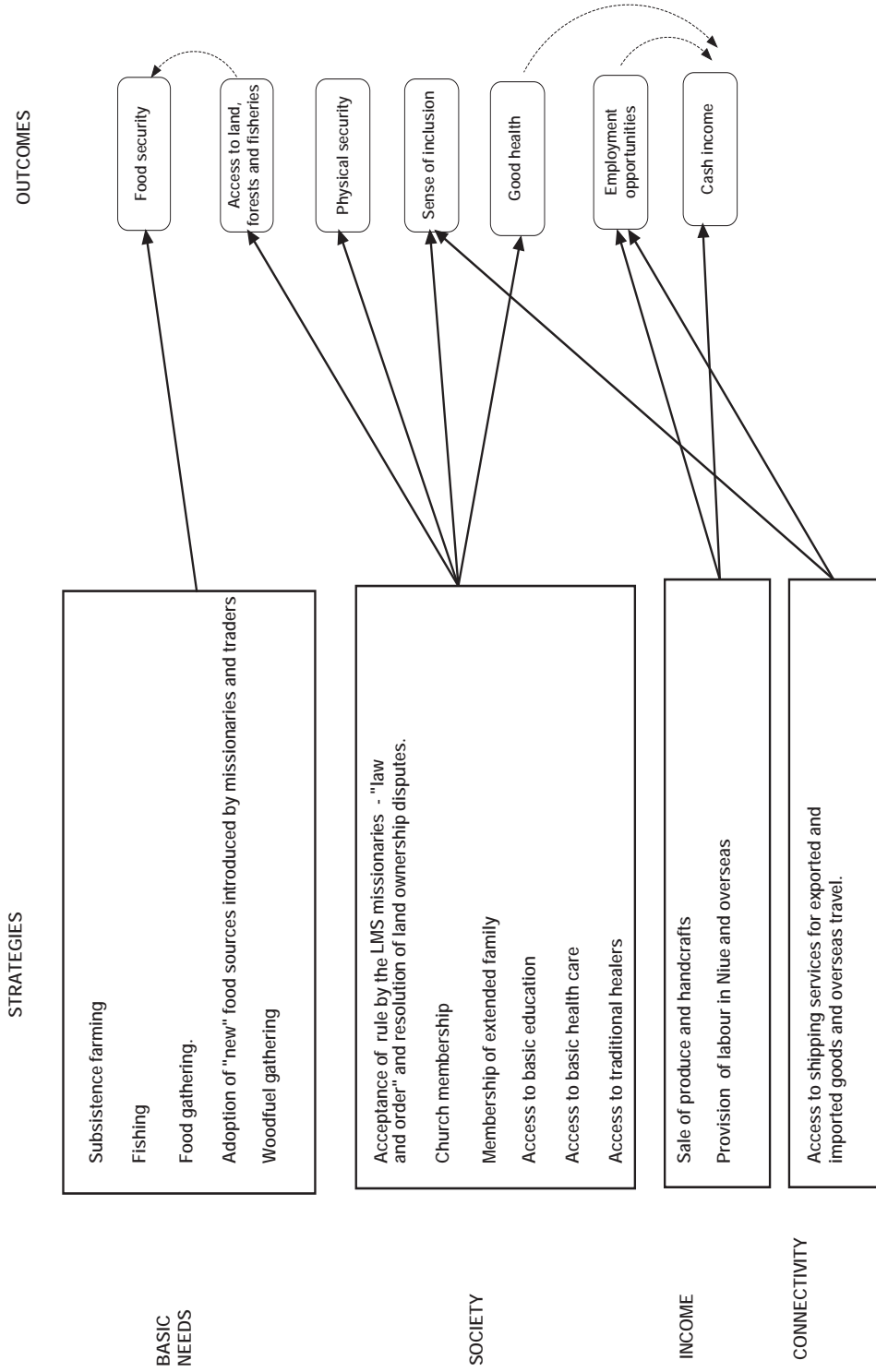
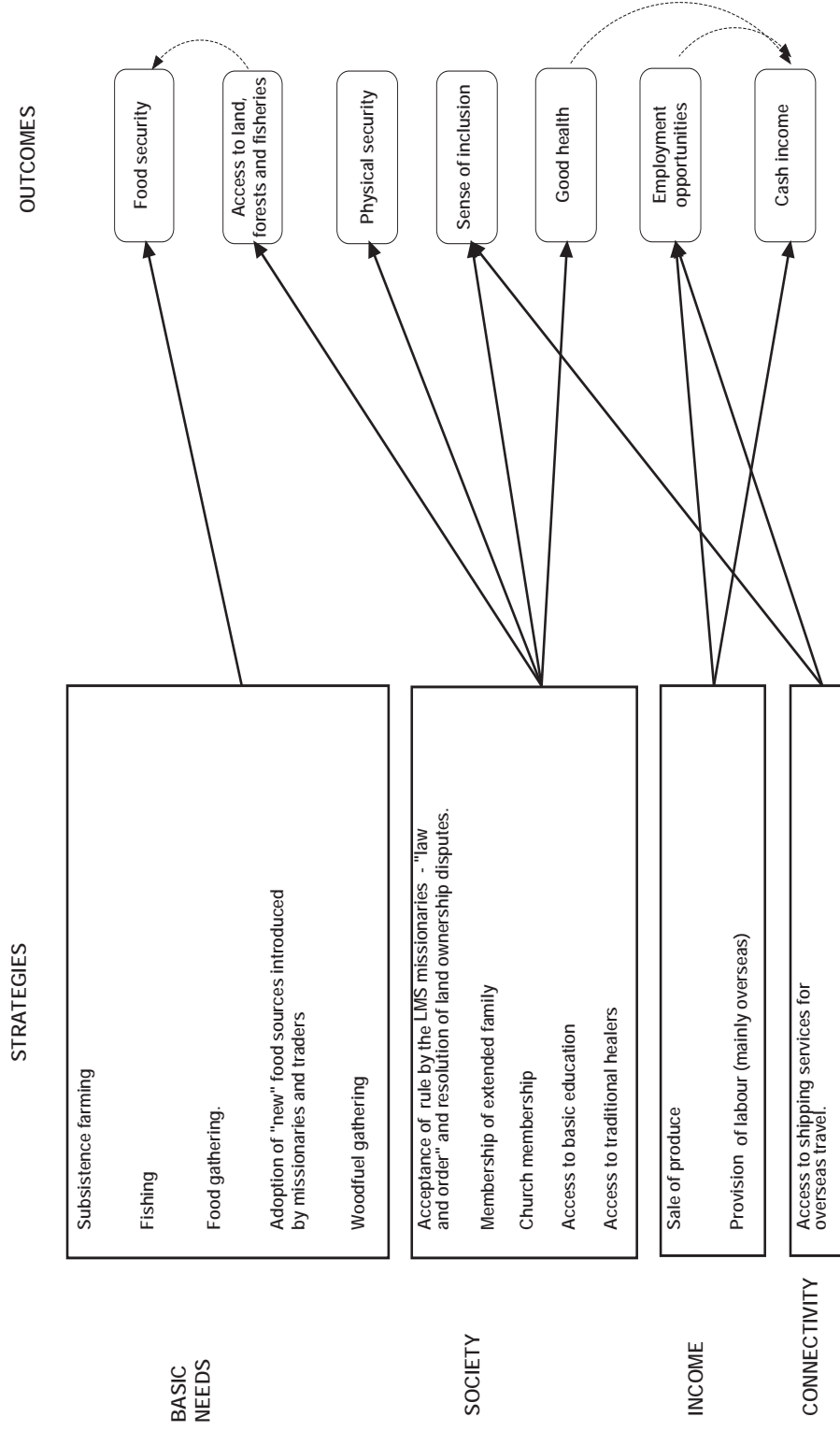


Figure 37 – Livelihood Strategies and Outcomes: Trader and Missionary Era – Tuvalu

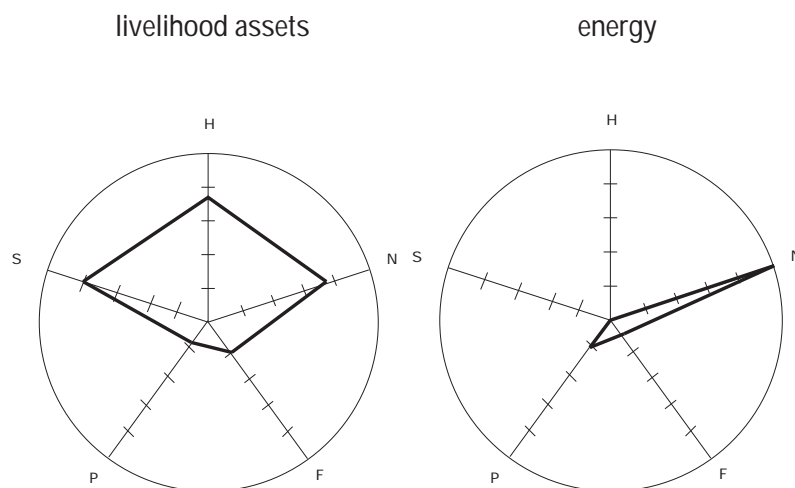


(b) Livelihood Assets**Niue**

Details of the analysis are shown in Table 22 in Appendix 2 and the results are summarised below and illustrated in Figure 38.

The livelihood strategies and outcomes discussed above resulted in changes to livelihood assets. In terms of impact on human capital, the trader and missionary era is likely to have had resulted in relatively minor changes to human capital from that of the pre-palagi era. As noted above, a low-level of formal education was introduced by the LMS but as described in Chapter 4, this was at a basic level aimed mainly at facilitating religious instruction; similarly, there was some basic health care but it is likely that this may have been outweighed by exposure of Niueans to new diseases introduced by the palagi visitors (Talagi, 1982, p. 118).

Figure 38 – Livelihood Pentagons: Trader and Missionary Era Niue



Natural capital continued to be strong being the only source of food and energy for most Niueans although small quantities of food may have been imported by the missionaries who also introduced new food sources including pigs and bananas.

As shown in Figure 38, the asset pentagon now shows small amounts of financial and physical capital which can be attributed to some degree to the introduction of commercial activity by George Lawes including payment for labour and goods and the arrival of the palagi traders. The commercial activity not only introduced the concept of financial capital but also enabled the purchase of goods which may have included household chattels and these together with the improved house construction will have resulted in a small level of increased physical capital. As the era progressed, some Niueans were recruited to work overseas and the wages earned will have added to financial and physical capital (Talagi, 1982, p. 119). Assessing the

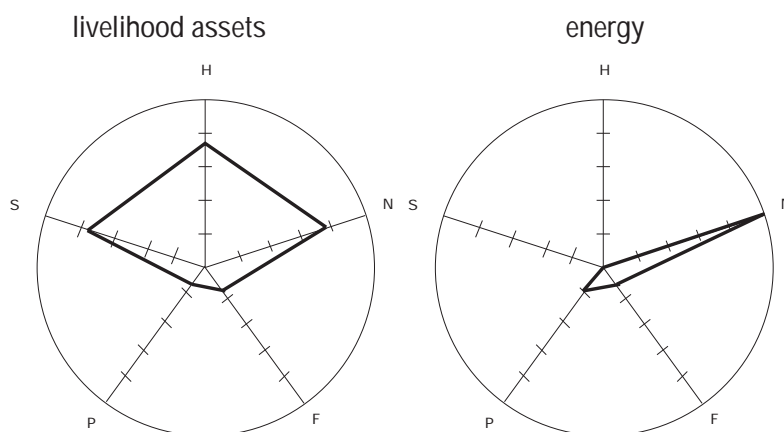
level of social capital is difficult: certainly, social capital would have been enhanced through the cessation of the apparently almost continuous conflict between the magafaoa and the introduction of a level of participation in community decision making through the introduction of the fono. However, as discussed in Chapter 4, the rule of the missionaries was seen as harsh at times, encouraging young people to seek work overseas and bringing back “bad ways” that disrupted the relatively calm day to day life in Niue (Heyn, 2003, p. 17; Talagi, 1982, p. 119). On balance, a small reduction in social capital is assumed to have occurred during this era.

Overtly, in terms of direct energy use, in Niue there was little change from the pre-palagi era and this is illustrated in the energy pentagon. There is likely to have been a small level of energy use related to physical capital in the use of kerosene for lighting by the missionaries and possibly in some better off households and the introduction of shipping services which at times involved steam ships which in turn used energy in the form of coal. There is also a link between these shipping services and financial capital with people travelling overseas for employment.

Tuvalu

Details of the analysis are shown in Table 26 in Appendix 2 and the results are summarised below and illustrated in Figure 39.

Figure 39 – Livelihood Pentagons: Trader and Missionary Era Tuvalu



As I noted earlier, in Tuvalu contact with palagi traders had commenced well before the arrival of the LMS missionaries. With this in mind, it is possible that financial capital may have been present before the arrival of the LMS missionaries together with some physical capital. While the missionaries discouraged the population control measures that prevailed during the pre-palagi era, the population increase during the era was not large – assisted by the activities of the Peruvian slavers in the respect to Funafuti and Nukulaelae – and there is no evidence that natural capital had come under stress as a result of any population increase

(Bedford et al., 1980). As in Niue, the missionaries provided some basic education and possibly health care although the success of the latter (if it existed) appears to have been largely negated by the introduction of new diseases. Social capital is judged to have increased slightly with the introduction of island councils replacing the all-powerful aliki – although the island councils were apparently dominated by the missionaries (Duckworth, 2002, p. 3) .

In terms of energy, natural capital in the form of woodfuel used for cooking continued to be dominant although there is reference in the literature to simple lamps using a cloth wick and a half coconut shell filled with coconut oil (David, 1913, p. 27). Financial capital as earnings either from selling goods to traders or working overseas will have had some dependence on shipping services that will in some cases have involved energy use. Physical capital will have included kerosene for lighting used by the missionaries and in better off households and energy used by the steamships providing cargo and passenger services.

6.2.3 The Colonial Era –the 1950s

The colonial era in both countries continued the gradual transformation that commenced during the trader and missionary era. As discussed in Chapters 4 and 5, there was no great enthusiasm by the initial colonial power, Great Britain, to take ownership of these two remote island communities and it is likely that the British government was happy to transfer the custody of Niue to New Zealand. What to do with these two communities with their limited resources remained an issue for the two colonial governments for much of the era.

(a) Livelihood Transformation

Initially, the colonial era had minimal impact in terms of transformation in either country. As shown in Table 13, the systems of governance put in place by the missionaries were largely adopted and continued by the colonial authorities in both countries with the Resident Commissioner taking over the role of the LMS as overall “ruler”. However, the influence of the church or Ekalesia remained strong in both countries and in the case of Tuvalu, the remote nature of the Outer Islands in particular meant that efforts by the colonial authorities to reduce this influence remain ineffective for much of the era (Hassall et al., 2011, p. 70; Rex & Vivian, 1982, p. 127). As discussed Chapter 2, by the 1950, the “era of development” was about to start, coupled with international pressure for decolonisation. These external pressures resulted in some first moves in the 1950s by the colonial authorities in both countries towards the limited social development described in Chapters 4 and 5.

Table 13: Transforming Structures and Processes – Colonial Era 1950s

COUNTRY	STRUCTURES	PROCESSES	EXTERNALITIES
<p>NIUE (Ref: Chapter 4: 4.5)</p>	<ul style="list-style-type: none"> Village and central fono set up by LMS largely retained by the colonial authorities with overall control moving from the LMS to the Resident Commissioner. LMS/Ekalesia retained significant influence throughout era. 	<ul style="list-style-type: none"> New laws enacted largely based on those drawn up by the LMS. Law and order enforced by police and justice/enforcement system with overall control by the Resident Commissioner. Education provision remained with the LMS until 1952. Health services established. Limited economic development mainly in the form of coconut and banana plantations providing employment opportunities 	<ul style="list-style-type: none"> Colonisation. Dawn of the “era of development” post-Second World War. Pressure for decolonisation increasing. Increasing reliance on imports (including fuels).
<p>TUVALU (Ref: Chapter 5: 5.5)</p>	<ul style="list-style-type: none"> Island councils or kaupule established on each island (based on the faipule set up by the LMS) LMS/Ekalesia retained significant influence throughout era. Retail cooperative society or fusi established to facilitate the sale of produce and purchase of goods. 	<ul style="list-style-type: none"> New laws enacted initialled based on those implemented by the LMS but progressively updated. Law and order enforced by justice/ enforcement system set in place by colonial authorities. Education provision on the islands remained with the LMS until 1953 with limited access to government-run secondary education available in Funafuti (later moved to Vaitupu) and in Kiribati. Health services established initially with medical officer in 1904 and hospital in 1913. Very limited economic development; main employment opportunity was working in Banaba in the phosphate mines. 	<ul style="list-style-type: none"> Colonisation. Discovery of phosphate on Banaba Second World War Dawn of the “era of development” post-Second World War. Pressure for decolonisation increasing.

Figure 40 – Livelihood Strategies and Outcomes: Colonial Era (1950s) – Niue

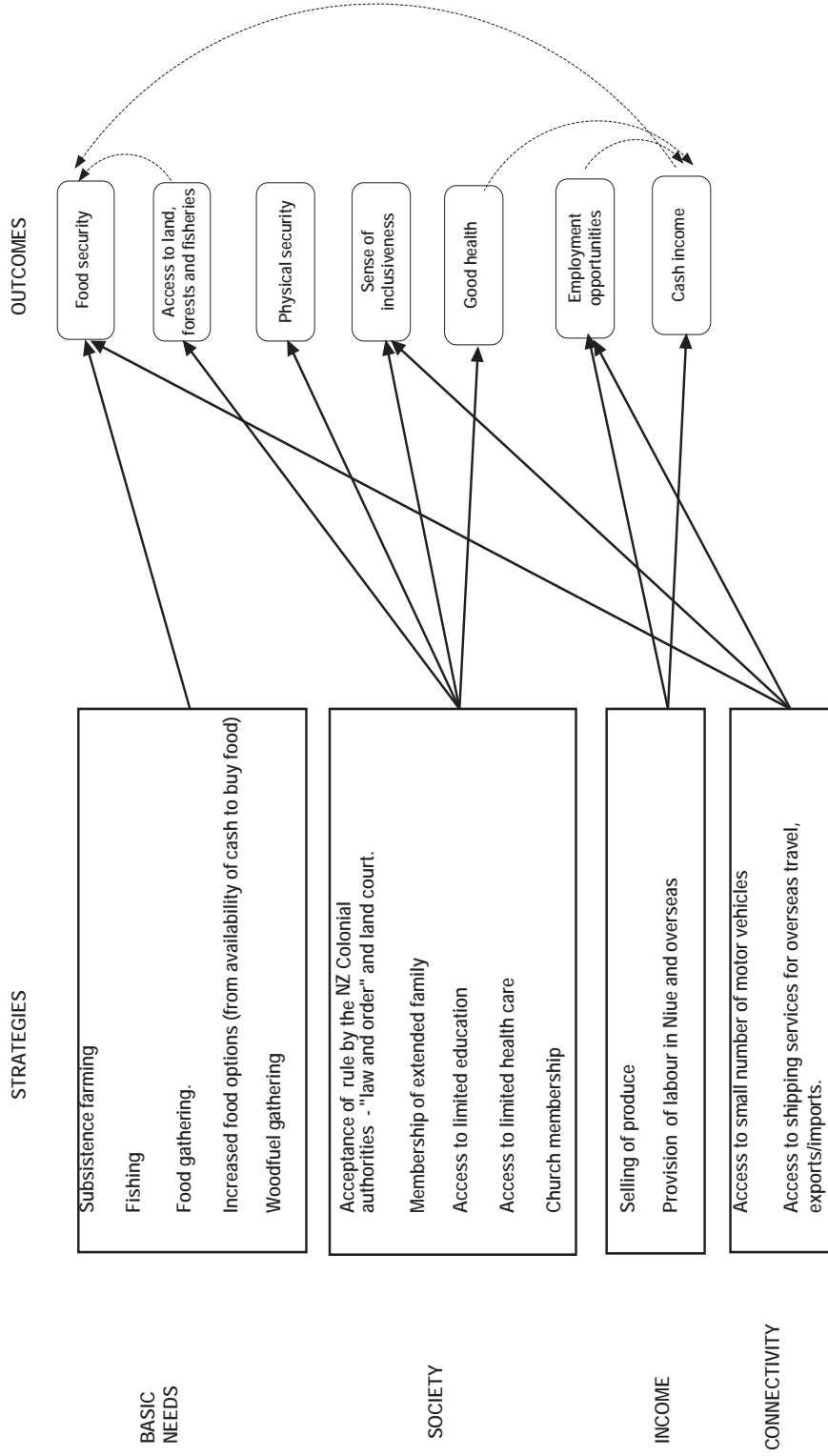
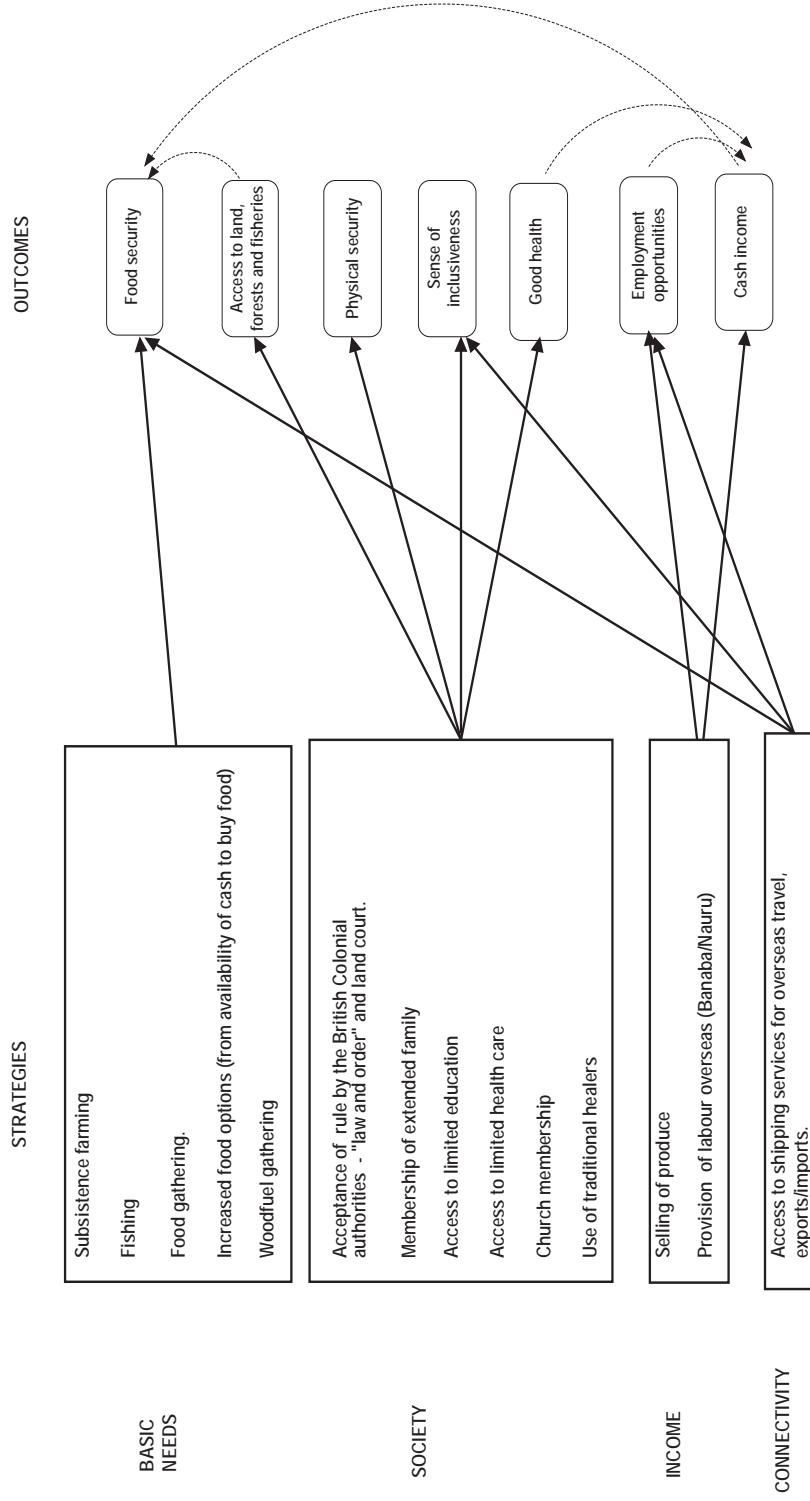


Figure 41– Livelihood Strategies and Outcomes: Colonial Era (1950s) – Tuvalu



As indicated in Figures 40 and 41, livelihood strategies had not changed a great deal during the colonial era up until the 1950s. In terms of energy use, woodfuel still remained the main energy source and while there was some use of kerosene lamps, it is difficult to assess the impact of this use in terms of livelihood impacts. However, it is likely that by the 1950s, the main hospitals in Niue and Funafuti would have been provided with diesel-powered electricity generators and this will have had a positive impact on the ability of the hospitals to provide effective medical treatment – but I have been unable to find any reference to this in the literature.

By the 1950s, there were regular shipping services serving both countries providing cargo and passenger services and enabling people to travel overseas for employment; this was of particular relevance for Tuvaluans who relied on employment in Banaba and Nauru as a source of cash income. Motor vehicles had made an appearance in Niue by the 1950s although as noted in Chapter 4, these were mostly for the transport of goods and for enabling people to visit the weekly market in Alofi. Subsistence farming and fishing continued as the main sources of food although as noted in Chapter 4 in Niue at least people were buying imported foods by the 1950s. Coconut and banana plantations provided some employment in Niue (Rex & Vivian, 1982, p. 129) and the phosphate mines in Banana provided the main source of employment for Tuvaluans (Faanui, 1983, p. 122). As the era progressed, some limited education and health services were instituted (Chapman, 1976, p. 7; Macdonald, 1971, p. 164); it is possible that these measures may have had a positive impact on people's employment opportunities and ability to work.

(b) Livelihood assets

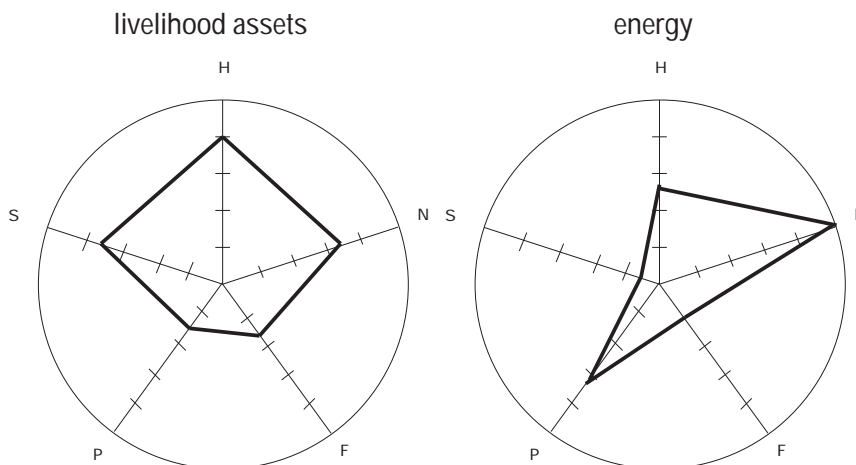
Niue

Details of the analysis are shown in Table 23 in Appendix 2 and the results are summarised below and illustrated in Figure 42.

In Niue, the period from 1901 to the 1950s was characterised by little economic and social development (Chapman, 1976, p. 8). However, some improvement in people's livelihoods took place over the 50 year period. Human capital benefited from the improved access in health and education services while the establishment of coconut and banana plantations in Niue provided further opportunities to earn wages and create financial capital (Rex & Vivian, 1982, p. 129). Furthermore, as discussed above, people travelled overseas for employment or as migrants in order to increase financial capital (Connell, 2008, p. 1023). In terms of natural capital, there was some improvement in water supply with two wells being constructed in order to provide some relief in the event of drought (Department of Island Territories, 1955, p. 64). As can be seen in Figure 41, the largest increase was in physical capital with the introduction of regular shipping services, increased use of kerosene lighting, on-site electricity generation at the hospital and wireless station and a small number of motor vehicles. In terms of individual political influence, social capital appears to have

remained unchanged from the trader and missionary era with the New Zealand Resident Commissioner taking over the governance role of the LMS while LMS as the Ekalesia retained considerable influence. On the other hand, the availability of motorised transport (albeit limited) and regular shipping services increased social capital in terms of mobility and connectivity (Cook Islands Administration, 1929, pp. 24,34).

Figure 42 – Livelihood Pentagons: Colonial Era Niue



The increasing relevance of energy is shown in the energy pentagon. The reliance on woodfuel for cooking continued as indicated by the high level of natural capital energy. The role of physical capital energy increased substantially as this provided the fuel for monthly shipping services, for electricity generation at the hospital and wireless station and for the small number of motor vehicles (Cook Islands Administration, 1926, p. 36; 1929, p. 34). The services these provided or enabled flowed through into increased human capital (improved health services), financial capital (facilitating movement of people and goods through motorised transport and regular shipping services) and social capital (improved mobility and connectivity).

Tuvalu

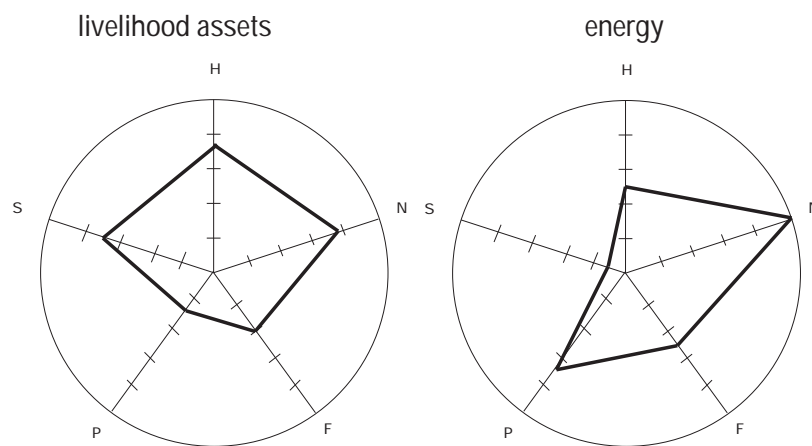
Details of the analysis are shown in Table 27 in Appendix 2 and the results are summarised below and illustrated in Figure 43.

From all accounts, as was the case with Niue, little or no economic and social development took place in Tuvalu during the colonial era up until the 1950s. As noted above, late in the era some efforts were made to improve access to education and health services and this will have resulted in a small increase in human capital and which is likely to have flowed through into improved financial capital through an increased ability to work (Macdonald, 1971, p. 118; Sapoaga, 1983, p. 146). On the other hand, natural capital is judged to have dropped slightly mainly as a result of the environmental damage that occurred during the Second World

War, notably the construction of airstrips on three islands which reduced land available for the growing of crops (Telavi, 1983, p. 142).

The opportunity to work in Banaba will have provided additional financial capital, thereby enabling people to buy goods resulting in an increase physical capital (Faanui, 1983, p. 22). Social capital is likely to have remained virtually the same as in the trader and missionary era. While the colonial authorities attempted to limit the power of the Ekalesia through a series of local government reforms aimed at increasing participation in decision-making at island level, it appears that these were only partly successful with the influence of the Ekalesia remaining strong.

Figure 43 – Livelihood Pentagons: Colonial Era Tuvalu



In terms of energy, as was the case in Niue, the importance of natural capital remained strong with the continuing reliance on woodfuel for cooking. The increased financial and physical capitals depended largely on shipping services for transport between Tuvalu and Banana requiring energy in the form of fuel. Shipping services will also have been a factor in improving human capital, particularly in education which necessitated travel to Vaitupu and Tarawa and possibly in health through travel to the hospital in Funafuti for treatment.

6.2.4 The Contemporary Era

Significant development took place on both countries during the last stages of the colonial era and continued into the contemporary era. However, in terms of infrastructure and the services that this supports, as can be seen from the descriptions in Chapter 4 and 5, Niue is considerably better off than Tuvalu. In part, this can be attributed to geographic reality with Niue comprising one relatively large island while Tuvalu is made up of nine and scattered small islands with a total land area one tenth that of Niue. Undoubtedly, though, a

major factor in the difference between the two countries was the highly favourable independence settlement that Niue achieved with New Zealand compared with that achieved by Tuvalu from Great Britain.

(a) Livelihood Transformation

Both countries inherited a “Westminster” constitutional framework which largely remains in place as shown in Table 14 below. As described in Chapter 4, the Niue Constitution Act 1974 while setting up the system of government for Niue also provided for continuing financial and administrative support from New Zealand which included the automatic right of New Zealand citizenship for Niueans. As a consequence, Niue receives considerable financial assistance in the form of ODA from New Zealand. As discussed in Chapter 4, this ODA has enabled Niue to provide good quality health and education services and the physical infrastructure to support those and other livelihood services. One consequence of the high standard of living is a heavy reliance on imports – of which energy is a major part – and a negative trade balance which has to be compensated by ODA.

At independence Tuvalu had no distributed electricity supply and still has no distributed water supply. Health and education services were in place but the geography of Tuvalu created challenges to providing services of a high standard throughout the country and particularly in the Outer Islands; these challenges remain. Electricity distribution systems are in place in eight of the nine islands, the exception being the small island of Niulakita. Access to an electricity supply together with communication and transport infrastructure enables a reasonable standard of living for most Tuvaluans but as noted in Chapter 5, there is a level of poverty and significant stress from over-population in Funafuti.

As shown in Table 14, Tuvalu receives ODA from a number of countries and is vital in maintaining the current standard of living. This is due largely to Tuvalu's lack of exploitable economic resources and without ODA, Tuvalu could not afford to import the food and energy in the form of petroleum fuels necessary to maintain livelihoods at the current level. Also important is the Tuvalu Trust Fund which, as described in Chapter 5, was set up in 1987 by a number of Tuvalu's international partners with the expectation that income from the Fund would provide budgetary assistance to the government. Unfortunately, since the Global Financial Crisis of 2008 Tuvalu has received no income from the Fund. The threat of sea level rise as a result of climate change is a major concern to Tuvalu and the government has drawn international attention to Tuvalu's vulnerability in this respect (Connell, 2013, p. 243).

Table 14: Transforming Structures and Processes – Contemporary Era

COUNTRY	STRUCTURES	PROCESSES	EXTERNALITIES
NIUE (Ref Chapter 4: 4.6)	<ul style="list-style-type: none"> Government Ministries and Departments. State owned enterprises. Commercial enterprises (retail, tourism, hospitality). NGOs – (examples include Niue Youth Council, Chamber of Commerce). Ekalesia Niue – retains some influence. 	<ul style="list-style-type: none"> Niue Constitution Act 1974 – established the Niue Legislative Assembly or Fono Ekepule. Fono Ekepule elected through universal suffrage with a three year term. Provisions of Constitution provide for continued financial and administrative support. Legislation (statutes and associated regulations). Law and order maintained by police force and administered by court system. Quality of life maintained through health and education services, physical infrastructure (electricity, water supply, transport and communication services) 	<ul style="list-style-type: none"> ODA – New Zealand, Australia, Japan and EU. High reliance on imports, including fuels. Pressure from New Zealand for increased self-sufficiency. Impacts of climate change.
TUVALU (Ref Chapter 5: 5.6)	<ul style="list-style-type: none"> Government Ministries and Departments. State owned enterprises. Tuvalu Cooperative Society (fusi). Commercial enterprises (retail, hospitality). NGOs. Ekalesia Tuvalu – retains strong influence. 	<ul style="list-style-type: none"> Constitution of Tuvalu – promulgated at independence in 1978 and amended in 1986. Fale i Fono elected through universal suffrage with a four year term. Law and order maintained by police force and administered by court system. Legislation (statutes and associated regulations). Quality of life maintained through health and education services, physical infrastructure (electricity, transport and communication services). 	<ul style="list-style-type: none"> Impacts of climate change. ODA – New Zealand, Australia, Japan, Taiwan and EU. High reliance on imports, particularly food and energy. High exposure to global financial crises.

Figure 44 – Livelihood Strategies and Outcomes: Contemporary Era – Niue

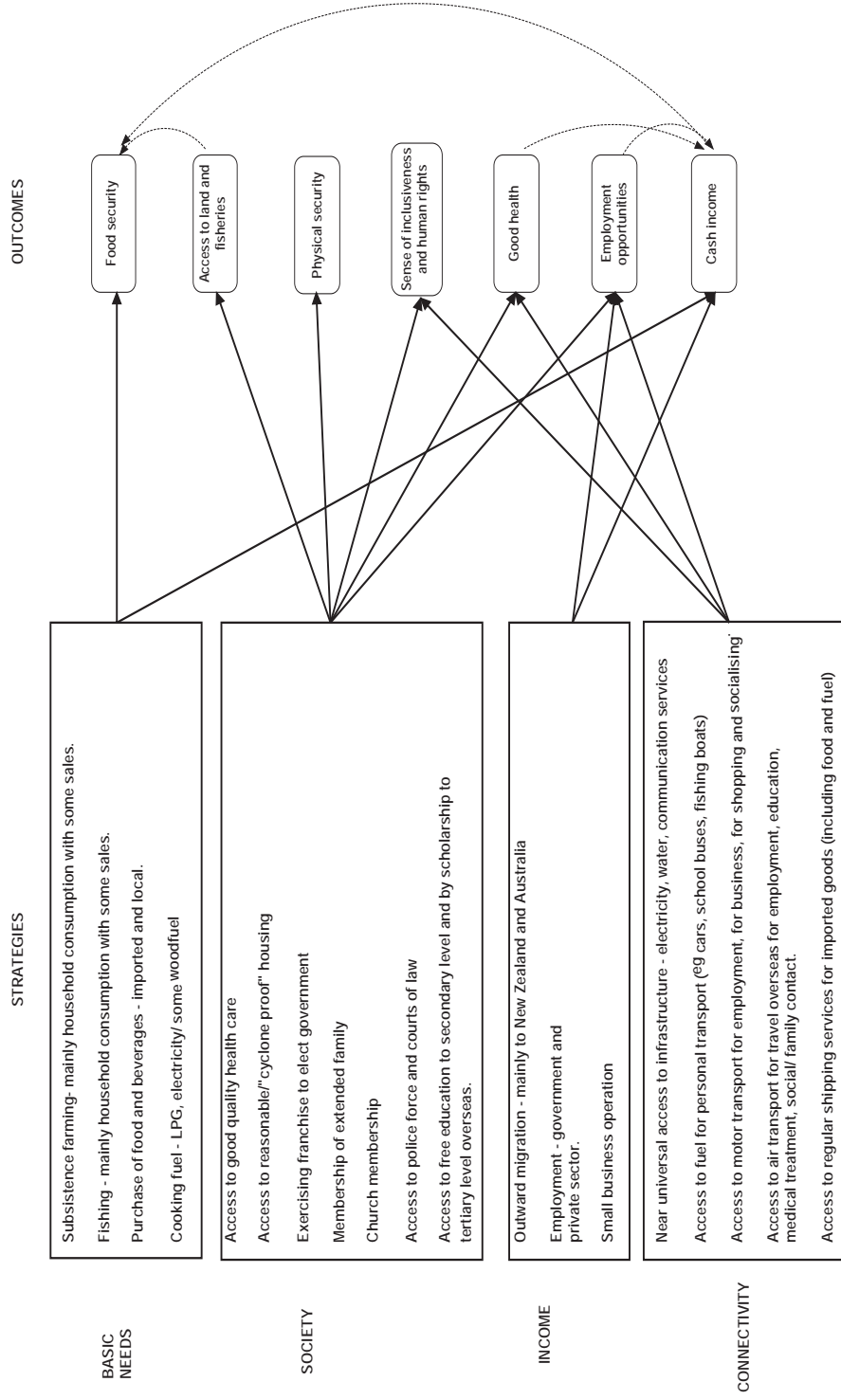
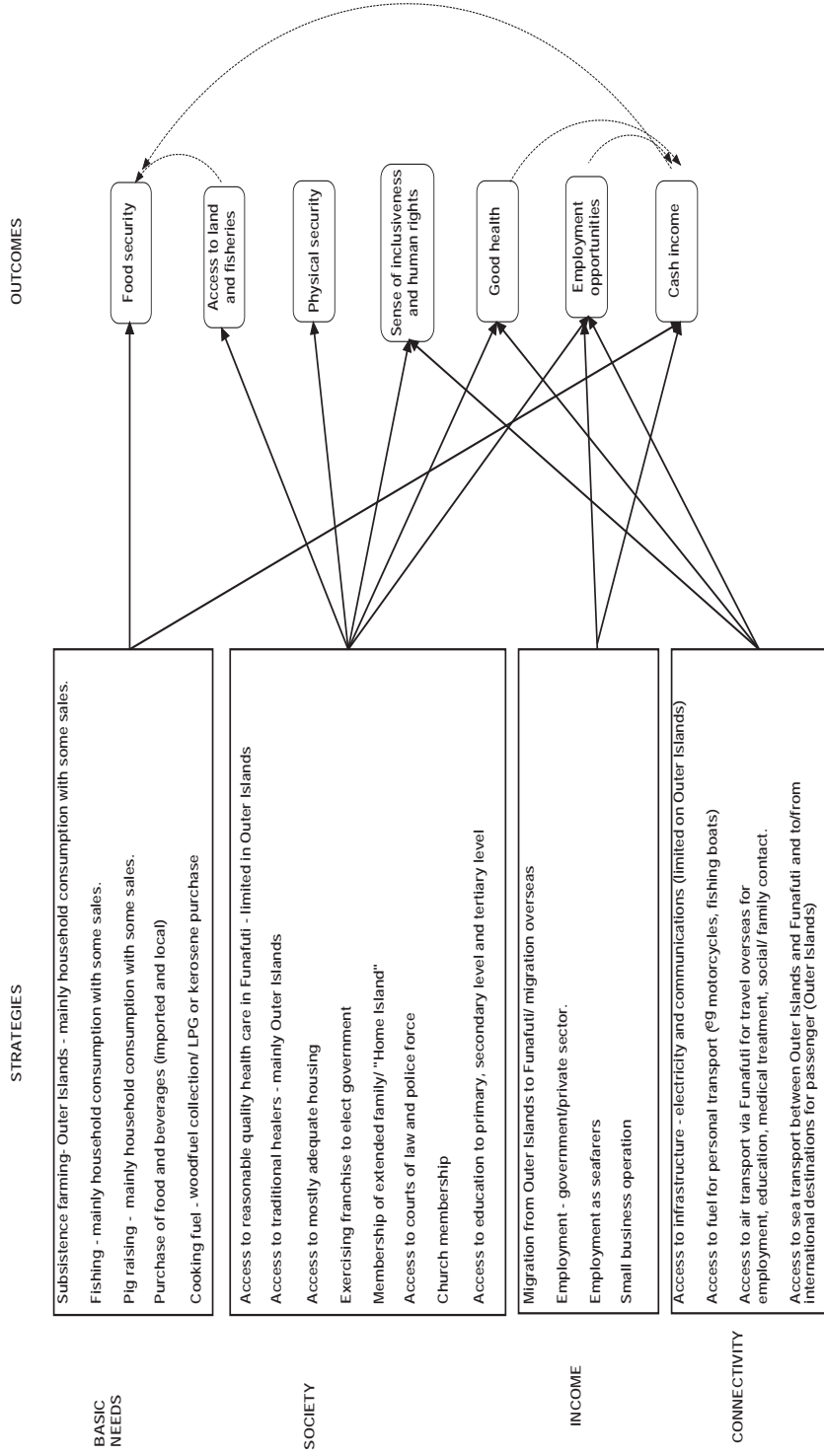


Figure 45 – Livelihood Strategies and Outcomes: Contemporary Era – Tuvalu



Figures 44 and 45 illustrate the increased complexity of contemporary livelihoods in both Niue and Tuvalu. Also illustrated is the increased role of energy in supporting livelihood strategies, notably in directly enabling the provision of electricity and transport services which in turn support the range of livelihood services that are an essential feature of livelihoods in both countries. Migration is a livelihood strategy in both countries but with different consequences: in Niue, the migration is to New Zealand and to Australia, the motivation being to seek better opportunities in terms of employment in particular and the result has been depopulation.

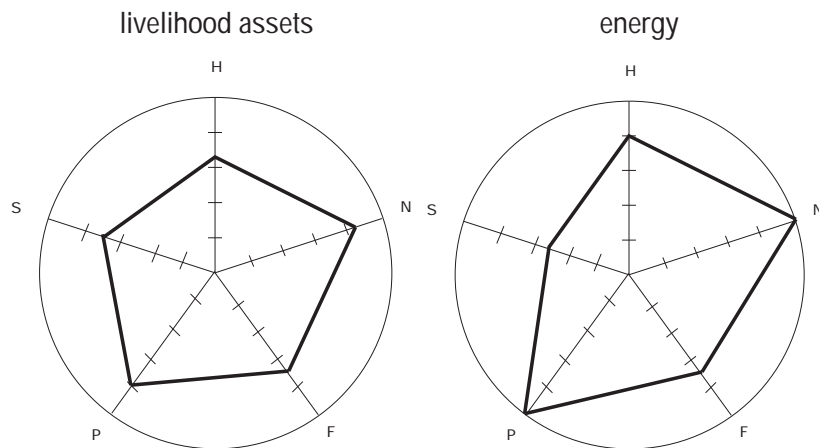
In Tuvalu, the migration is from the Outer Islands to Funafuti, again mainly to seek better employment opportunities and probably exacerbated by the disparity in health and education services between Funafuti and the Outer Islands and the somewhat unreliable shipping services between Funafuti and the Outer Islands. The result is two-fold: depopulation of the Outer Islands and over-population of Funafuti, the consequences of which include poor housing and risks to health through inadequate sanitation. Efforts by the government to stem the migration to Funafuti including the passing of the Falekaupule Act 1997 have not proved successful to date. As discussed in Chapters 4 and 5, working for the government is another strategy common to both countries. However, both countries have strategies in place to encourage private sector employment, notably the tourism project in Niue and the National Strategy for Sustainable Development 2005 – 2015 or Te Tekakeega II in Tuvalu (Government of Tuvalu, 2005; Hall, 2009). As noted in Chapters 4 and 5, according to informants, the importance of the extended family has decreased during the contemporary era in both Niue and Tuvalu although in Tuvalu, an individual's home island is clearly of importance in terms of identity. One's extended family links, however, become very important when issues of land ownership arise.

(b) Livelihood assets

Niue

Details of the analysis are shown in Table 24 in Appendix 2 and the results are summarised below. As shown in Figure 46 below, the asset pentagon is more balanced in terms of asset values. Overall, this suggests reasonable levels of wellbeing and resilience. Human capital is above average in value than for previous eras but lower than natural and physical capitals in spite of access to good and reportedly effective health and education services, this being due to the low population and the resultant lack of a labour pool. Financial capital is moderate; this capital was difficult to evaluate because while income in the form of wages is relatively low, people appear to be reasonably well-off in terms of adequate housing, ownership of “mod-cons” and vehicle ownership. With this in mind, it is possible that my assessment might be lower than justified.

Figure 46 – Livelihood Pentagons: Contemporary Era Niue



Natural capital is strong which is largely due to the low population density enabling good access to land to grow crops in bush gardens and to the sea and seashore to fish and gather seafood. Also strong is physical capital reflecting the good physical infrastructure, the closely related level of home appliance and vehicle ownership and adequate transport services in the form of shipping and air services. Social capital is moderate with the relationship element assessed as being relatively weak owing to the influence of the extended family being less than in the past, possibly influenced by marriage outside of the extended and migration overseas, mainly to New Zealand.

In contemporary Niue, energy supply has an influence on all five livelihood capitals and this is demonstrated in the energy pentagon. The influence of energy can be direct and obvious, as in natural and natural and physical capital where both these capitals include strong elements of energy supply and usage. Natural capital has traditionally been an essential source of energy in the form of woodfuel and while this may have reduced in importance, another natural capital resource in the form of solar energy used for electricity generation is becoming increasingly important. However, physical capital provides over 90% of energy requirements in the form of imported fuels while including the infrastructure that accounts for much of the fuel usage – electricity generation and distribution, transport, household appliances and communications. There are also a number of less obvious beneficiaries of energy supply such as elements of human capital including health and education services, both of which as described in Chapter 4, rely on electricity to a greater (health) or lesser (education) degree. Some benefits are indirect: for example, increased physical capital in the form of household appliances reduces time spent on household activities which provides greater opportunity for income generation (increased financial capital) and involvement in community/political, church or family activities (increased social capital). A subtle but very significant influence across all five capitals is the reliance on private motor vehicles for transport for a variety of

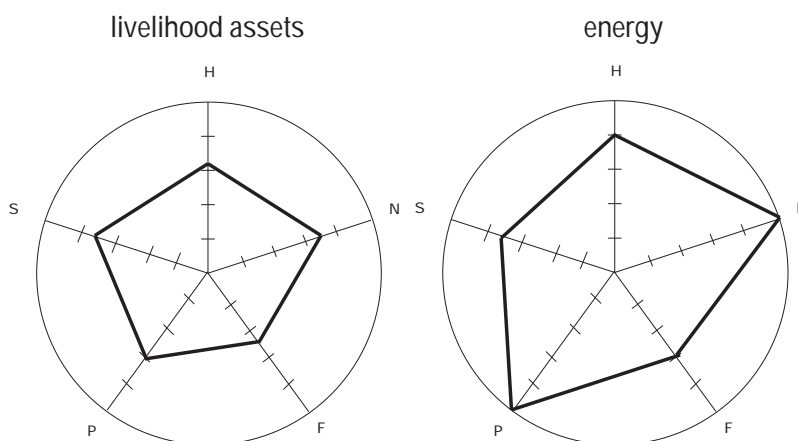
livelihood activities including travelling to and from places of work, bush gardens and social activities. Similarly, modern communication systems which rely on electricity, while categorised as part of physical capital, impact positively on human and social capital. In the case of human capital, television, radio and the internet contribute to connectivity with the outside world and enhance education both in formal and informal senses. Social capital is increased through the ability to readily communicate with absent extended family members.

Tuvalu

Details of the analysis are shown in Table 28 in Appendix 2 and the results are summarised below and illustrated in Figure 47.

As can be seen in Figure 47 the asset pentagon for contemporary Tuvalu is also balanced but with asset values generally less than that of Niue. This suggests a lower standard of living, an assumption that is supported by a GDP in 2011 of approximately \$3,700⁹² per capita compared with Niue with a GDP in 2009 of \$16, 575 per capita. (MFAT, 2014c, 2014d)

Figure 47 – Livelihood Pentagons: Contemporary Era Tuvalu



Human capital is judged to be average, the value being depressed by health and education services that can best be described as fair in quality and in access, particularly in respect to those living on the Outer Islands. In the case of Funafuti, there are public health risks associated with poor sanitation and poor housing. Natural capital is assessed as moderate mainly because of land access issues in Funafuti and the risk of drought with the increased population stretching water resources and also ground water pollution in Funafuti. The low level of financial capital is influenced by a level of poverty throughout society and reliance on a subsistence lifestyle in the Outer Islands. Physical capital is judged to be moderate only; electricity

⁹² Converted from \$A3,273 per capita (Tuvalu Central Statistics Department, 2013).

supply is good on Funafuti and fair in the Outer Islands with a reasonably high level of home appliance ownership (Kaly, 2013, p. 58). On the other hand, water supply infrastructure is inadequate and effective sanitation non-existent (ADB, 2006, pp. 110, 111). Social capital is shown as moderate having dropped a little since the colonial era, this being mainly due to migration to Funafuti and while the connection with people's home islands remains strong when living in Funafuti, there is some social cost particularly the inability to buy land for housing. On the other hand, the internet has improved connectivity between separated families, in particular families of seafarers.

Although the asset pentagon as shown in Figure 47 does not indicate a strong livelihood profile, the reliance on energy is still high. Health and education services rely on electricity. Natural capital in the form of solar generation is an increasingly important source of energy while woodfuel is still extensively used. There is a heavy reliance on physical capital in the form of imported fuels while physical capital assets rely on energy, including transport services, communications and household appliances. Financial capital relies on employment in the government sector which is a major user of electricity and on remittances from seafarers working on overseas ships. Physical capital in the form of communication services enhances social capital through enabling family members to keep in touch, particularly those families that include seafarers.

6.2.5 Summary

Figures 48 and 49 below summarise the outputs of the analysis as discussed above in terms of the asset and energy pentagons and compares the changes over the four eras in each country. Both series of pentagons show a steady increase in both assets and in the role of energy. The asset pentagons are very similar for both countries for the first three historical eras except that the financial capital is judged to have been marginally higher in Tuvalu than Niue as a result of significant numbers of Tuvaluans working for wages in Banaba and Nauru. However, while both pentagons for the contemporary era are balanced, the values of capitals in Niue are higher, indicative of the higher standard of living. Notably, in Niue human capital is the weakest being rated as of "moderate" strength while the other capitals are rated as "strong", a situation that can be attributed to the small population which creates problems in terms of a lack of a labour pool on one hand and lack of opportunity on the other. Contemporary Tuvalu does not suffer from lack of people but rather a lack of opportunity for people to gain appropriate skills, particularly those living in the Outer Islands; this is reflected in the borderline "moderate" financial capital owing to some unemployment and underemployment as represented by poverty. Unfortunately, the steady reduction in employment of seafarers by overseas shipping companies is likely to exacerbate the situation.

Figure 48 – Livelihood Asset Pentagons over time : Pre-palagi to Contemporary Eras

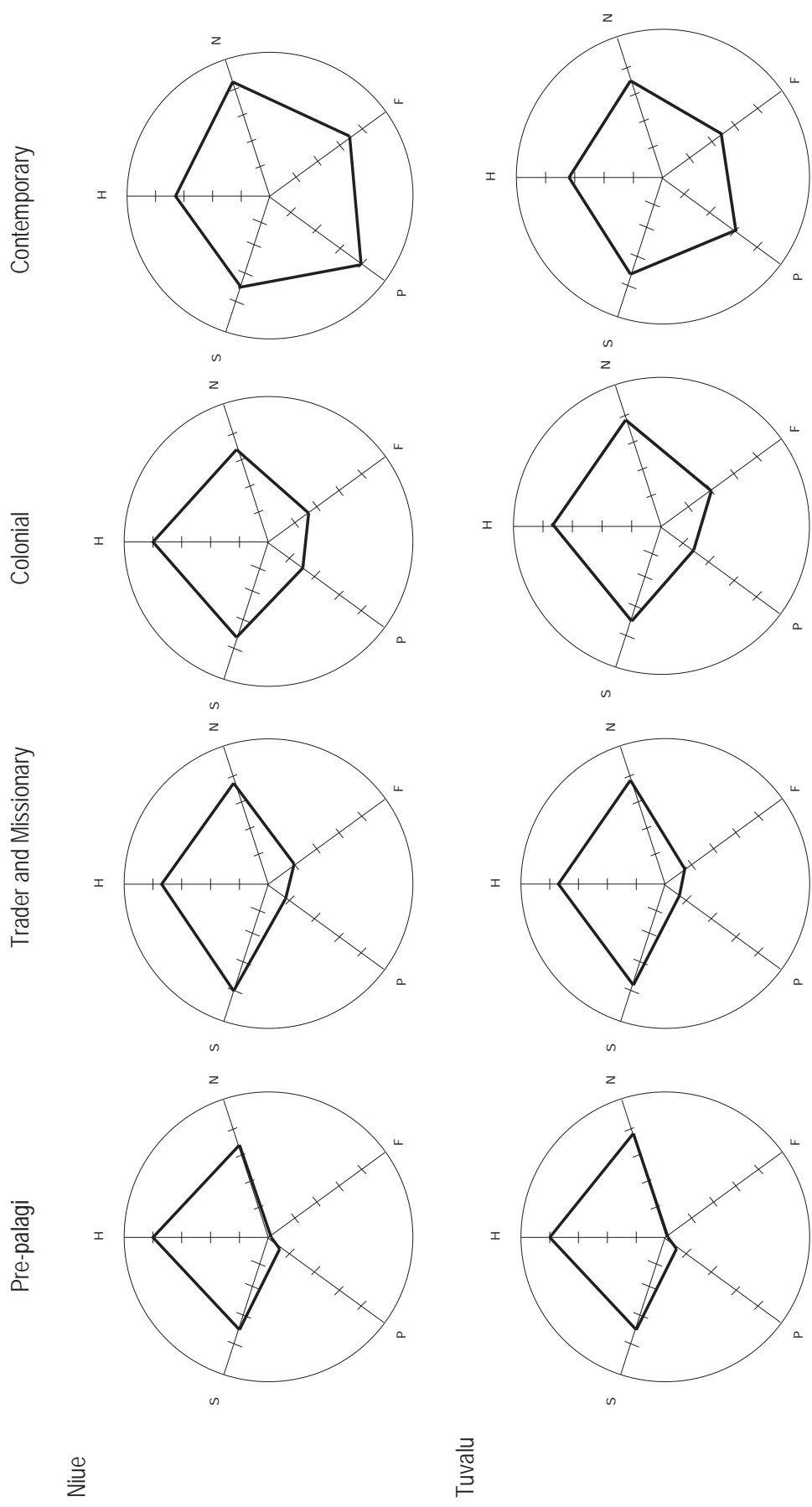
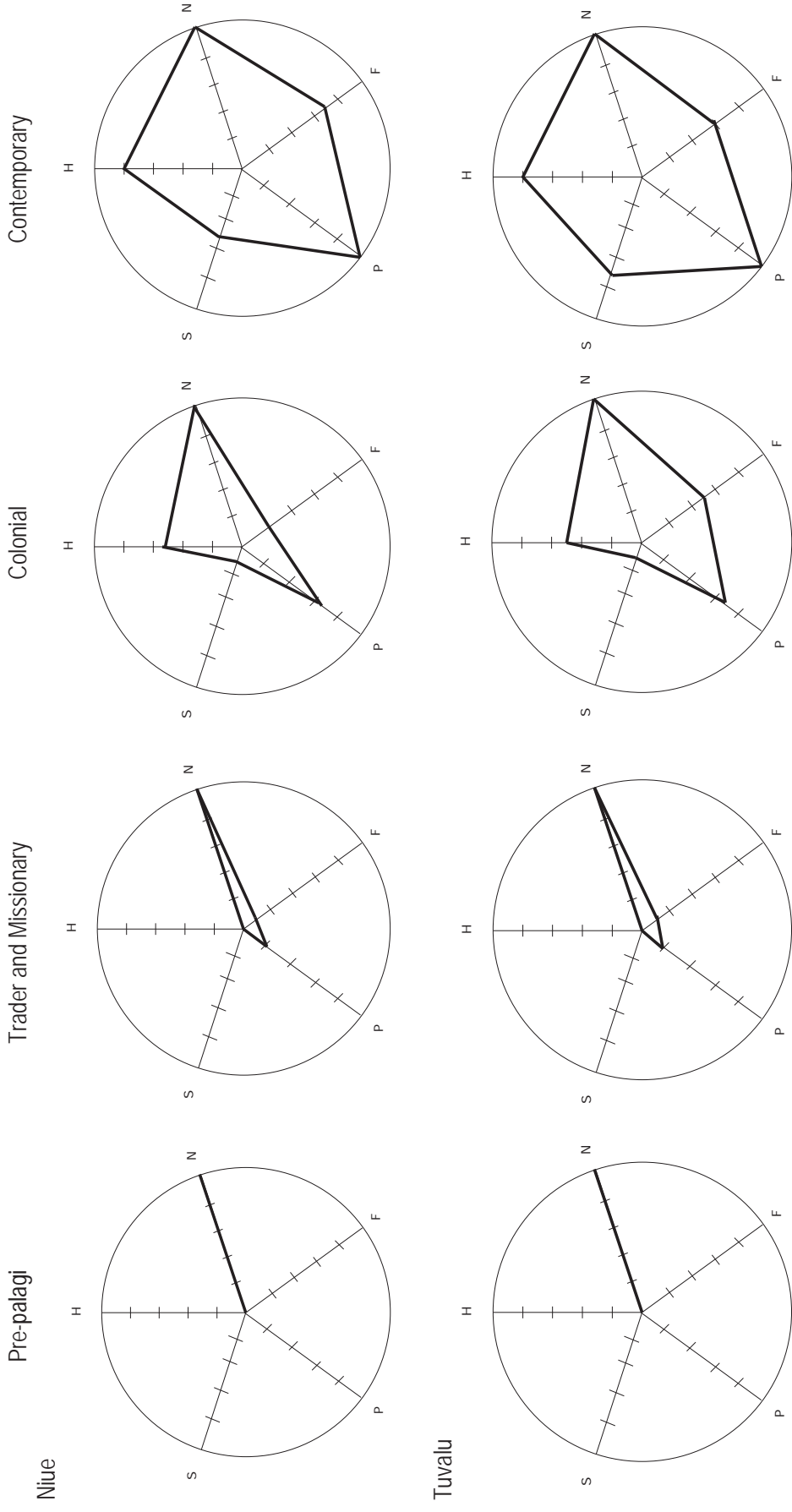


Figure 49 – Livelihood Energy Pentagons over time : Pre-palagi to Contemporary eras



The energy pentagons for Niue and Tuvalu are virtually identical for the first two eras where energy in the form of natural capital – woodfuel – was dominant. Energy became increasingly relevant in both countries during the colonial era, arguably slightly more so in Tuvalu due a strong relationship between financial capital in the form of wages from working in Banaba and Nauru relying on shipping services for the transport of workers. The contemporary era pentagons for both countries are very similar indicating that while the asset pentagons show a lower level of values for capitals in Tuvalu, there is nevertheless a high dependency on energy to maintain those levels. Given that both countries rely heavily on energy to maintain the contemporary standards of living, of interest is what could happen should energy supply be constrained. This “energy deprived” scenario will be addressed in Chapter 7.

As shown in Figure 29, livelihoods exist within a vulnerability context and this is the subject of the next section of this chapter. The discussion under a separate heading is not intended to imply that vulnerability is unrelated to those four livelihood components discussed above. To the contrary, the links are strong and this will become clear in the discussion that follows.

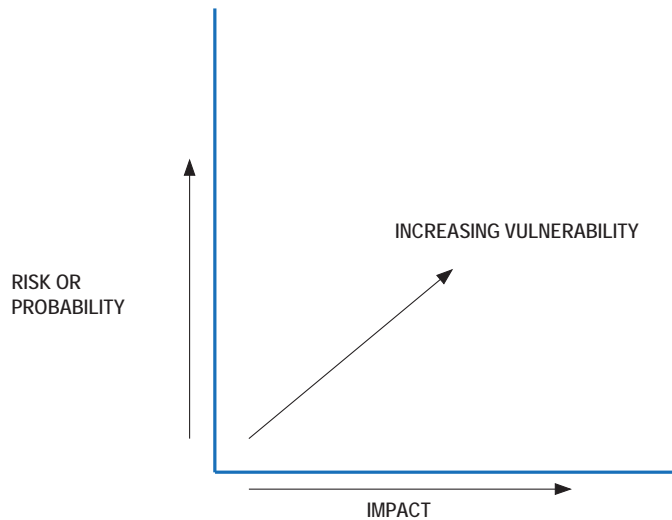
6.3 THE VULNERABILITY CONTEXT

The vulnerability context is described in DFID as framing “the external environment in which people exist” (DFID, 1999b, p. 2.2). As discussed in Chapter 3, vulnerability includes changes that can be ecological, economic, social and political and is of particular relevance to small isolated island communities that have insufficient economic resources of their own to maintain a reasonable standard of living. Both Niue and Tuvalu rely on ODA to balance this resource shortfall. In this section, a series of vulnerability profiles are developed to illustrate the nature of the vulnerability context for each country during a given period - that is the four historical eras as previously defined. The DFID framework refers to three categories of vulnerability: trends, seasonality and shocks; however, based on information in the literature and from informants, seasonality is not considered to be an issue at present for the case studies. It is possible that this could change in the future should tourism in Niue grow substantially given that the tourism in the South Pacific tends to be seasonable with the busiest time during the period May to September and this could impact on employment and income during the “off-season”.

Trends and shocks are considered in this analysis and a profile is developed for each category for each of the historical eras and combined to provide an overall vulnerability profile. These profiles are based on my assessments and as such are essentially subjective in that the assessments are not based on quantitative data, the main purpose being to identify the change in vulnerability over the four historical eras and what, if any, what was the role of energy either in the creation of vulnerability or countering vulnerability. Events that create vulnerability are identified and assessed in terms of the risk or probability of occurrence and the impact of the event on the community. These are shown in graphical form with risk or probability forming the

vertical or “y” axis and impact forming the horizontal “x” axis with level of vulnerability being the function of the two as shown in the example in Figure 50 below.

Figure 50 – Vulnerability Profile

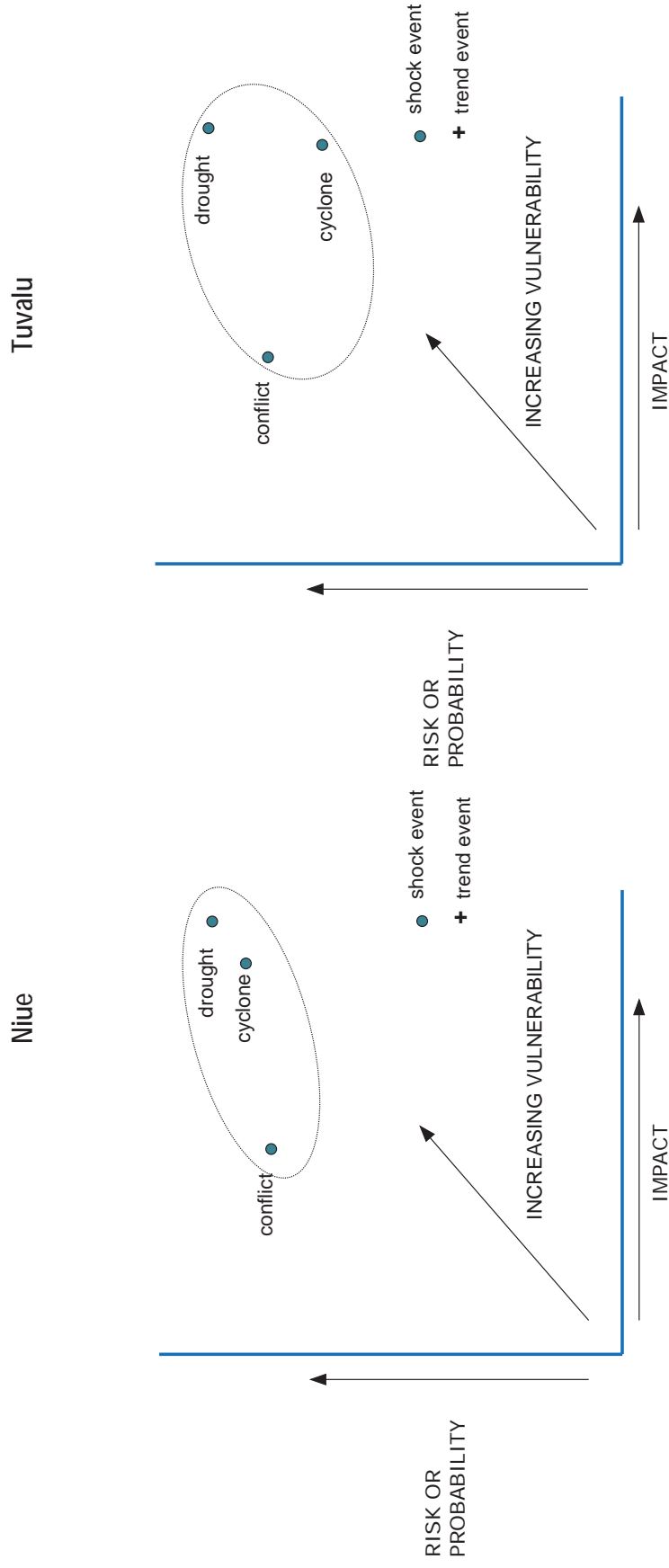


6.3.1 Pre-palagi Era

Figure 51 below shows the profiles for Niue and Tuvalu. These are very similar except that the profile for Tuvalu reflects the lower risk of cyclone discussed below. During the pre-palagi era, the vulnerability context was very similar in both countries. It is considered unlikely that trends and seasonality were issues in either country.

However both countries shared vulnerability to shocks with threats of cyclones, drought and conflict. There is little mention of cyclones in the literature when discussing the pre-palagi era in either country; however there is no reason to believe that these did not occur. Cyclones occur most frequently within the 10–20° latitude band of both hemispheres and do not occur within about 5° of the Equator (Walsh, McInnes, & McBride, 2012, p. 155). Niue, which is located 19° South is just within the 10–20° latitude band whereas eight of the islands of Tuvalu are to the north of 10° latitude, the exception being Niulakita. However, cyclones that impact on the islands of Tuvalu do occur, the most severe recent example being cyclone Bebe which struck Funafuti in October 1972 (Walsh et al., 2012, p. 157). Between 1904 to 1990, Niue was struck by 21 cyclones (Barker, 2000, p. 196). Damage from cyclones will have been severe destroying houses and wiping out food crops if the experience of damage from cyclones in recent years is assumed to apply and possibly greater in Tuvalu given the low-lying nature of the islands.

Figure 51 – Vulnerability Profiles: Pre-palagi Era



Both countries appear to have been subject to drought with the resultant risk of famine. The risk of conflict was present in both countries from incursions by warriors from other South Pacific islands, notably Samoa and Tonga but also Kiribati and the Cook Islands. Internal conflict occurred between magafaoa in Niue and between islands and between island clans in Tuvalu (Koch, 1961, p. 193; Loeb, 1926, p. 128; Percy Smith, 1983, p. 61; Samuelu, 1983, p. 36; Talagi, 1982; Turner, 1856, p. 469). While the risk of conflict was apparently high in both countries, the assessment has assumed that while severe for those affected, the impact was localised rather than affecting the whole country. Energy made no contribution – negative or positive – to the vulnerability profiles in this era.

In both Niue and Tuvalu people adopted similar livelihood strategies to cope with vulnerability. Living in extended families – magafaoa – or clans, provided some form of protection, albeit not always effective, against attacks by outsiders, and also provided a form of law and order. However, there was little people could do to protect themselves against drought and cyclone other than call upon their local deities for assistance (Loeb, 1924, p. 396; Nia, 1983, p. 65).

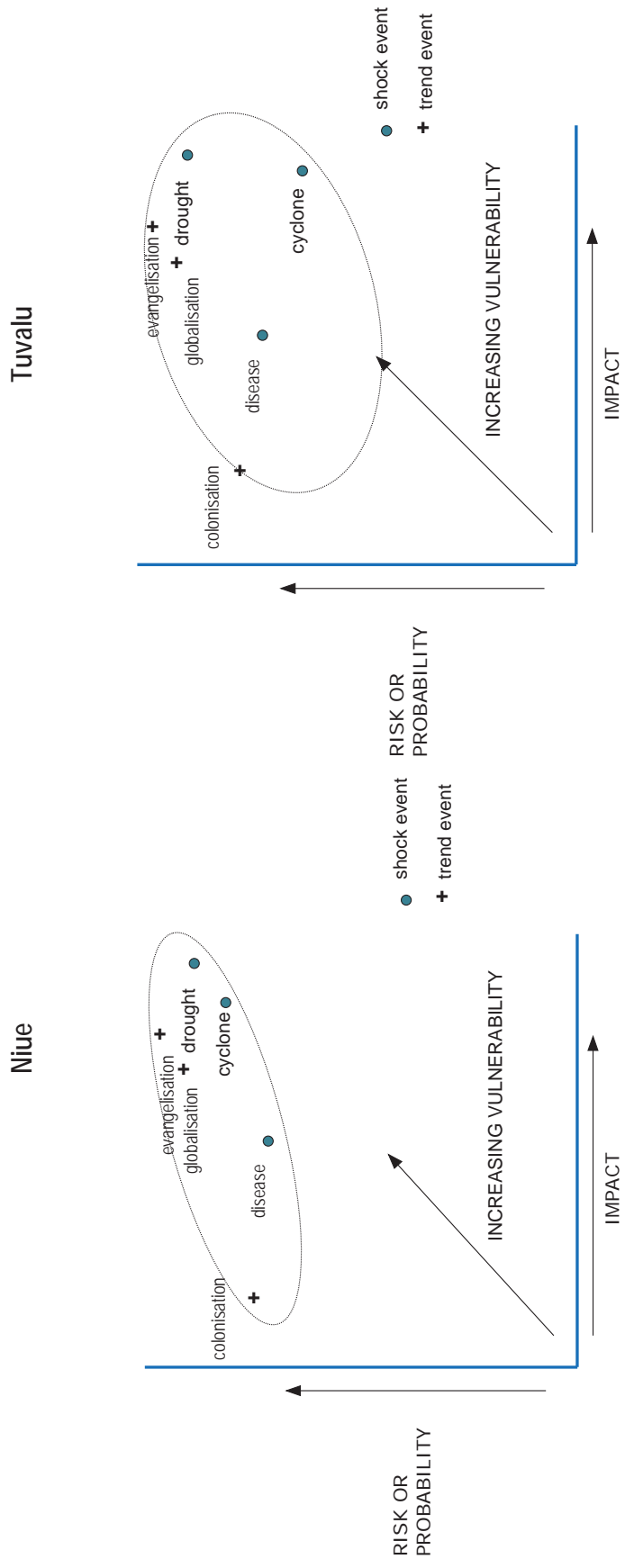
6.3.2 Trader and Missionary Era

Vulnerability to cyclones and drought continued in the trader and missionary era. What if any action the LMS missionaries were able or willing to take to alleviate the impacts of such disasters is not apparent from the literature. On the other hand, conflict appears to have largely disappeared with the arrival of the LMS missionaries. Unfortunately, the palagi visitors – traders and missionaries – brought with them a number of diseases to which the Niueans and Tuvaluans had little natural immunity (Bedford et al., 1980, p. 210; David, 1913, p. 21; Thomson, 1901, p. 923).

Figure 52 below shows profiles for Niue and Tuvalu for the trader and missionary era. Events that are categorised as shocks and those as trends are identified separately. As in the profiles for the pre-palagi era, the risk of cyclones is assumed to be higher in Niue. On the other hand, the impact of disease is assumed to be higher in Tuvalu given the apparent absence of even basic health care. The trader and missionary era provided no new means to reduce the risk or impact of drought and cyclone.

The major trend of the era was nascent globalisation which created a number of similar vulnerabilities in both countries. This commenced with the arrival of traders, a situation that was not necessarily negative in impact (other than introducing diseases as noted above). However, labour recruiters seeking workers for plantations in other parts of the South Pacific were not always scrupulous in their recruiting methods nor were the plantation owners, the worst example being the Peruvian slavers who in 1863 abducted large numbers of people from Niue and Tuvalu (Macdonald, 1982, p. 42; Talagi, 1982, p. 119).

Figure 52 – Vulnerability Profiles: Trader and Missionary Era



Another significant trend was evangelisation and while it can be argued that evangelisation was part of globalisation, I am treating it as a trend in its own right as it was driven by a desire to “save” the “savage peoples” of the South Pacific rather than an apparent desire for trade (Lovett, 1899, p. 5; Stanley, 1990, p. 56). The activities of the LMS resulted in major changes to society in both countries with positive and negative outcomes. Positive outcomes included the cessation of conflict as noted above and the introduction of some basic healthcare and education although this appears to have been more successful in Niue than in Tuvalu (Talagi, 1982, p. 118). Negative outcomes were what are described as the harsh rule of the LMS and outlawing of customs that were in many cases harmless and added to people’s enjoyment of life (Heyn, 2003, p. 17)(Kofe, 1983, p. 118).

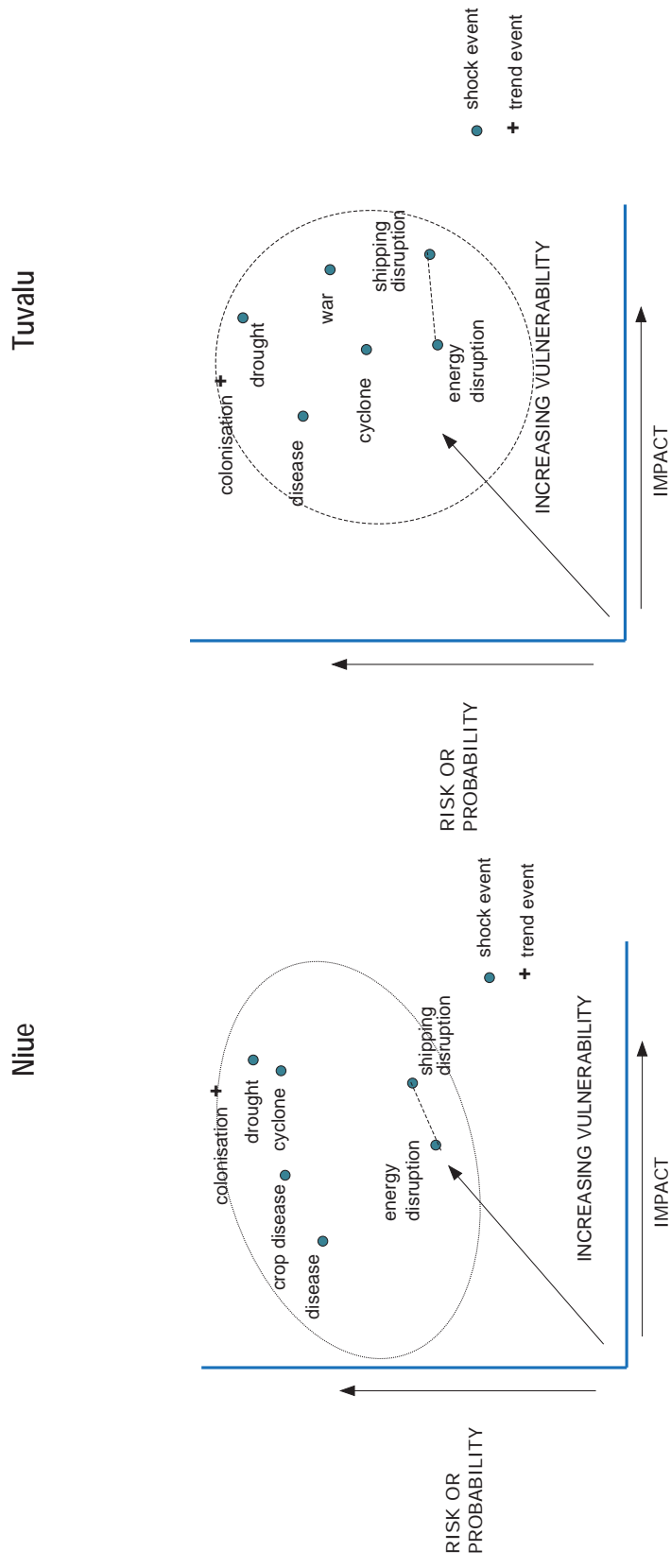
Energy was closely involved in globalisation: as discussed in Chapter 2, energy had a major role in enabling the industrialisation that ultimately resulted in globalisation through the need of the industrialised countries for markets and raw materials. As the era progressed, globalisation led to rivalry between the industrialised powers – the United States, Great Britain, Germany and France – and resulted in the commencement of another trend: colonisation in the South Pacific, a situation that ultimately led to both Niue and Tuvalu becoming colonies within the British Empire.

In reality, in both Niue and Tuvalu there was very little people could do to resist the trends and shocks that confronted them. In respect to the impacts of evangelisation and globalisation, it was a matter of acceptance and adaption. In the case of Niue, the prospect of colonisation was welcomed due to a feeling of insecurity owing to the ‘great power rivalry’ mentioned above (Scott, 1993, p. 17; Tafatu & Tukuitoga, 1982, p. 125). Whether or not Tuvaluans were in favour of colonisation is not clear from the literature but it appears that their views were not regarded as of particular relevance (Teo, 1983, p. 128).

6.3.3 Colonial Era – the 1950s

As represented in Figure 53 below, the vulnerability profiles for both countries show a slight overall reduction in vulnerability over the colonial era. While the probability of cyclones and drought events remained unchanged from the previous era, it is assumed that the impact will have been reduced somewhat through intervention by the colonial authorities. For example, in Niue two wells were constructed with diesel pumps in the 1950s which at least provided water for household needs (Department of Island Territories, 1955, p. 64). Infectious disease continued to be a problem in both countries but improved health services later in the era will have reduced the impact.

Figure 53 – Vulnerability Profile: Colonial Era



A major shock event in Tuvalu was the occupation by United States armed forces during the Second World War and while the social impact appears to have been remarkably small, the environmental damage to three islands – Funafuti, Nukufetau and Nanumea – in the construction of airfields was substantial. (Telavi, 1983, p. 141). Close to the end of the colonial era, the Niue economy suffered a shock when disease virtually wiped out banana production (Barker, 2000, p. 196; Rex & Vivian, 1982, p. 129). It is hard to judge the impact on people's day to day lives but while this will have reduced incomes in the form of wages from working on the plantations, there is no suggestion in the literature that this resulted in widespread distress. Transport in the form of shipping services had become important in the colonial economies for movement of goods and people and disruption could have resulted in some hardship and possibly more so in Tuvalu with the reliance on inter-island shipping services.

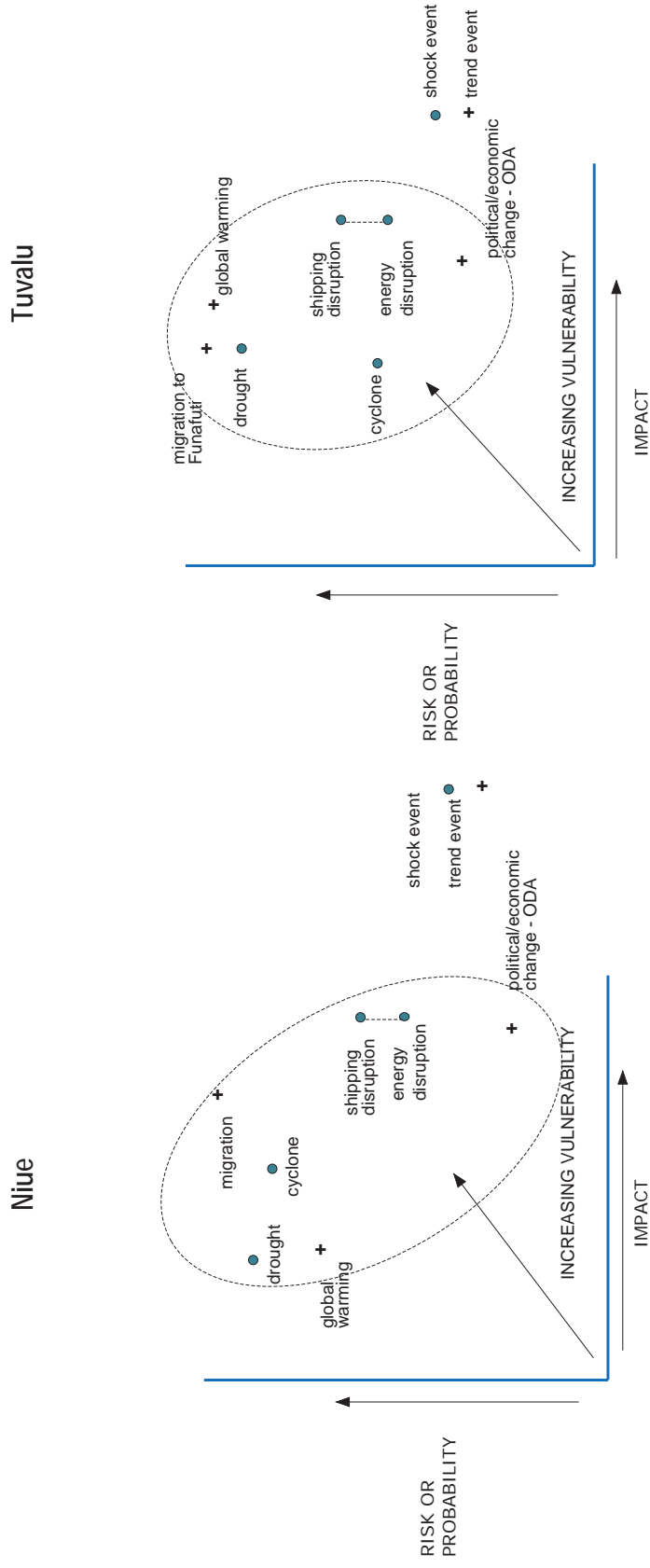
In terms of vulnerability, energy supply had become relevant as a vital component in the maintenance of shipping services which had become increasingly important over the colonial era in both countries. Energy in the form of diesel and petrol supplies was used on a limited basis for electricity generation at the hospitals and at wireless stations and for a small number of motor vehicles but arguably the most important role was as fuel for shipping.

6.3.4 The Contemporary Era

Figure 54 below shows vulnerability profiles for both countries. The most well publicised vulnerability in the case of Tuvalu is the threat of sea-level rise from global warming while Niue, given that much of the island is 25 metres or more above sea level is less vulnerable to this threat. Cyclones remain a threat in both countries but more so in Niue. According to Walsh et al (2012, p. 152) while the severity of cyclones may increase as a consequence of global warming, the frequency may decrease. To reduce the impact of cyclones, as discussed in Chapter 4, from the 1960s onwards houses in Niue have been built to withstand cyclone-force winds. Drought remains a threat in both countries but in Niue, the impact has been much reduced by the installation of water pumping stations at locations around the island (SOPAC, 2007a, p. 31). However, drought still impacts badly on bush gardens meaning that people have to buy more food. In Tuvalu, the impact of drought can be very severe as experienced in 2011 (Banyan, 2011). The installation of additional desalination plants in Funafuti will mitigate the impact but not eliminate it.

Energy supply and shipping services both create a level of vulnerability and again are shown as linked in that there is inter-reliance – energy imports rely on shipping and shipping relies on energy supply. Energy has become an increasingly important factor in livelihoods as demonstrated in Figure 37 in the previous section of this chapter. For example, without an energy supply, water pumping would not be possible in Niue or desalination in Tuvalu.

Figure 54 – Vulnerability Profiles: Contemporary Era



Shipping services are closely linked to energy: the ships rely on energy for propulsion while ships transport energy to both countries in the form of fuel. In the event of disruption to shipping services, Tuvalu in particular could face food shortages given the high reliance on imported food, notably rice and flour (Government of Tuvalu, 2010, p. 23). Both governments recognise the need to reduce the dependency on imported fuels and have commenced renewable energy programmes with the assistance of overseas agencies.

Migration is a continuing trend in both countries but of a different nature. In Niue, migration is outward mainly to New Zealand but also to Australia and as discussed in Chapter 4, is of major concern to both the Niue and New Zealand governments. In Tuvalu, as discussed in Chapter 5, migration from the Outer Islands to Funafuti is creating social and environmental problems with poor housing and poor sanitation resulting from severe overcrowding. Of concern is that based on the 2012 census results, measures taken by the Government of Tuvalu to reduce migration to Funafuti do not appear to have been successful (Tuvalu Central Statistics Department, 2013).

Both Niue and Tuvalu rely on ODA for economic and financial support and while the likelihood of the international donor agencies involved ceasing to provide this support is considered small, the impact on livelihoods would be severe. For example, one impact would be the inability to pay for fuel imports. The two countries have adopted differing strategies aimed at maintaining the flow of ODA: Niue relies on the Niue Constitution Act which, as discussed earlier, commits New Zealand to providing “economic and administrative assistance” (New Zealand Government, 1974) while Tuvalu uses political negotiation including the recognition of the Republic of China (that is, the Taiwan-based government) and reminding the international community of the country’s vulnerability to climate change, a situation for which Tuvalu bears no responsibility.

6.3.5 Summary

Undoubtedly, the nature of the vulnerability context has changed over time. In the pre-palagi era, both Niue and Tuvalu were subject to threat of cyclone and drought. Both those threats remain but the impact has been reduced, largely through increased physical capital in various forms, examples being improved house construction in Niue, desalination plants in Tuvalu and pumping stations in Niue. The willingness of overseas partners to assist in the event of crisis is a further mitigating factor. However, new threats have emerged including migration causing very different problems – depopulation in Niue and over-population in Funafuti. Energy supply disruption is major threat in both countries given the heavy reliance of livelihoods on the services that rely on imported fuels.

6.4 CHAPTER DISCUSSION

The sustainable livelihoods approach has provided a useful basis for the method of analysis which operationalised sustainable livelihoods in an energy context. Specifically, the analysis enabled an understanding of how energy supply has influenced the components of people's livelihoods as illustrated in the livelihood asset and energy pentagons summarised in Figures 48 and 49.

The assessments of people's livelihoods, and particularly the evaluation of capitals, are based on my appraisals using information gathered during field visits and from the literature. The analysis of livelihood strategies and outcomes demonstrates the increasing complexity of livelihoods over the four eras. In the contemporary era, the extent of the direct and indirect influence of energy in virtually all livelihood outcomes – and therefore capitals – becomes clear. The complexity creates some challenges when applying the sustainable livelihoods approach in other than relatively simple livelihood situations, particularly if planning some form of intervention (Cherni et al., 2007, p. 2; Norton & Foster, 2001, p. 14). Applying the sustainable livelihoods approach as an "indicative tool", however, is useful and appropriate as long as the limitations are understood, particularly recognition that the capitals used in the asset pentagon of the DFID framework may not represent fully the perspectives of people in Niue and Tuvalu.

In the analysis of livelihood assets, human, natural and social capitals were found to have been dominant in both Niue and Tuvalu throughout the first three eras. This is not surprising as had these capitals not been strong, maintenance of living communities would have been difficult if not impossible. In the contemporary era, human capital has reduced in spite of improved health and education services which are important factors in maintaining this capital. In Niue, the reduction in human capital is attributed to depopulation having reduced the human resource pool while in Tuvalu, overcrowding in Funafuti is seen as creating public health risks while poor access to health and education services have created a situation of inequality for those living in the Outer Islands. Notably, in the contemporary era, in both countries financial and physical capitals have steadily increased and now form significant components of people's livelihoods in both countries, and are particularly strong in Niue.

The energy pentagons provide an indication of the extent to which energy supports a livelihood asset and this is particularly relevant in the contemporary era. Natural capital energy is strong throughout, initially because of the heavy reliance on woodfuel for cooking but while this reliance on woodfuel has reduced in the contemporary era, the renewable energy programmes adopted by both countries mean that reliance on natural capital energy will continue. Physical capital energy is complex, involving both energy as part of physical capital – that is, fuel imports – and the infrastructure services that rely on energy. This physical capital energy supports a wide range livelihood services, including health, education and transport, which in turn support all five capitals.

As demonstrated in the analysis of transforming structures and processes, while energy has provided support to livelihoods in all four eras, energy did not cause the transformation processes, these being imposed on both Niue and Tuvalu by external influences: 19th century globalisation, evangelisation, colonisation and post-Second World War development. Undoubtedly, energy played an important role in the implementation of these influences, including the indirect role in 19th century globalisation through facilitating “northern” industrialisation.

Some aspects of vulnerability have reduced in both countries over time, notably disease and conflict. Drought and cyclone remain risks; however, the impact has been reduced albeit not eliminated. Water pumps enabling access to the fresh water lens under Niue mean that drought no longer results in water shortages for household use but subsistence agriculture is still affected. Increased water desalination capacity in Funafuti has reduced to a small degree the impact of drought in Funafuti but the Outer Islands remain fully exposed. Most houses in Niue are built to withstand cyclone force winds, however, based on my observations, this is not the case in Tuvalu. Clearly access to energy has therefore reduced some aspects of vulnerability, either directly – such as the water supply in Niue – or indirectly through improved health services reducing exposure to disease. The reliance on energy, however, has created a new vulnerability in terms of the risk of energy disruption creating a constrained energy supply, a scenario that will undoubtedly create difficulties, possibly severe. The extent and nature of these difficulties requires further analysis and this is the topic of the next chapter.

CHAPTER 7: USING THE SUSTAINABLE LIVELIHOODS APPROACH TO ANALYSE AN “ENERGY-DEPRIVED” SCENARIO.

7.1 INTRODUCTION

In this chapter, I move from the historical approach adopted in the preceding chapters and look towards the future with the objective of addressing the second, third and fourth research questions. The approach I adopt in addressing the three questions are outlined below.

In order to address these questions, energy-deprived scenarios are developed and the impacts analysed using the sustainable livelihoods approach in an identical manner to that adopted in Chapter 6 again utilising the DFID sustainable livelihoods framework as the model for analysis. This methodology is used for similar reasons to those stated in Chapter 6 in that it permits examination of the impacts of a change in energy supply across the spectrum of people’s livelihoods. Furthermore, it enables the livelihood profiles developed for the contemporary era in the two countries to be used as baselines, thereby providing points of comparison. The scenarios include a level of speculation and are intended to provide an illustration of what could happen in an energy-deprived situation.

The development of the energy-deprived scenarios is discussed in the following section. The scenarios assume a situation where imported fuel supplies, comprising diesel oil, petrol, kerosene and LPG are severely constrained. As a consequence, Niue and Tuvalu would have to rely on domestic energy resources to meet energy needs. There are a range of circumstances under which this scenario could come about (Ölz, Sims, & Kirchner, 2007, p. 13). Such a situation could arise where international oil supplies are severely disrupted to the extent that either the price of oil-based fuels becomes prohibitive, particularly for small island countries already heavily reliant on ODA to enable payment for a wide range of imports, or that oil supplies are simply no longer available. I consider that the most likely causes of a sudden and severe long-term disruption to be either a major conflict in the Middle East that halts oil production in that region or a Pacific conflict that paralyses shipping movements to the extent that oil supplies are cut off to nations in the South Pacific. Supply constraints due to demand exceeding supply cannot be discounted and while there is general acceptance that oil supply will sooner or later be unable to meet demand, when this will happen is a topic of considerable debate. Some authors argue that this point – “Peak Oil” – has already arrived with others taking the view that this is some years away (Almeida & Silva, 2011, p. 1046; Bardi, 2009, p. 323; IEA, 2013). Urry (2013, p. 199) in particular drew some alarming conclusions for society given the reliance on “easy oil” with predictions of societal collapse and conflict. Urry concluded that there is a need to develop a “low carbon civil society” – but fears that the odds of achieving such a societal change development are low (Urry, 2013, p. 240). A further possibility, albeit seen as unlikely at this time, is political change where a major donor of the ODA that enables the purchase of imported fuel is no longer prepared or able to continue that ODA.

In the energy-deprived scenarios, available domestic energy resources are assumed to include biomass and renewable energy electricity generation plant which either exists or is at an advanced stage of planning in terms of technical design and committed funding. As noted in the Question Portfolio (Appendix 1), interviews included a discussion on how people would cope with a much reduced energy supply and the responses, which are discussed in Section 7.3 below, were taken into account in the analyses.

For the purposes of this analysis, I am assuming that the international partners currently providing ODA to Niue and Tuvalu will continue to provide funding for sufficient fuel to permit for some minimal “lifeline” services including shipping and air services to continue but at a much reduced frequency. Based on these scenarios, livelihoods analysis is carried out using methodology adopted in Chapter 6 and the results shown below in the form of livelihood and vulnerability profiles. Germane to the analysis is the discussion in Chapter 2 on the energy-poverty nexus and the recognition that access to affordable energy – notably the statement in Goldemberg and Johansson that “energy is an essential ingredient of socio-development and economic growth” (1995, p. 1). The corollary of that statement is that should access to affordable energy be curtailed, then there is a risk of a decline in socio-development and economic activity and a potential risk of a lapse into poverty. The section concludes with a summary of the likely impacts of a constrained energy supply.

The discussion then moves to the second and third questions and commences with an outline of the plans that the two governments have in place to reduce dependency on imported fuels and for disaster risk management. Using the outputs from the analysis of the energy-deprived scenario and the likely impacts, a critique of the plans is undertaken. The conclusion, which addresses the fourth research question, is that implementation of these plans will go some way to reducing the dependency on imported fuel but not to the extent necessary to significantly reduce the impact of severely constrained energy supply. To reduce that impact, there would be considerable benefit in the governments of Niue and Tuvalu with the assistance of their overseas partners preparing strategic action plans specifically addressing a constrained energy situation and identifying a range of actions to mitigate the impacts.

7.2 ENERGY-DEPRIVED SUPPLY SCENARIOS

In this section, energy- deprived scenarios are developed for Niue and Tuvalu. This section is intended to “set the scene” and is followed by Section 7.3 which comprises the analysis of the likely impacts on livelihoods in the event of such a scenario occurring.

7.2.1 Niue

Table 15 below summarises the energy supply and consumption situation in contemporary Niue, based on the information referred to and discussed in Chapter 4. Domestic energy resources currently used comprise

electricity generated from photovoltaic (PV) plant and to a relatively limited degree, woody biomass – wood and coconut shell in particular, referred to herein as “woodfuel” – used as a cooking fuel.

Table 15: Niue – Energy Supply Imports and Consumption Data

Fuel imports (2009) ⁹³ :	
Petrol	532,000 litres
Diesel ⁹⁴	1,200,000 litres
LPG	25.8 tonnes.
Electricity generated (2012)	3.584 GWh
Maximum electricity demand	530 kW (approximately)
Diesel used for electricity generation (2012)	943,691 litres

Sources: Crawley (2014), SPC (2012a).

The capacity and operating status of the PV plant is shown in Table 16 below. The installation of the PV generation plants at the Hospital, High School and Airport was funded by the European Union under EDF9 and 10, while the plant at the Power Station was funded by the Japanese government through the Pacific Environment Community (PEC) fund (Chapter 4: 4.6.4). On completion of the Power Station and Airport installations, total renewable generation capacity will be 326 kW. All four installations are grid-connected and feed directly into the Niue distribution and operate in parallel with the diesel generator plant.

Table 16: Niue – PV Generation Plant

Location	Nominal peak capacity (kWp)	Operating status ⁹⁵
Hospital	30.6	Operating
High School	20.4	Operating
Power Station	200	Operating
Airport	75	Under construction (May 2014)

Sources: Crawley (2014), SPC (SPC< 2012a).

Actual output of the PV generation plant will be less than the nominal outputs in Table 16 due to power losses in the systems. Furthermore, the nominal outputs are based on ideal sun conditions which in practice will vary considerably from the ideal due to factors such as time of day, time of year and cloudiness. Using data recorded during the operation of the existing Hospital and High School installations, Crawley (2014, p.

⁹³ The figures exclude kerosene for which no 2009 data was available. I understand that imported kerosene is mainly used for aviation purposes and principally the weekly Air New Zealand service between Niue and Auckland.

⁹⁴ Diesel fuel consumers include electricity generation, motor vehicles (mainly trucks) and fishing boats. I note that consumption figures vary significantly from year to year possibly due to timing of imports rather than actual consumption.

⁹⁵ As at May 2014.

114) estimated that annual output over the three year period 2010 to 2012 averaged about 70,000 kWh, indicating a capacity factor of approximately 16%, the capacity factor being the amount generated as a percentage of that which would be generated had the plant operated at the nominal peak output for 24 hours a day. Applying this capacity factor to the projected total PV generation output, the estimated annual electricity production from the four PV installations listed in Table 17 is 454,000 kWh which is 13% of the current generation of 3.584 GWh (3,584,000 kWh) as shown in Table 16.

The above figures suggest that in the event of a complete cessation of diesel fuel imports for power generation, a small amount of electricity will still be available for essential services. However, there are no batteries⁹⁶ to store surplus generation during periods where demand is below the output of the PV generation plant or to feed back electricity when demand exceeds PV output such as during the night or in cloudy weather. The situation is further complicated due to the nature of the system design as explained to me by a key informant, Warren Crawley⁹⁷, who has specialist knowledge in the technology and who has recently completed a research paper on the Niue power system (Crawley, 2014). The system is designed as “grid-connected” and operates in parallel with the diesel generator plant and relies on the diesel generators to set the electrical frequency (50 Hertz). If the PV systems are to operate without the diesel generators, then modifications will need to be made. Even with these modifications, without batteries, the electrical output will at times fluctuate wildly as clouds pass over the sun and without the diesel generators to compensate⁹⁸. To summarise, with the current design, the PV generation systems will not provide a substitute source of electricity should the diesel generators not be available due to lack of fuel – or for any other reason, the power station fire of 2006 mentioned in Chapter 4 being an example. However, it should be stressed that the PV systems are not intended to provide “standby” in such an event; rather, as discussed in Chapter 4, the goal is reduce Niue’s dependency on imported fuel.

The consequences of no electricity would be severe given the high level of dependency on electricity for livelihood services at government and household level. The situation would be further exacerbated through the non-availability of imported fuels generally: the lack of petrol and diesel for transport and the lack of LPG for cooking. In terms of food supply, fortunately people still maintain the traditions of growing crops in bush gardens and fishing (Chapter 4: 4.6.1). The lack of LPG or electricity for cooking would mean that people would have to revert to woodfuel and use umu or some form of woodstove for cooking. Reverting to woodfuel may not be as a significant step backwards as it might seem at first sight: Crawley (2014, p. 36) noted that

⁹⁶ The 200 kW installation at the Power Station is provided with batteries but these only provide a limited amount of storage to maintain stability of the plant during partly cloudy weather when the solar output will fluctuate.

⁹⁷ Warren has given his consent for me to identify him as a key informant for the purpose of this thesis.

⁹⁸ The issue of system stability in systems with a high proportion of renewable energy generation – such as PV or wind turbines – is a complex issue requiring specialist knowledge and is considered beyond the scope of this thesis. Examples of technical papers on this topic include Eltawil and Zhao (2010) and Kim et al (2009). Crawley (2014) also discusses the issue of system stability in the context of the Niue power system.

due to a number of the LPG stoves provided under EDF10 failing, some households had adapted by reverting to using the umu and charcoal stoves. Given that as discussed in Chapter 4, in pre-palagi times, Niue natural resource stocks were able to support a population of between 4,000 and 5,000, I am assuming that these stocks – food supplies and woodfuel – should be able to support the current population, based on the 2011 census figure of 1,460 (Government of Niue, 2011, p. 14). Drought would be a major threat as without electricity, the pumps that transfer water from the fresh water lens under the island would not operate. The availability of motor vehicles is an important feature of the contemporary lifestyle in Niue as demonstrated by the high level of vehicle ownership which was in the 2011 census found to be just under two vehicles per household (Chapter 4: 3.6.4). Lack of transport due to non-availability of petrol and diesel is likely to mean that people would not be willing to walk or cycle the relatively long distances from the villages on the eastern side of Niue to Alofi for work and in any event, may need to spend time on subsistence activities. Furthermore, without transport, a range of government services would be likely to cease with those that remain being of an essential nature such as health and the maintenance of law and order. Health services would clearly suffer given the high level of reliance on electricity to enable the use of diagnostic and treatment equipment and to power the refrigerators necessary for the storage of vaccines and medicines. In summary, the modern lifestyle now enjoyed in Niue would largely cease to exist – but people could revert to subsistence livelihoods.

While the above “doomsday” scenario is possible, I consider that the reality is that should such a major and long term (if not permanent) fuel crisis occur, it is unlikely that a New Zealand government would abandon Niue completely and some “lifeline” services would be provided (assuming that New Zealand is in a position to do). This would result in constrained imported energy supply rather than zero energy supply. For the purposes of the livelihood analysis of the deprived-energy scenario, the following assumptions are made:

- Shipping services continue at a reduced frequency, say three monthly, and would provide essential supplies such as a limited amount of fuel and medical supplies.
- A small amount of diesel fuel would be provided, sufficient for the generators at the Hospital and at Niue Telecom to operate on a reduced basis and also for the government to provide a limited transport service for people and goods. This public transport service would enable some employment to continue, children to attend school and for people to access healthcare at the Hospital.
- Limited air services, say monthly, primarily to enable essential travel on government business or for urgent healthcare in New Zealand.

In this scenario, while maintaining some aspects of the contemporary lifestyle, the impact on livelihoods would still be severe, requiring considerable adaptation by the part of the Niue community.

7.2.2 Tuvalu

Table 17 sets out the energy supply and consumption situation in contemporary Tuvalu using the information referred to and discussed in Chapter 5.

Table 17: Tuvalu – Imported Energy Supply and Consumption Data

Fuel imports by sector (2009) ⁹⁹ :	
Transport	2,071,131 litres
Fishing	61,240 litres
Cooking	121,500 litres.
Electricity	1,784,382 litres
Electricity generated using diesel – Funafuti (2010)	4.997 GWh
Electricity generated using diesel – Outer Islands (2010)	0.939 GWh
Maximum electricity demand – Funafuti	circa 820 kW

Sources: Isaka et al (2013b), Government of Tuvalu (2012b)

Domestic energy resources currently used comprise woody biomass and electricity generated from photovoltaic (PV) plant. The capacity and operating status of the PV plant is set out in Table 18:

Table 18: Tuvalu – PV Generation plant

Location	Nominal peak capacity (kWp)	Operating status
Vaitupu (Motufoua School) (Hybrid PV/diesel with batteries)	46	Operating – since 2009
Funafuti – sports stadium	40	Operating – since 2008
Funafuti – adjacent southern end of airport	42	Operating – since 2012 ¹⁰⁰
Funafuti – Public Works Department	66	Operating – since 2013 ¹⁰¹

Source: Government of Tuvalu (2012b).

As discussed in Chapter 5, there are three additional PV generation projects which at the time of writing (August 2014) are in an advanced stage of planning and for which funding has been finalised. It is assumed

⁹⁹ 2009 is the most recent year for which reliable data can be found and is by sector rather than by fuel type. I note that there is significant variation from year to year during the period 2006 to 2011 which may be due to dates of inward fuel shipments rather than representing consumption.

¹⁰⁰ This installation was complete during my field visit of March 2013 but awaiting final connection to the Funafuti distribution system.

¹⁰¹ This installation was in an advanced stage of completion during my visit of March 2013.

that in an energy-deprived scenario, these projects will be operation; these are summarised in Table 19 below.

Table 19: Tuvalu – Proposed PV Generation Plant

Location	Nominal peak capacity (kWp)	Funding Agency	Status
Funafuti – government (existing and new) building roofs.	500	New Zealand Aid Programme and Abu Dhabi Fund for Development.	Advanced planning stage
Outer Islands - Nanumaga, Nanumea, Niutao, Vaitupu	Various	New Zealand Aid Programme	Contract awarded
Outer Islands -- Nui, Nukulaelae, Niulakita	Various	European Union	Contract awarded ¹⁰²

Sources: Kaly (2013), Pipeline Magazine (2014), The Jet (2014)

The two Outer Island projects involve hybrid PV- diesel systems on each island and as described in Chapter 5, the batteries will provide storage of electricity for between three and five days during cloudy weather. In the case of the New Zealand funded project, it is estimated that diesel consumption will reduce to between 5 and 10% of current levels even when allowing for electricity being available for 24 hours each day compared with the current maximum of 18 hours a day (Kaly, 2013, p. 4). I have not been able to access detailed information on the EU funded project but the limited information I have found indicates that the technical objectives are similar to those of the New Zealand funded project in terms of diesel consumption savings and 24 hour availability (The Jet, 2014). Unlike the grid-connected systems in Niue, the Outer Island systems will be able to supply electricity without the diesel generators operating. However, in the energy-deprived scenario, with diesel fuel no longer available, I consider it likely that electricity supply would need to be rationed, particularly during cloudy periods when the PV arrays are unable to generate the full amount of electricity required.

The proposed additional 500 kWp PV capability in Funafuti when added to the existing capability as set out in Table 18 will increase total nominal PV generation output to about 650 kWp. In Chapter 5, the output of existing PV plant was calculated to be 1,510 kWh per kWp installed (Chapter 5: 5.6.4), which equates to a capacity factor of 17%. Applying this capacity factor to the projected PV generation output of 650 kWp, the projected annual output is estimated to be just under 1 GWh (1,000,000 kWh) which represents just over 20% of total current generation from the diesel plant. However, the combined PV systems in Funafuti will be

¹⁰² According to the "Jet" newspaper of 28/03/2014 in Fiji, a contract has been awarded to a Fijian company.

grid-connected and as with the Niue systems, can only operate in parallel with the diesel generators and therefore will not be available in the event of a cessation of diesel electricity generation.

In the energy-deprived scenario, therefore, people on the Outer Islands will be better off in energy supply terms than those in Funafuti as they will still have access to an electricity supply, albeit at a reduced level. As noted in Chapter 5, subsistence agriculture and fishing are still important components in people's livelihoods and these activities are likely to be only marginally affected in the event of a cessation in fuel supplies. The diet would change somewhat with access to imported and manufactured foods reducing substantially. Cooking would revert entirely to woodfuel except in the small number of locations where biogas digesters are in place (Chapter 5: 5.6.4 (a)). Given the limited land area of the Outer Islands and the poor and shallow soils, survival without access to imported food may become a challenge particularly in times of drought. In that context, it should be noted that the population of the Outer Islands in 2012 was 4,643 compared with less than 2,700 in the early 19th century (refer Table 8 in Chapter 5), a population that the early Tuvaluans considered should not be exceeded if the natural resource base was to be maintained at replenishment level (Chapter 5: 5.3). The situation in Funafuti would be much worse and not only because of the lack of electricity. The very high population density means that there is very little land available for crop production, a point confirmed by my observations during field visits. Pig raising and fishing would meet some needs as would the Taiwanese garden referred to in Chapter 5. However, as noted in Chapter 5, only 12% of household food needs are met by home production in Funafuti and given the extremely limited land available, it is very difficult to identify any means to increase production to any significant degree (Chapter 5: 5.6.4). Even cooking food could become an issue given the limited biomass resource. Drought would continue to be a problem, worsened by the inability to supplement water storage from the desalination plant which relies on electricity for the desalination process.

The lack of electricity in Funafuti would impact severely on the provision of services at the Princess Margaret Hospital. The Health Posts in the Outer Islands would continue to be supplied with electricity but the services provided would be limited given that for any condition beyond that treatable by a registered nurse or midwife, people need to travel to Funafuti for treatment or even to Fiji for serious conditions. In any event, lack of transport fuel would limit or prevent travel between the Outer Islands and Funafuti. In terms of land transport, the small size of the islands of Tuvalu would mean that bicycles and walking could replace motor vehicles – mainly motorcycles – albeit with some level of inconvenience. However, while the cessation of fuel supplies would impact on livelihood services, the most serious threat would be to food supply, particularly in Funafuti.

Similarly to Niue, I consider it to be unlikely that even in a severe fuel supply crisis, Tuvalu's neighbours – in particular, New Zealand and Australia – would abandon Tuvalu to a fate that could include starvation. For the purposes of the livelihood analysis, I am assuming a constrained rather than zero imported energy supply and the following assumptions are made;

- Shipping services continue at a reduced frequency, say three monthly, and would provide essential supplies such as food – particularly rice – and a limited amount of fuel and medical supplies.
- A small amount of diesel fuel would be provided, sufficient for the generators at the Princess Margaret Hospital and at Tuvalu Telecom to operate on a reduced basis and also for the government to provide inter-island shipping services, primarily to enable food and woodfuel to be transported from the Outer Islands to Funafuti. The shipping service will also enable people from the Outer Islands to travel to Funafuti for medical treatment and for other travel considered essential – for example, to enable technicians to maintain the electricity and communication systems.
- Limited air services, say monthly, primarily to enable essential travel on government business or for urgent healthcare in Fiji or elsewhere.

It is possible that Tuvalu's neighbours may relax immigration restrictions and allow those Tuvaluans who wish to migrate to do so. However, for the purpose of analysis, it is assumed that any such arrangement would not materially affect the overall scenario. The assumption is therefore that the support described above will prevent starvation and enable a basic lifestyle but will require major adaptation. The extent of this adaptation and the measures and strategies required are the subject of the next section.

7.3 THE IMPACTS OF CONSTRAINED ENERGY AS PERCEIVED BY INFORMANTS

During interviews, I asked informants how they would cope should energy become in short supply and what actions they would take – for example, would they use wood for cooking? The question was deliberately framed simplistically in order to introduce the issue in a way that people could relate to and build the conversation from that point. This approach was taken for the reason that a significant reduction the availability of energy supply is not something people regularly think about. Not unexpectedly, informants working in the energy sector had a better understanding of the issue. Two Tuvalu informants recalled an electricity outage that occurred in the early hours of the morning and people woke up to no electricity. As a result a large crowd congregated outside the power station wanting to know when the supply was to be restored (male, >40, March 2013, male, >50, March 2013). However, one of these informants expressed concern that people had become complacent and that a major and extended outage would be extremely disruptive. I commented that essential facilities such as the hospital and the communications systems will have standby generator plant but his response was that while this might be the case, he had real concerns regarding the maintenance of these generators and their availability in the event of a disaster.

Niue informants referred to the disruption following the power station fire in 2011 and referred to in Chapter 1 (male, >60, March 2010; male, >50, March 2010; male, > 60, September 2010). From all accounts, people coped well until electricity was restored albeit on a limited basis after one week. People coped by using

wood fires and umu and oil lamps and the situation was helped by the availability of the Fish Processing Factory refrigeration facilities.

Understandably, informants responded to the question by referring to their personal or household situation – “...we will use firewood to cook food and as we often do this already, this will not be a big deal...” (male, >50, March 2009). When asking how they would cope without a refrigerator, most felt they would manage with older informants in both Niue and Tuvalu recalling the days before widespread electrification (female, >60, March 2010; male, >70, March 2011). One younger informant in Tuvalu was not convinced and said she “could not imagine” being without a refrigerator and freezer (female, <30, September 2009). Three Tuvaluan informants told me how in pre-refrigeration days, fish was preserved by salting, drying or baking (male, >40, March 2013; female, >40, September 2009; male, >50, September 2009). In both countries, a number of informants commented that if refrigeration was no longer available, then people would have to revert to “traditional” foods that they can grow themselves (female, >40, March 2010; male, >60, March 2010; male, >50, September 2010; male, >50, March 2011). Interestingly, the impacts on water supply due to a lack of electricity was not identified by informants as a major concern. The prospect of no fuel for motor vehicles – cars in Niue and mainly motorcycles in Tuvalu – was seen as a matter of some concern by virtually all informants. A similar widespread level of concern was expressed at the lack of electricity for computers, televisions and DVD players.

To summarise, informants’ responses were not unexpected. My impression was that there was confidence that there is sufficient traditional knowledge dating back to the pre-modern energy era available to ensure survival but a recognition that many of the features of a modern lifestyle that people appreciate would be lost.

7.4 TRANSFORMATION AND LIVELIHOOD ASSETS

The results of a series of livelihood analyses are summarised and discussed in this section. The process follows the methodology set out in Section 6.2 of the previous chapter. The analysis commences with an examination of the three components of transformation – transforming structures and processes, livelihood strategies and livelihood outcomes – with the objective of identifying the changes to these components that could become necessary for people to adapt to the energy deprived scenarios in Niue and Tuvalu. This is followed by the development of livelihood asset and energy pentagons, again using the approach described in Chapter 6.

Table 20: Transforming Structures and Processes: Energy-Deprived Scenario

COUNTRY	STRUCTURES	PROCESSES	EXTERNALITIES
NIUE (Ref Chapter 4:4.6 Chapter 7: 7.2.1)	<ul style="list-style-type: none"> Niue Constitution Act 1974 – established the Niue Legislative Assembly or Fono Ekepule. Legislation (statutes and associated regulations). Government Ministries and Departments. Village fono (may increase in importance) State owned enterprises. Commercial enterprises (individual/ family enterprises may increase). NGOs – (examples include Niue Youth Council, Chamber of Commerce). Ekalesia Niue – retains some influence. 	<ul style="list-style-type: none"> Fono Ekepule elected through universal suffrage with a three year term (Government of Niue, 2013). Provisions of Constitution provide for continued financial and administrative support from New Zealand. Law and order maintained by police force and administered by court system. Essential livelihoods maintained through limited government services. 	<ul style="list-style-type: none"> Reduced access to imports, including fuels. Impacts of climate change.
TUVALU (Ref Chapter 5: 5.6 Chapter 7: 7.2.2)	<ul style="list-style-type: none"> Constitution of Tuvalu – promulgated at independence in 1978 and amended in 1986. Legislation (statutes and associated regulations). Government Ministries and Departments. Island Falekaupule (will increase in importance) State owned enterprises. Tuvalu Cooperative Society (fusi). Commercial enterprises (individual/ family enterprises may increase). NGOs. Ekalesia Tuvalu – retains strong influence. 	<ul style="list-style-type: none"> Fale i Fono elected through universal suffrage with a four year term. Law and order maintained by police force and administered by court system. Essential livelihoods maintained through limited government services 	<ul style="list-style-type: none"> Reduced access to imports, including food and fuels. Impacts of climate change.

7.4.1 Transforming Structures and Processes

As shown in Table 20 above, transformation structures and processes are expected to remain largely unaltered from those of the contemporary era in both Niue and Tuvalu. It is possible that given the reduced access to transport, the roles of the village fono in Niue and the island falekaupule in Tuvalu will increase in importance – arguably, more so in Tuvalu than in Niue given the remoteness of the Outer Islands from central government in Funafuti. However, the role of government will become difficult with the need to maintain essential food supplies with the reduced transport services and the need to provide essential livelihood services such as transport, health and education. Policies backed up with regulations will be required to prioritise scarce fuel supplies if those essential services are to be maintained. The maintenance of law and order may also face new challenges with disputes over land ownership assuming an increasing importance in terms of access to land for food production.

7.4.2 Livelihood Strategies and Outcomes

These two components are closely related and are discussed below for each country.

(a) Niue

Possible livelihood strategies and outcomes are shown in Figure 55 below. Subsistence farming and fishing will become increasingly important in the achievement of food security. This will include food supply for both household consumption and for sale. With a reduction in access to imported meat, pig raising is likely to increase and possibly also chicken farming¹⁰³ for both eggs and meat, given the large numbers of feral chicken that can be seen when travelling around Niue. As a consequence of the increased growing of food crops, there is the risk of a rise in disputes over land ownership which would necessitate intervention by police and the courts or through customary systems. Education and health services will continue but may reduce in terms of quality and access for reasons that will be discussed in Section 7.4.3 below. The role of education may become primarily a means of achieving societal cohesion and awareness of human rights while moving to educate people for the new livelihood paradigm. Extended family relationships may regain importance in respect to access to land for food production. Employment in both the government and the private sector will decline with increased subsistence activities diverting people away from formal employment and possibly the reduced ability to use private motor vehicles to travel to work.

¹⁰³ I have been told by a reliable informant who visited Niue in mid-2014 that a chicken farm to supply eggs and meat has recently been set up by a local entrepreneur.

Figure 55 – Livelihood Strategies and Outcomes: Niue – Energy Deprived Scenario

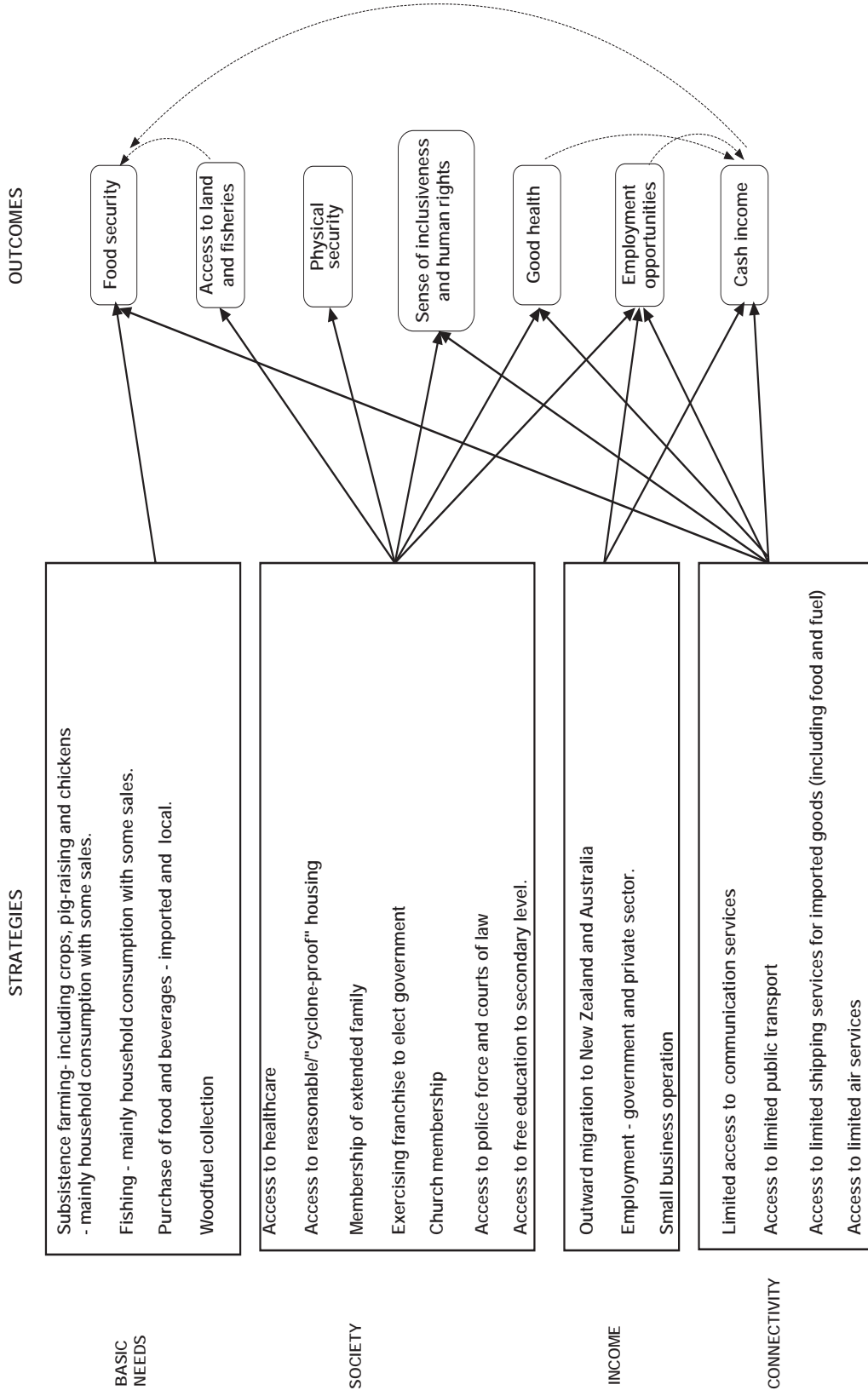
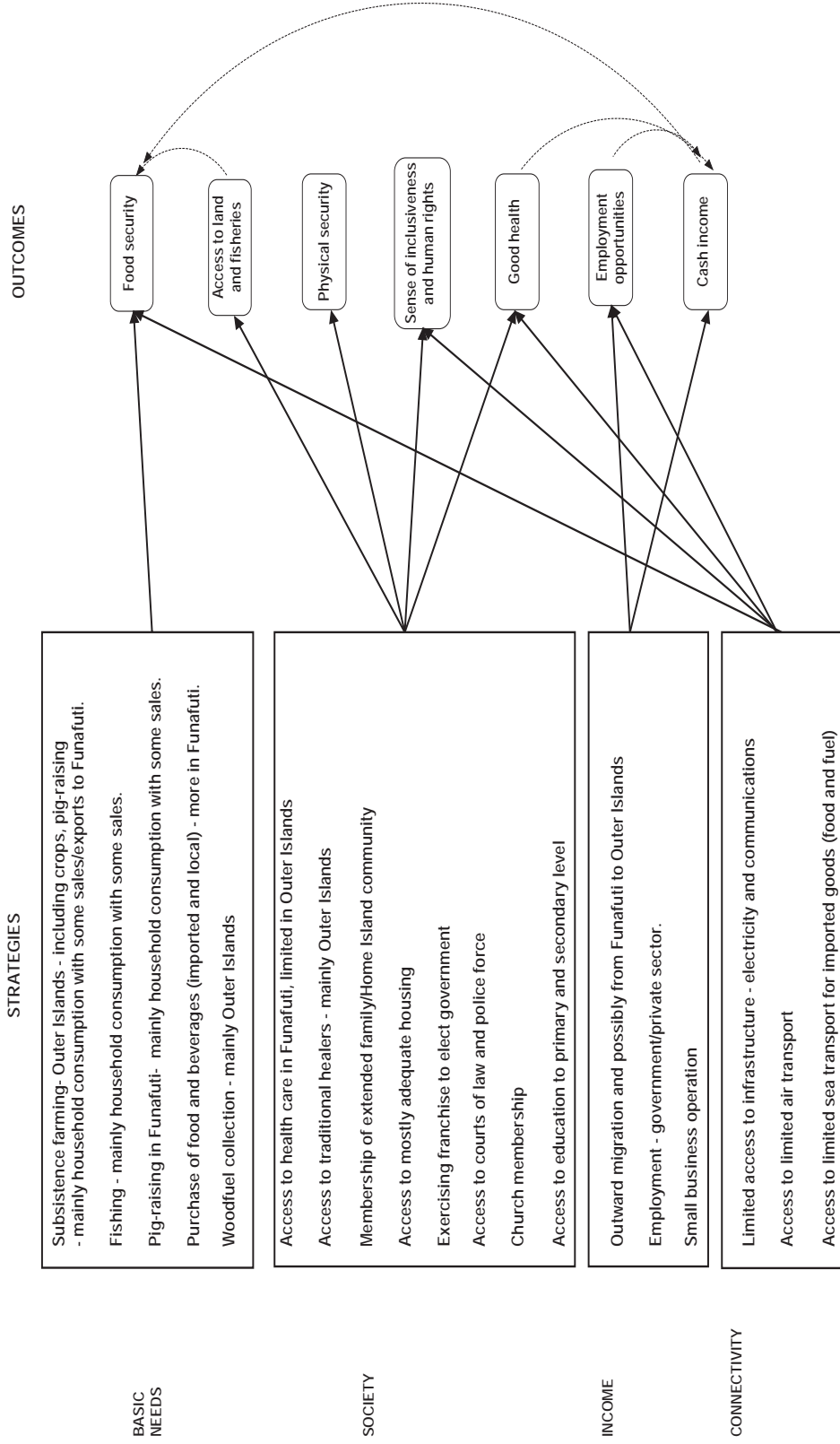


Figure 56 – Livelihood Strategies and Outcomes: Tuvalu – Energy Deprived Scenario



The private sector will be badly affected by the cessation in tourism but to some degree, there may be an increase in small business activity in food production and gathering and selling of woodfuel. The lack of private motor transport will change lifestyles and one consequence could be increased importance of village and church-based activities in people's social lives. Migration to New Zealand and Australia could be a strategy adopted by an increasing number of Niueans; however, in a situation of severe energy supply constraints that would also affect New Zealand and Australia, the attraction of migration may no longer be as compelling as is the case in contemporary Niue¹⁰⁴.

(b) Tuvalu

As discussed above, the situation in Tuvalu is complicated by the very different circumstances that exist in the Outer Islands and Funafuti. As shown in Figure 56, subsistence farming and fishing will become of increased importance in the Outer Islands as a source of income from increased demand in Funafuti due to reduced food imports. This is based on the assumption that food imports will be limited to products that cannot be met from within Tuvalu, rice being the main example. Pig raising may become of increasing importance in Funafuti to compensate for reduced imports of meat although space limitations may restrict the number of additional pigs that can be accommodated. Extended family and home island relations may become increasingly important in respect to access to and ownership of land. Disputes over land ownership could increase, resulting in additional work for the police and the courts, a situation that could be aggravated in the likely event that some households now resident in Funafuti move back to their home island to claim access to family land for food production. Education and health services would continue but can be expected to reduce in quality and as in Niue, the role of education may become primarily a means of achieving societal cohesion. Employment in both the government and the private sector will decline with increased subsistence activities diverting people away from formal employment but informal or family enterprises may compensate to some degree.

As noted above, some families may move from Funafuti to their home island but it is difficult to judge the extent to which this reverse migration might occur. Some families may also choose migration to neighbouring countries, most likely New Zealand and Australia but as noted above, this will depend on the willingness of other countries to accept migrants from Tuvalu in other than small numbers.

7.4.3 Livelihood assets

Figures 55 and 56 above demonstrate the complex series of linkages between livelihood strategies and livelihood outcomes. In turn, these outcomes impact on people's livelihood assets and these are analysed in Tables 29 and 30 (Appendix 3) using the same methodologies and parameters to those used in Chapter

¹⁰⁴ However, if the experience in 19th century Britain as described in Chapter 2 can be taken as a guide, it could be that people regard even a deprived urban life is preferable to rural poverty?

6. The results of the analysis are expressed in the form of livelihood pentagons and are shown below in Figures 57 and 58 together with the pentagons developed for the contemporary eras in each country. Also as in Chapter 6, livelihood energy pentagons are developed in order to illustrate the role in supporting the five livelihood capitals and are compared with those of the contemporary era. The main results and conclusions of the analysis are summarised below.

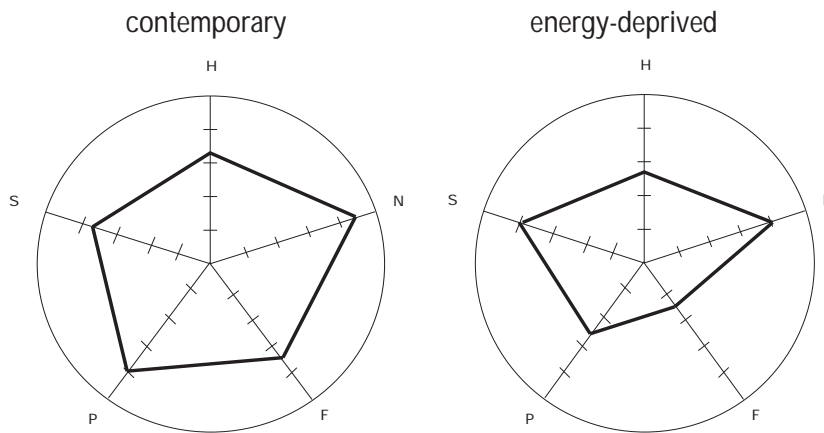
(a) Niue

Figures 57 and 58 below compare livelihood asset and energy pentagons for Niue in the contemporary era with those predicted for the energy-deprived scenario. Four of the five livelihood capitals are expected to reduce from the values in the contemporary era, in particular financial capital reflecting the likely reduction in incomes from employment and business activities. To some degree this will be counteracted by a growth in the informal economy including sales of produce from bush gardens and from woodfuel or charcoal sales. Physical capital will also reduce substantially owing to the curtailed access to electricity and piped water supply and very limited access to transport.

In terms of human capital, the impact on health services could be significant. As shown in Figure 5 in Chapter 2, there is a relationship between energy use and life expectancy and infant mortality and on this basis, health services appear particularly vulnerable in an energy-deprived scenario. The provision of hospital services is expected to continue but the ability to recruit and retain medical practitioners with appropriate qualifications may be reduced and the ability to transfer patients for treatment in New Zealand will be affected by reduced air services. At most risk in such a situation will be the most vulnerable: the very young and the elderly and an increased risk of infant and maternal mortality. Education will also suffer through lack of electricity at home reducing the ability for home study and limiting access to the internet. Access to tertiary study overseas may also be affected.

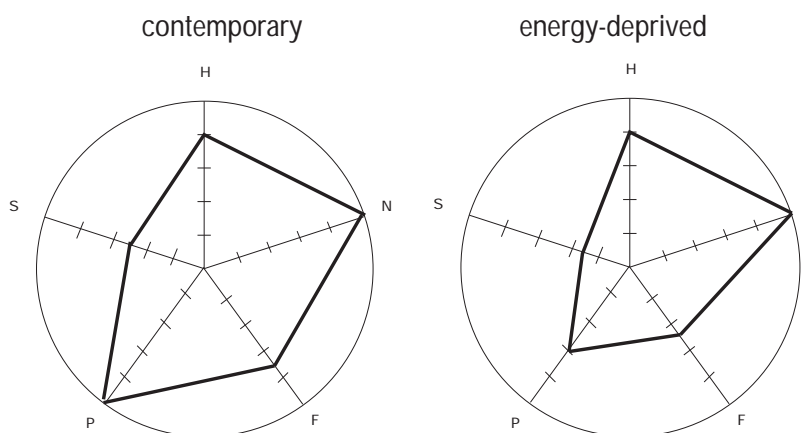
Natural capital is expected to remain unchanged; while the lack of electricity will reduce the level of access to the water lens, the natural resources of the island are relatively abundant given the low population density and the importance of these resources will increase, particularly in respect to woodfuel needed to compensate for the lack of LPG and electricity now commonly used for cooking. However, solar energy will no longer be available because as explained above, the configuration means that the PV generation plant cannot operate unless the diesel generators are also operating. A possible beneficiary could be social capital due to the village regaining its role as a central part of people's lives with the reduced level of mobility and perhaps even a level of camaraderie in the face of adversity – an example being the electricity crisis following the power station fire in 2006 and described in Chapter 4. There may also be "secondary" impacts across capitals: for example, reduced access to adequate health services may result in people's ability to work being reduced due to poor health which, in turn, would reduce financial capital. Reduced access to transport may also affect people's ability to work.

Figure 57 – Livelihood Asset Pentagons: Contemporary versus Energy- Deprived – Niue



In Figure 58, in the “energy-deprived” livelihood energy pentagon, the human capital energy factor remains strong because even though human capital decreases, energy supply while at a much reduced level will remain important in the maintenance of health, education and transport services. Natural capital energy retains its very strong rating given that it becomes the sole source of household cooking fuel. With the reduction in formal employment opportunities, the financial capital energy factor is reduced but still has some importance through the provision of (limited) transport services. The link between physical capital and energy is both reduced and changed in nature. In the case of energy for cooking, physical capital in the form of electricity and LPG will be replaced with natural capital in the form of woodfuel. Physical capital in the form of household appliances which, as discussed in Chapter 4, are used extensively in Niue households will without electricity become useless.

Figure 58 – Livelihood Energy Pentagons: Contemporary versus Energy- Deprived – Niue



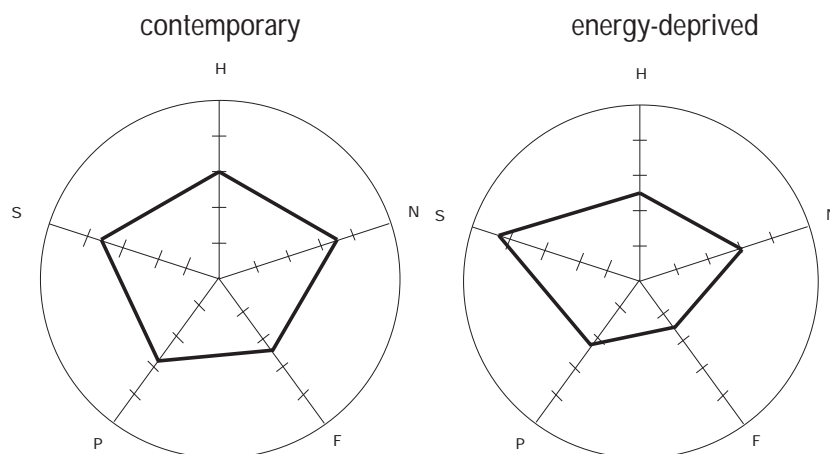
Some physical capital livelihood services such as communication and public transport are expected to continue to be accessible through a limited fuel supply. The relevance of energy in respect to social capital

is expected to reduce slightly as people will have reduced access to transport leading to social life becoming increasingly village-based.

(b) Tuvalu

Livelihood asset pentagons for Tuvalu comparing the situation in the contemporary era with that predicted for the energy-deprived scenario are shown in Figure 59 below. The impacts of constrained energy are similar to those predicted for Niue with all capitals other than social capital expected to decrease in value, the expected increase in social capital being due to people developing a greater level of self-sufficiency, particularly in the Outer Islands. It is possible that this expectation may be optimistic as there is the possibility of some social disruption in Funafuti from disputes between the landowners – the Funafuti “home” islanders – and settler families from other islands over access to limited natural resources. Financial and physical capitals are expected to decrease for the same reasons as in Niue: the likely reduction in incomes from employment and business activities and curtailed access to electricity and imported fuel supply. Human capital will reduce a little mainly due to reduced access to health and education services.

Figure 59 – Livelihood Asset Pentagons: Contemporary versus Energy- Deprived – Tuvalu

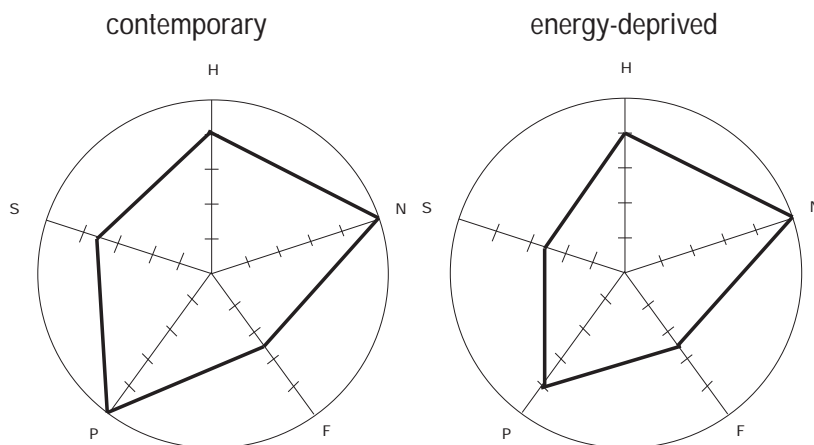


As noted in Chapter 5, however, people in the Outer Islands already have to cope with limited access to health care in particular with traditional healers forming part of people’s healthcare strategy. As with Niue, reduced access to health care will impact on the very young and the elderly and introduce an increased risk of infant and maternal mortality. Natural capital is also expected to reduce slightly, mainly due to the potential for the already limited natural resource base in Funafuti to become further stressed. Some secondary impacts may occur across capitals in a similar manner to Niue, such as reduced access to adequate health services resulting in people’s ability to work being reduced due to poor health which in turn would reduce financial capital. A further risk that is difficult to evaluate is the potential for natural capital to be impacted by climate change, an example being increased infiltration of sea water resulting in ground water salinization,

affecting crop growth. In an energy-deprived scenario, the inability to grow food crops would be extremely serious because imported food may not be readily available.

The energy pentagons shown in Figure 60 demonstrate that even in an energy-deprived scenario, energy continues to play an important part in supporting the livelihood capitals.

Figure 60 – Livelihood Energy Pentagons: Contemporary versus Energy- Deprived – Tuvalu



In the case of human capital, the limited energy supplies that are available will support health and education services while natural capital energy will provide the woodfuel essential for household cooking and in the Outer Islands, electricity from the PV generation systems. The limited energy supply will support the transport services that enable some income generation activities to continue such as growing food and gathering woodfuel in the Outer Islands for shipment and sale in Funafuti. The electricity supply in the Outer Islands even if rationed should enable households to continue the use of refrigerators and other household appliances and therefore physical capital energy remains relatively high there although not in Funafuti. As with Niue, the relevance of energy in respect to social capital is expected to reduce slightly as people reduce travel with social life becoming increasingly island based. However, an important and associated issue is the impact of the energy-deprived scenarios on vulnerability and this is the subject of the following section.

7.5 THE VULNERABILITY CONTEXT

Vulnerability profiles for the energy-deprived scenario have been developed for Niue and Tuvalu and compared with those developed in Chapter 6 for the contemporary era. The approach is as used in Chapter 6 and events that create vulnerability are identified and assessed in terms of the risk or probability of occurrence and the impact of the event on the community. These are shown in graphical form with risk or probability forming the vertical or “y” axis and impact forming the horizontal “x” axis with level of vulnerability being the function of the two. As also in Chapter 6, trends and shocks only are considered, with seasonality not being seen as an issue of vulnerability in either country. The analysis is essentially subjective in that the

assessments are not based on quantitative data, the main purpose being to identify the likely change in vulnerability between the contemporary era and the energy-deprived scenario.

7.5.1 Niue

Vulnerability profiles for the contemporary era and the energy-deprived scenario are shown in Figure 61 below. All the shock or trend events identified for the contemporary era remain in the energy-deprived scenario but some changes can be expected in terms of impact, notably drought in that while the probability of drought is unlikely to change, the impact will increase through lack of access to the water lens due to unavailability of electricity to drive the water pumps. Similarly, while the probability of climate change that affects Niue remains unchanged in the energy-deprived scenario, the impact is likely to be greater through reduced ability in terms of adaption. The probability of political or economic change affecting the flow of ODA is considered likely to increase in an environment where international oil supplies are disrupted, a situation that will have political and economic implications for Niue's ODA partners by reducing their ability to maintain ODA at current levels. Such a situation could also impact on the ability or willingness of Niue's international partners to provide assistance in the event of a cyclone and for this reason, the impact is considered likely to increase. While shipping services and energy supply will reduce, these services remain critical and therefore vulnerability to shipping service disruption remains. Conflict over land access is added in the energy deprived scenario although at a fairly low level of probability and impact with people having access to law enforcement through police, the courts and possibly customary processes. Migration is identified above as a livelihood strategy but to what extent this will increase or decrease in the energy-deprived scenario is very hard to judge as this would be dependent on the opportunities for employment and access to health and education in New Zealand, all of which could be adversely affected by an international energy crisis.

7.5.2 Tuvalu

As shown in Figure 62 below, the main changes in the vulnerability profile for the energy-deprived scenario compared with that for the contemporary era are the addition of conflict as a possible shock event and the migration trend from flow to Funafuti reversing. The limited resources of the islands that make up Tuvalu could result in conflict over access to those resources as a microcosm of the conflict predicted by Urry (2013, p. 199). There are two potential conflict scenarios: firstly, the very high population density in Funafuti means that there is very little land available and what there is owned by families whose home island is Funafuti and there is a possibility that this could result in resentment on the part of families whose home island is other than Funafuti – as noted in Chapter 5, this is already a cause of some resentment (Chapter 5: 5.6.1). Secondly, some families may move from Funafuti to their home island to claim access to land there, a situation that could possibly create resentment on the part of resident family members who have enjoyed relatively unfettered access to that land. To what extent, resettlement in the Outer Islands is a strategy likely to be adopted by many families in Funafuti is open to conjecture but nevertheless is a possibility?

Figure 61 – Vulnerability Profiles: Contemporary versus Energy-Deprived – Niue

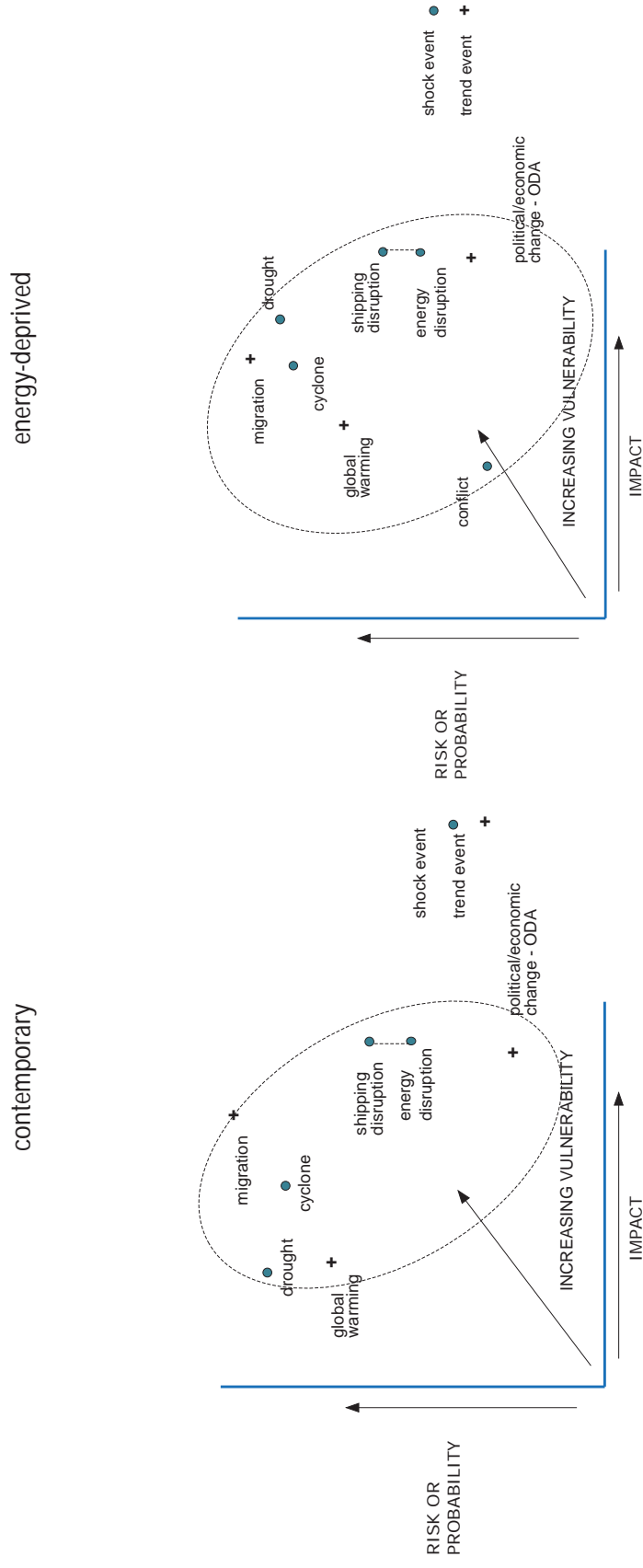
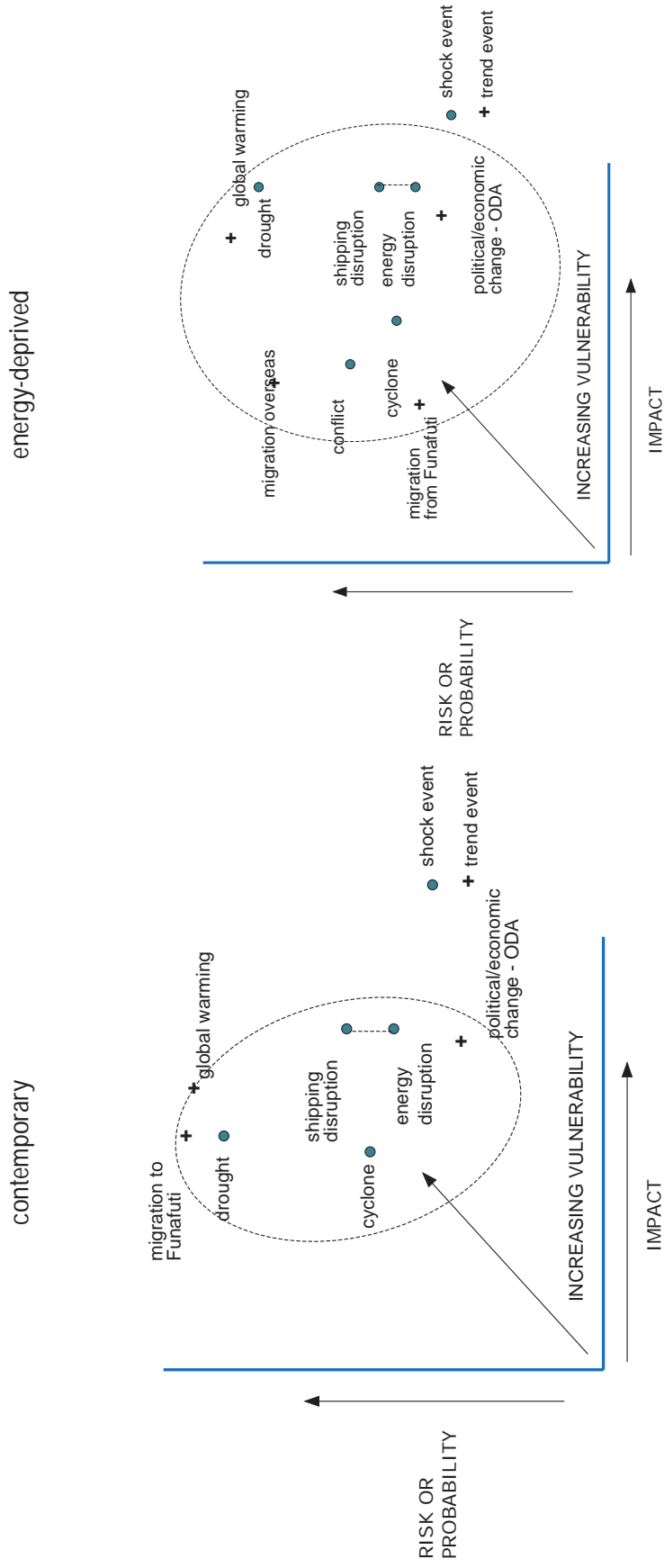


Figure 62 – Vulnerability Profiles: Contemporary versus Energy-Deprived – Tuvalu



Another open question is whether migration to neighbouring countries, notably New Zealand and Australia, will remain possible and although I have designated this as a “risk”, would the impact be positive or negative?

The probabilities of drought and cyclone will be unchanged but the impact could be greater. In the case of drought, lack of electricity to power the desalination plant will mean that stored rainwater is the only source in Funafuti; furthermore, the ability of the international community to ship water supplies to Tuvalu as happened in 2011 (Chapter 5: 5.6.4 (c)) may be limited in an international oil supply crisis. For the same reason, post-cyclone relief could also be less forthcoming. As with Niue, the probability of climate change affecting Tuvalu remains unchanged in the energy-deprived scenario but the impact is likely to be greater through the reduced ability to adapt. Shipping services and energy supply will be at a reduced level but of critical importance given that as discussed above, dependence on food imports will continue. As in Niue, the international political and economic situation may reduce the ability of Tuvalu’s ODA partners to maintain the current levels of ODA. Migration overseas is identified as a possible risk but this would require neighbouring countries and particularly New Zealand and Australia to accept increased migrants on humanitarian grounds.

In the next section, I review the plans that the governments of Niue and Tuvalu have in place to reduce the dependency on imported fuels and also in respect to disaster risk management.

7.6 NATIONAL STRATEGIES AND PLANS

7.6.1 Energy Related Strategies

In common with other South Pacific island nations, Niue and Tuvalu have put in place national development plans. These plans, while different in style and presentation, are similar in terms of content and objectives and include strategies aimed at good governance, economic development, social development, infrastructure and environmental protection. In this respect, the Niue and Tuvalu plans have much in common with a number of other small Pacific Island countries that share these concerns in their national development strategies. Table 21 below sets out in summary the strategies related to energy and for comparison purposes, includes references to the plans of three neighbouring island countries: the Cook Islands, Kiribati and Tokelau.

Table 21: National Strategies for Sustainable Development – Niue, Tuvalu, Cook Islands, Kiribati and Tokelau – Energy Related Strategies

NIUE	TUVALU	COOK ISLANDS	KIRIBATI	TOKELAU
Niue National Integrated Strategic Plan 2009 – 2013	T E KAKEEGA II National Strategy for Sustainable Development 2005 - 2015	National Sustainable Development Plan (NSDP) 2011-2015	Kiribati Development Plan 2012-2015	Tokelau National Strategic Plan 1 July 2010 – 30 June 2015
"The National Development Pillars"	"The Eight Strategic Areas"	"The National Goals"	"Key Policy Areas"	"Policy Outcome Areas"
PILLAR: ECONOMIC DEVELOPMENT: Includes "aim is for Niue to be 100% carbon neutral within the next three years. Niue is exploring renewable energy options to reduce reliance on fossil fuels and is considering energy efficient products such as electric cars and solar powered street lights"	STRATEGIC AREA 4: FALEKAUPULE AND OUTER ISLANDS: "Provide better infrastructure (water storage, roads, jetties, causeways/ bridges, seawalls, airfields, power, and other infrastructure, including renewable energy technologies, communications/ internet, and sanitation".	GOAL 3: ENERGY SECURITY: "Renewable energy for energy security to enhance our economic and social development and environmental integrity"	KPA 6: INFRASTRUCTURE: "Installation of solar power points and exploration of wind energy options on the outer islands".	GOAL 2: IMPROVED STANDARD OF LIVING THROUGH RELIABLE, ADEQUATE AND EFFICIENT INFRASTRUCTURE "To implement renewable energy project with the generation of power solely from solar and bio-fuel technology"

Sources: Government of Niue (2009a), Government of Tuvalu (2005), Government of the Cook Islands (2010), Government of Kiribati (2012), Government of Tokelau (2010) .

As can be seen in Table 21, all five national plans refer to energy and specifically to the development of renewable energy. Of these, the Tokelau plan is the most specific with the objective of all electric power being generated from “solar and biofuel technology”¹⁰⁵. The Cook Island plan is notable as it makes specific reference to energy security as a “National Goal”, the only plan to make specific reference to energy security as a key objective. In the Tuvalu plan, the only reference to energy in the list of “Eight Strategic Areas” is in the context of the Outer Islands. This apparent omission, however, is compensated to a large degree in two related documents, the Kakeega II Matrix, and Enertise Tutumau 2012-2020 (the Electricity Master Plan discussed in Chapter 5), the relevance of both of which is discussed below.

Considering further the Niue national development plan, in addition to the general statement in Table 21, the plan includes energy related strategies and targets notably (paraphrasing):

- A review and implementation of the Strategic Energy Policy and Action Plan by 2010.
- By 2009, conduct studies on the impacts of introducing more renewable electricity generation into the grid and to implement findings by 2011.
- Work towards 20% electricity generation from renewable energy by 2013 while maintaining grid stability.

(Government of Niue, 2009a, p. 18).

As discussed in Chapter 4 and in Section 7.2.1 above, progress has been made towards achieving the goal of 20% of generation from renewable energy although as also discussed, there are some indications of grid instability.

I have made enquiries regarding the National Strategic Energy Policy and Action plan together with an internet search but I have been unable to locate any documents more recent than the Niue National Energy Policy and the Niue National Energy Action Plan, both published in 2005 (Government of Niue, 2005a, 2005b). The policy covered energy planning, petroleum imports, transport, new and renewable sources of energy, the environment and energy conservation and efficiency while the energy action plan sets out the proposed measures to implement policy. The common thread in both documents was the need to minimise energy costs by securing “a reliable supply of petroleum products at minimum landed cost” and the implementation of energy conservation and efficiency. In respect to renewable energy, the policy included:

- To promote sustainable energy options for power generation including solar, wind and biomass energy resource.

¹⁰⁵ According to an informant in MFAT, the recently completed PV generation installations on Tokelau’s three atolls are meeting about 90% of consumption which is in line with expectations. Diesel rather than bio-fuel is still being used for the balance of generation.

- Assess and promote the natural resource potential and improve the technical capacity to meet Niue's energy needs.

(Government of Niue, 2005b, p. 8)

The action plan included "on-going resource assessments of Niue's new and renewable energy resource and noted four potential sources of renewable energy for assessment:

- Biomass (with the objective of meeting 30% of total fuel consumption by 2015).
- Solar (including the objective of 100 kW PV generation by 2010)
- Wind (to "facilitate the process of installing wind generators connected to the national grid".)
- OTEC/Tidal/Wave energy (to assess technical and economic feasibility of these technologies_

(Government of Niue, 2005a, p. 10).

In the case of Tuvalu, while the only reference to energy supply in the national plan is in the context of the Outer Islands, the associated planning document, The Kakeega II Matrix includes under the heading "8. Strategic Area: Infrastructure and Support Services - Public Works and Energy- 'Reduce reliance on fossil fuel thru energy conservation and renewable energy' "(Government of Tuvalu, 2009) . As noted in Chapter 5, the Government of Tuvalu and TEC have prepared "Enetise Tutumau", the master plan for renewable energy and energy efficiency which has the objective of generating 100% of electricity by renewable energy by 2020 (Government of Tuvalu, 2012b). Enertise Tutumau 2012-2020 includes a detailed implementation plan aimed at meeting the above objectives together with estimated costs and as noted in Chapter 5, certain of the projects identified in the plan are either under construction or at an advanced planning stage (Government of Tuvalu, 2012b, p. 4).

7.6.2 Disaster Risk Management

The need for energy security in the context of disaster planning is recognised by both governments in the National Action Plans for Climate Change and Disaster Risk Management (Government of Niue, 2012b; Government of Tuvalu, 2011a). In both plans, renewable energy and energy efficiency are identified as strategies to improve energy security. The key actions in the Niue National Action plan include:

- A review of the National Strategic Energy Policy and Action Plan.
- Promotion (including incentives) of private sector involvement in renewable energy and energy efficiency initiatives.
- Education and awareness programmes on energy efficiency and renewable energy.
- Strengthening electricity infrastructure.
- Development of renewable energy options (such as PV) for water pumping.

(Government of Niue, 2012b, p. 38).

Tuvalu's National Action Plan has five key strategies which are summarised below together with proposed implementation actions:

- Reduce reliance on fossil fuels through renewable energy and energy efficiency – actions include: training and awareness in energy efficiency and conservation; promotion of use of PV systems and other renewable energy sources; installation of PV systems on all islands.
- Promote energy efficiency and conservation programmes – actions include: development of awareness material and programmes for schools; development of awareness materials and programmes for the community at large followed by delivery of the programmes using all media outlets.
- Energy legislation and regulations promoting and supporting renewable energy and energy efficiency – actions include: review and development of legislation and regulations; review of other legislation impacting on the energy sector; the development of an Energy Bill.
- Mitigation plans for agriculture and waste management sectors to reduce greenhouse gas emissions – actions include: feasibility studies on using landfill and pig waste to generate methane; implementation of methane recovery and use; training in operation and maintenance.

(Government of Tuvalu, 2011a, p. 51)

Both countries hold reserves of bulk fuels to provide some level of security in the event of supply disruption: Niue maintains reserves that are equivalent to 60 days normal consumption while in Tuvalu the reserves are equivalent to 28 days normal consumption (SPC, 2012a, p. 12; 2012c, p. 13).

7.6.3 National Strategies and Plans – a Critique

The livelihood analysis demonstrates that in an energy-deprived scenario, direct impacts will include much reduced electricity supply, much reduced LPG supplies affecting household cooking and much reduced transport fuels. These direct impacts will affect virtually every aspect of day to day life through reduced livelihood services such as health, education, water supply, transport and communications. To some degree, as discussed above, the Niue National Integrated Strategic Plan 2009 – 2013 and Enertise Tutumau address the issue of electricity generation through the objective of 100% generation by renewable energy although in respect to Niue, there is no clear plan for achieving that goal. The Niue National Energy Policy and National Energy Action Plan of 2005 included worthwhile objectives and plans but neither document appears to have been updated.

The focus in both countries on electricity generation is understandable given that this sector is the single biggest user of imported diesel fuel (Isaka et al, 2013a, 2013b; SPC, 2012a, 2012b). As noted in Chapters 4 and 5, however, the non-electricity energy sector, which includes transport and household cooking, accounts for about 50% of fuel imports in both Niue and Tuvalu. As can be seen from the livelihoods analysis in Appendices 2 and 3, people in both Niue and Tuvalu rely on motorised transport ranging from motor scooters to ships and planes. As also can be seen from the analysis in Appendix 3, a constrained

supply of transport fuel would impact adversely on all five capitals. The importance of motorised transport creates a conundrum in that alternatives to diesel, petrol and aviation kerosene are not readily available. Some mention of transport is made in the Niue National Integrated Strategic Plan 2009 – 2013 with reference to electric cars while in the case of Tuvalu, the World Bank Energy Sector Development Project (ESDP) includes a study on the potential use of electric bicycles, scooters and motorcycles (Government of Niue, 2009a, p. 8; Government of Tuvalu & TEC, 2013, p. 4). The feasibility of adopting electric cars in Niue will need careful study, not only because of the cost but also the impact in terms of increased electricity demand. The possible use of electric bicycles, scooters and motorcycles in Tuvalu is a different proposition to electric cars in Niue, however, given firstly, the electricity demand of these vehicles will be less than an electric car and also the small size of the islands of Tuvalu means that people travel much smaller distances and therefore will use less electricity.

Based on my field research and as discussed in Chapters 4 and 5, LPG is the preferred cooking fuel in both countries. As shown in Table 15 above, in 2009, Niue imported 25.5 tonnes of LPG and in an energy-deprived scenario, it is probable that this energy source would no longer be available and in this case, the likelihood is that people would need to revert to woodfuel. I have been unable to find LPG import data for Tuvalu but based on the figure for Niue and adjusting for (a) population and (b) based on my observations in Tuvalu that woodfuel is used in many households as well as LPG, I estimate that imports are likely to be in the order of 90 tonnes¹⁰⁶. Based on the 2012 census (Tuvalu Central Statistics Department, 2013), which showed that over 50% of the population of Tuvalu live in Funafuti, current annual LPG consumption in Funafuti could be around 45 tonnes and given the very high population density, this raises the question as whether adequate supplies of woodfuel would be available to compensate for a long term disruption in LPG supply?

In terms of disaster risk management, it is unclear from either of the National Action Plans whether a long term disruption in imported fuel supplies has been considered. Both plans include the promotion of energy efficiency and conservation and the use of renewable energy through awareness and education programmes and incentives; however, these actions appear to be aimed reducing reliance on imported fuels rather than addressing the situation where imported fuels are either not available or available in much reduced quantities.

7.7 CHAPTER SUMMARY

In both Niue and Tuvalu, the impact of an energy-deprived scenario on livelihoods assets will be negative and substantial resulting in a reduction in well-being. The impact will include much reduced electricity supply

¹⁰⁶ This is based on populations of 1,460 for Niue (Government of Niue, 2011, p. 14) and 10,590 for Tuvalu (Tuvalu Central Statistics Department, 2013) and assumes that per capita use in Tuvalu is 50% of that in Niue

that affects services such as health, education, communications and water supply, much reduced LPG supplies affecting household cooking and much reduced transport fuels affecting virtually every aspect of day to day life.

In terms of transforming structures and processes, both governments have a limited range of options but if the options are well implemented the impacts of energy deprivation could be reduced although not eliminated. Options will include new measures such as the provision of a public transport service¹⁰⁷ in Niue or continuation of existing services such as the inter-island shipping service in Tuvalu.

Allocation of the limited fuel supplies to ensure that essential livelihood services – such as health, education and communications – are maintained would be an important government role and may involve prioritisation of services requiring fuel supply supported by regulation. As can be seen from the energy pentagons, even in the reduced asset portfolio situation, energy continues to have an important and arguably a critical support role. Appropriate government action will enable people to adopt livelihood strategies to cope better with the impacts of energy deprivation on livelihood services. Technical options to enable the PV generation plant in Niue and Funafuti to operate without diesel generators are available but will require significant funding. These options include battery storage and modified system controls. Tuvalu's Outer Island communities will be better off than Funafuti because the hybrid PV-diesel generation systems can operate without the diesel component but output will be reduced, particularly during cloudy periods when solar generation capability is reduced.

In both Niue and Tuvalu, the vulnerability profiles indicate that the vulnerability context will expand in an energy-deprived scenario. A new vulnerability event identified is a risk of conflict in both countries over access to natural resources, a situation believed to be more potentially serious in Tuvalu than in Niue due mainly to the much smaller land area and the very high population density in Funafuti. Otherwise, the main increase in overall vulnerability can be attributed to the increased impact of some shock and trend events, an example being drought, the impacts of which are mitigated significantly in contemporary Niue through electricity enabling water to be pumped from the underground lens and to a lesser degree in Funafuti by means of the electricity powered desalination plant. The probability of cyclone events will remain as in the contemporary era but the impact could be more severe through the reduced ability of the international community to provide rapid assistance following such an event. Other events are likely to remain unchanged in terms of probability or impact, global warming being an example – although it could be argued that an energy-deprived world may have reduced ability to assist in the event that Tuvalu becomes increasingly threatened by sea-level rise, a situation further exacerbated by fewer resources for adaptation. The impact

¹⁰⁷ As noted in Chapter 4, the only public transport service in Niue is the school bus service.

of shipping and energy supply disruption is considered unlikely to change as this is already a significant vulnerability in both Niue and Tuvalu.

To summarise, the analysis indicates that in an energy-deprived scenario, well-being would decrease while vulnerability will increase, giving rise to the question as to whether the governments of Niue and Tuvalu are aware of the potential risk and what plans are in place to mitigate this risk. The strategies and plans in place and discussed above show that both governments are aware of the need to reduce dependency on imported fuels but this appears to be driven by an economic imperative rather than a concern at the risk of a significant and long term disruption to imported fuel supplies. Options are available to the governments to improve resilience should the energy-deprived scenario eventuate, however, and these are discussed in the next chapter.

CHAPTER 8: THESIS REVIEW AND CONCLUSIONS

In the Introduction, I described my initial reaction when visiting Niue for the first time in 2002. It was one of surprise at the high standard of living when compared with other South Pacific island nations with virtually 100% electrification, a high level of vehicle ownership, houses with “mod-cons” – refrigerators, freezers, washing machines – and good public services – health, education, telecommunications and water supply. However, in later visits it became clear to me that much of this lifestyle and the associated livelihoods that maintained that lifestyle were dependant on imported energy in the form of diesel, petrol, LPG and kerosene. Furthermore, the cost of these fuel imports constituted nearly 29% of total imports and this was only affordable through ODA, mainly from New Zealand. In Tuvalu, the extent of vehicle ownership is less – and mostly motorcycles or scooters rather than cars – and households, particularly in the Outer Islands, do not have the same level of “mod-cons”. Nevertheless, in spite of a GDP per capita about one fifth of that of Niue, there is still a heavy reliance on imported fuels, the cost of which accounts for 16% of the total import bill. As with Niue, Tuvalu is reliant on ODA to pay for much of the imports that support day to day life.

This thesis set out to investigate my concern at the reliance on imported energy and the vulnerability that this situation has created in both Niue and Tuvalu. I was interested to explore firstly, how and why this situation has come about; secondly, what would happen in Niue and Tuvalu if the supply of imported energy was cut or severely constrained and thirdly, what, if anything, is being done to plan for such a situation. These questions and concerns are encapsulated in the research questions which are discussed below. Before I do this, I will first review my adoption of the sustainable livelihoods approach as a methodology for research and analysis.

8.1 USING THE SUSTAINABLE LIVELIHOODS APPROACH AS A METHOD OF ANALYSIS

In Chapter 3, when reflecting on the use of the sustainable livelihoods approach to design a methodology, I concluded that it provides an effective basis for planning and designing a research methodology. This view was based on two main features of the sustainable livelihoods approach: firstly, it focuses on people's livelihoods as a whole enabling the impact of an externality, such as energy supply, to be understood across the spectrum of livelihoods and, secondly, it lends itself to considering a range of options or scenarios. These features also enabled the development of the novel, systematic form of analysis used in this thesis, the output of which was the series of livelihood profiles including livelihoods asset pentagons that illustrate changes in livelihood assets. The parallel series of livelihood energy pentagons demonstrate the influence of energy on individual assets and livelihoods as a whole. Combined, the two series of pentagons provide a visual indicator of the influence of energy on human development. The link between energy and human development, however, is demonstrated more starkly by the analysis of the energy-deprived scenario by illustrating the impact in terms of livelihoods should a situation arise where energy supply is severely constrained.

In Chapter 3, I described the development of the method used for the analysis, the results of which are set out in Chapters 6 and 7. The method provides a good practical example of the flexibility of the sustainable livelihoods approach that enables examination of livelihoods over a range of circumstances. The method also demonstrates the adaptability of the DFID sustainable livelihoods framework to suit a given context. Care is required in applying the sustainable livelihoods approach, however, and particularly the DFID framework. As I discussed in Chapter 3, there is a risk that application may place undue emphasis on material values at the expense of people's social needs, reflecting more the values of the researcher rather than the people at the centre of the research. This potential limitation is particularly relevant when using the sustainable livelihoods approach in designing a development project or programme intervention but less critical in the context of this thesis, where the goal is to understand the impact of an external influence over livelihoods in qualitative terms. It is important therefore to acknowledge that some aspects of my analysis, particularly in respect to people's livelihood strategies may not fully reflect how people react in "real life" circumstances.

8.2 THE RESEARCH QUESTIONS

8.2.1 How has energy supply shaped the development of Niue and Tuvalu?

As discussed in Chapters 1 and 3, in the Human Development Report 1990, the UNDP described human development as "a process of enlarging people's choices" (UNDP, 1990, p. 10). The ability to make choices is closely linked to the livelihood assets, these forming the basis for the capabilities that provide the opportunity for people to choose between economic and social possibilities and to achieve well-being. (Scoones, 2009, p. 177; Sen, 2008, p. 278; UNDP, 1990, p. 10). Furthermore, the stronger the asset base, the greater the ability to avoid or reduce vulnerability (Rakodi, 2002, p. 15).

Based on the concept that the livelihood asset pentagon (DFID, 1999b, p. 2.1) by representing the assets of a society, provides a "snapshot" of the level of well-being and human development in that society at a given time, the asset pentagons developed in Chapter 6 and shown in Figure 36 illustrate the progression in development in Niue and Tuvalu from pre-palagi to the contemporary era. Overall, the asset pentagons show an increase in livelihood assets over the four historical eras in both countries indicating an increase in well-being. The asset pentagons for the pre-palagi, trader and missionary and colonial eras are virtually the same for both countries. The pentagons for the contemporary era, however, diverge in that the pentagon for Niue indicates a more balanced asset base, mainly due to greater levels of natural, financial and physical capital than in Tuvalu, representing a greater level of overall resilience. The difference represents the higher standard of living in Niue in terms of GDP per capita, health and education services and infrastructure, particularly water supply.

In parallel to the asset pentagons, a matching series of energy pentagons was developed in Chapter 6 and these were set out in Figure 37. As discussed in Chapter 6, the energy pentagon is intended to show the relationship between energy and a given capital. For example, in all the energy pentagons, the value of natural capital energy is high indicating the importance of energy from natural capital – historically woodfuel but more recently also solar energy using PV generation. The energy pentagons also show a steady increase in terms of the importance of energy in supporting livelihoods. In the pre-palagi era, the two societies were entirely dependent on natural capital energy, a situation that remained substantially unchanged until the colonial era when physical capital energy that included imported fuels increased. From late in the colonial era, the role of energy in supporting livelihoods both increased and expanded.

The relationship between development and energy is not a surprise: as discussed in Chapter 2, there are strong links between development and energy supply. For example, as shown in Figures 1 and 2, during British industrialisation from 1750 to 1960, both energy consumption and HDI increased approximately in parallel. Furthermore, from the 1990s onwards there has been increased awareness that energy is a critical factor in development and in particular, poverty elimination, an awareness underlined by the inclusion of access to energy¹⁰⁸ in the proposed Sustainable Development Goals that are due to replace the MDGs in 2015 (United Nations, 2014, p. 5). Energy however does not create development: rather, as discussed in Chapter 2, energy enables services that contribute to economic and social development. For example, as discussed in Chapters 4 and 5, livelihood services in contemporary Niue and Tuvalu such as health, education, transport and infrastructure services all rely on energy supply if the current levels of service are to be maintained.

The analysis in Chapter 6 also considered vulnerability and the series of profiles developed show a decreasing level of vulnerability over the four historical eras, particularly in respect to drought and cyclone. This decrease is not due to reduced risk or probability but reduced impact owing to increased resilience. However, the vulnerability created from increased reliance on imported energy and ODA has at least partly offset the reduced vulnerability to drought and cyclone. The reliance on imported energy and ODA – the need for a significant part of which can be attributed to the cost of the imported energy – underlines the difference between the development and provision of energy services and the associated livelihood services in industrialised countries from that of Niue and Tuvalu. In an industrialised economy, most households can afford to pay the true cost of energy be it in the form of electricity or transport fuels or incorporated in the cost of livelihood services. The “true cost” not only includes the cost of the primary energy resource but the costs associated with the delivery infrastructure, operating and maintenance and also depreciation to ensure that funds are accumulated to replace plant and equipment when required. In Niue and Tuvalu, the electricity infrastructure was paid for from ODA and as noted in Chapters 4 and 5, the price charged for electricity is

¹⁰⁸ SDG 7 reads: “Ensure access to affordable, reliable, sustainable, and modern energy for all”.

below the true cost. The reality is that neither country has the economic strength to pay for the imported fuel needed to support the contemporary lifestyle. Niue and Tuvalu are not alone, however: as Connell points out, small islands and small island states are characterised by a range of factors that limit economic development including small populations, limited resources, fragmentation and vulnerability to natural disasters and external economic shocks (2013, p. 18). The reliance on ODA to support energy supply will not cease with the planned increased renewable energy generation. On one hand, diesel fuel imports and diesel generator maintenance and replacement costs will decrease but on the other hand, there will be significant capital, operating and maintenance costs associated with renewable energy plant, particularly batteries and inverters in the case of PV and wind generation systems.

To conclude, the role of energy in both Niue and Tuvalu has changed from an essential but limited role to one that is all pervasive. As the two countries moved from the pre-palagi era, there was little impact in direct terms with woodfuel retaining an essential but limited role. However, indirectly energy through industrialisation and globalisation played a part in profound changes to both societies. The livelihood services that maintain human capital in Niue and Tuvalu rely heavily on energy, particularly health and education services. People's lives are made more comfortable through the use of labour saving household appliances and modern communications. Children in Niue no longer have to walk long distances to attend school.

8.2.2 What are the risks to the future development of Niue and Tuvalu from disruption to energy supply?

The analysis in Chapter 7 illustrates the negative impact to both Niue and Tuvalu in terms of well-being of a significant disruption in energy supply. In the case of the asset pentagons, there is considerable overall "shrinkage" in both countries. Natural capital remains strong, mainly because this is a critical energy source. Physical capital reduces for the obvious reason that this capital depends on imported fuel both as an energy supply and as energy users – motor vehicles and home appliances being the two main examples. Economic activity is likely to decline as people need to devote more time to subsistence activities exacerbated by reduced availability of transport fuel. Human capital declines due to reduction in access to health and education services and a risk of increased migration. Social capital however, is expected to increase as people will need to rely on each other more and village and island networks become more important owing to reduced mobility. There will be a greater need to work together for food production, along with the likelihood of reduced access to television, DVD players and the internet increasing the likelihood of greater social interaction. To sum up, the risk to development in the event of a significant disruption to fuel is substantial with the likelihood of a large reduction in well-being and reduced capability – but compensated to some degree by the likelihood of increased social capital. Furthermore, the reduced asset-base will

increase vulnerability particularly in respect to the impact of drought and cyclone and also the potential for heightened social conflict from competition for resources, particularly in Tuvalu.

8.2.3 What measures are being taken to mitigate these risks?

Both Niue and Tuvalu have plans in place that address the issue of reliance on imported energy as discussed in detail in the previous chapter. These include Niue's National Integrated Strategic Plan 2009-2013 and Tuvalu's Enertise Tutumau as well as both countries' National Action Plans for Climate Change and Disaster Risk Management. In both Niue and Funafuti, a number of PV generation plants are in service or in an advanced stage of planning, while in the Outer Islands contracts have been let for the installation of hybrid PV-diesel generation plants on all island except for Niulakita. As discussed in Chapters 4 and 5, in both countries, a number of international donor agencies are actively involved and in Tuvalu in particular, there appears to be a good level of coordination between donors. The World Bank Energy Sector Development Project (ESDP) addresses a wide range of energy issues rather than just focussing on renewable electricity generation in Funafuti including bio-fuel from coconut oil, electricity system optimisation and energy efficiency improvements.

8.2.4 Are those measures likely to be effective?

The PV generation plant in Niue and in Funafuti are "grid-connected" and, as configured, can only operate in parallel with diesel generator plant – unlike the hybrid PV-diesel plant in Tuvalu's Outer Island which will be able to operate without diesel generation. If and when the implementation plans in Enertise Tutumau are completed, 100% renewable energy generation in Funafuti will provide a good level of security in respect to electricity, but as explained in Chapter 5, I believe the complexity of the system described in Enertise Tutumau to provide Funafuti with 100% electricity from renewable energy raises a number of questions in respect to practicality, cost and maintainability (Government of Tuvalu, 2012b, p. A2). It is possible, however, that the studies being undertaken as part of the World Bank may resolve some of the issues of concern. Of concern is that only limited attention is given in the strategies and plans to the energy needs of transport and households. In both Niue and Tuvalu, these sectors use approximately 50% of fuel imports and would be severely adversely affected in an energy-deprived scenario.

8.3 A WAY FORWARD

The preparation of strategic action plans to evaluate the risk and impact of a severe and long term disruption to imported fuel supply would be a good first step towards mitigating the impacts of such an event. Once the risks and impacts are understood, mitigation measures could be developed using current plans – such as Enertise Tutumau – as a starting point. Given that the impacts of a disruption to fuel supplies will be across the full spectrum of livelihoods, the studies involved will need to be comprehensive rather than just focus on the energy sector. As noted above, while electricity generation is the main focus of existing plans, transport

and cooking fuels are only given limited attention in spite of these sectors accounting for around 50% of imported fuel usage.

Measures in the action plans should include the legal and regulatory framework and processes to deal with such a situation. To some degree, fuel use prioritisation as part of a legal and regulatory framework to respond to an energy-deprived scenario may be sufficient to enable essential transport services (shipping and air services together with local public transport services) to be maintained. As an immediate measure, consideration could also be given to modifying the existing or planned PV generation systems in Niue and Funafuti to enable these systems to supply electricity without the need to operate the diesel generators if required. If batteries are also provided, then there could be some – albeit limited – capability to operate water pumps in Niue to access the water lens and to operate desalination plant in Funafuti, thereby reducing vulnerability to drought to some degree.

Unfortunately, available renewable energy resources are limited. To date, PV technology has been favoured because of the relatively simplicity compared, for example, with wind turbines, and assisted by the reduced cost of solar modules in recent years. Wind generation has been of some interest in both countries but concerns have been expressed by energy sector informants in both Niue and Tuvalu over vulnerability to cyclones and difficulties with maintenance in a tropical, marine climate. Also, according to Dornan and Jotzo (2012), electricity generated by wind turbines is currently marginally more expensive than that generated by PV technology. Ocean energy technologies such as tidal, ocean thermal energy conversion (OTEC) and wave generation are emerging technologies (Lewis et al., 2011, p. 520) and as such, application in a remote island environment is unlikely in the immediate future. Sources of hydro or geothermal generation do not exist in either Niue or Tuvalu. Biomass is available as an energy source and, as discussed in Chapters 4 and 5, is used extensively in both countries as a cooking fuel, more so in Tuvalu than in Niue.

In the context of Niue and Tuvalu, biomass includes wood, coconut, plants and plant residues and animal wastes. Biomass has a significant advantage over PV and wind technologies in that it can be stored (Sims & El Bassam, 2003, p. 1). The potential that energy from biomass offers is recognised to some degree in Tuvalu as demonstrated by the use of biogas generated from pig manure. Also, as discussed in Chapter 5, the World Bank ESDP includes a study on the viability of using coconut oil as a bio-fuel for diesel generation in the Outer Islands of Tuvalu (Government of Tuvalu & TEC, 2013). Of the biomass energy options available, coconut oil is identified by Cloin (2005) and Woodruff (2007) as offering the greatest potential as substitute for diesel. Coconut oil has a particular advantage in that the coconut palm is an endogenous species and cultivation avoids the risks associated with introducing new species of biomass (P. Smith et al., 2014, p. 870). It is recognised, however, that there are a number of obstacles to developing coconut nut as a significant energy resource. In both countries, in common with other South Pacific island nations, the copra industry has been in decline for a range of reasons including “a combination of volatile prices, weak

management, limited investment, natural disasters and rising labour costs" (Woodruff, 2007, p. 61) and in Niue, this is evidenced by the existence of senile coconut plantations. In Tuvalu, land available for cultivation is limited (Dornan, 2012); however, as noted in Chapter 5, a case study in Woods et al (2006, p. 485) suggested that there is sufficient land for the cultivation of coconut palms to supply enough coconut oil to displace a substantial proportion of the diesel used for electricity generation. A further problem is that the gathering and processing of copra to produce oil is labour intensive and in Niue, the lack of labour necessary to exploit and manage the resource on a large scale could present difficulties (Wade, 2005a, p. 29).

Nevertheless, there is possible potential for biomass as an energy source given the wide range of technologies in various stages of maturity, including biogas, biomass gasifiers and biodiesel, either as straight coconut oil or reformulated to biodiesel (Cloin, 2005, p. 47). Further studies of the potential appear justified, particularly given the very limited range of renewable energy options available in both Niue and Tuvalu (Chaturvedi, 2004, p. 174; Sanday & Lloyd, 1993, p. 145; Wang, Weller, Jones, & Hannab, 2009, p. 574). Importantly, if further studies indicate that biomass – and in particular coconut oil as a diesel substitute – has genuine potential, this could provide a useful supplement to PV generation and help reduce the level of battery storage needed. Biomass has a further advantage over other renewable energy options in that the cultivation, harvesting and utilisation of biomass provides opportunities for employment, for the development of small businesses and the acquisition of new technical skills, leading to an increase in human and financial capital (A. Barnett, 2001, p. 30; Chaturvedi, 2004, p. 178). In an energy-deprived situation where employment opportunities become limited, increased use of biomass as an endogenous energy source could therefore provide useful sources of income.

To summarise, increased use of endogenous biomass could not only reduce dependency on imported fuels and thereby reduce the level of vulnerability that results from this dependency but also has the potential to provide small business and employment opportunities.

8.4 SOME FINAL REFLECTIONS

Energy has had a vital role in shaping the development of Niue and Tuvalu over the past two centuries, a role that has become all-pervasive with energy supporting virtually every aspect of people's contemporary livelihoods. Energy and the associated technologies have transformed people's lifestyles by enabling access to the services and infrastructure that define a modern society. Undoubtedly, the impact of access to energy in these societies is positive and is in line with the global literature and understanding of development agencies. A recent example is the inclusion of access to modern energy in the UN's Sustainable Development Goals, Goal 7 of which is "affordable, reliable, sustainable, and modern energy"

Certainly, most people in Niue and Tuvalu have access to modern energy. To the householder, it appears to be relatively affordable – but only because in both countries, electricity is subsidised. Reliability is variable

but overall could be described as generally acceptable. In no sense, however, can energy supply be regarded as sustainable given the reliance on ODA to pay for the imported fuel and for the cost of installation and maintenance of the energy infrastructure and the vulnerability to disruption of fuel imports, a factor beyond the control of both governments?

The problem confronting Niue and Tuvalu and other similar small islands and small island states, is that modern energy is a construct of the developed, industrialised world, conceived as part of the industrialisation process of the 19th and 20th centuries. As a consequence, modern energy supply relies on an industrialised – or post-industrialised – economic base to pay for the energy and the associated infrastructure. Neither Niue nor Tuvalu have such an economic base or easily accessible sources of domestic energy and have relied and continue to rely on ODA for the provision of the energy infrastructure and to enable the purchase of imported fuel. The result is that while positive in terms of lifestyle and overall wellbeing, transformation of both societies has been accompanied by increased dependency in the form of imported fuels and reliance on ODA. This dependency has created vulnerability in that a significant reduction in access to imported fuel owing to a cessation in ODA or an international energy crisis would have a serious and negative impact on people's livelihoods and wellbeing. This vulnerability provides a challenge for the governments of Niue and Tuvalu and also for the industrialised developed countries that through historic events such as globalisation and colonisation have to bear some responsibility for this situation.

There is an awareness of the need to address the reliance on imported fuel. Measures implemented and planned by the governments of Niue and Tuvalu and their overseas partners, however, focus on reducing economic dependency rather than reducing the risks from supply disruption. Furthermore, the measures are technically "one-dimensional" with an emphasis on electricity generation using PV technology, a technology that requires a level of technical skill to operate and maintain, particularly where batteries are installed. The potential exists, therefore, for increased dependency on specialist technical assistance from overseas (Tisdell, 2002, p. 906). This should not be seen as a reflection on the capabilities of the people in Niue or Tuvalu responsible for operating the plant but rather a recognition that the technology is complex and specialised. To the contrary, my observation is that the management and staff in the two electricity corporations both do very well to provide a reliable electricity supply under difficult circumstances.

In order to reduce the risk from a significant reduction in imported fuel supply, consideration should be given by both governments to the preparation of strategic action plans that evaluate the risk and impact of a severe and long term disruption to imported fuel supply. The plans could build on existing plans but should be more comprehensive and consider not only the electricity sectors but also the transport and household energy sectors. The plans would also provide an opportunity to consider an energy future that draws to a greater extent on a fuller range of endogenous energy sources, notably biomass. Such an energy future would not only provide greater security against fuel supply disruption but also open new economic opportunities in the

development, operation and management of the energy infrastructure involved. Added to these tangible impacts would be an increase in societal wellbeing from a reduced sense of dependency, a step towards returning to the era when both societies were self-sufficient, but without requiring people to give up the benefits of a modern lifestyle. Achievement of this objective corresponds with the intent of SDG 7 – and as such can be seen as not only underlining the current understanding of the importance of energy for sustainable forms of human development, but also more broadly reflecting a more integrated and sustainable understanding of development.

REFERENCES:

- ADB. (2006). Tuvalu: 2006 Economic Report- From plan to action. Manila: Asian Development Bank (ADB) and the Australian Government.
- ADB. (2011). About Regional and Sustainable Development Department. Retrieved 17/0/2/2011, from <http://www.adb.org/rsdd/about.asp>
- ADB. (2013). Asian development outlook 2013 - Update: governance and public services delivery. Manila: Asian Development Bank.
- Ali, I. (2004). Food import dependency in Niue In J.P.Terry & W.E.Murray (Eds.), Niue Island: Geographic perspectives on the Rock of Polynesia. (pp. 227-241). Paris: International Scientific Council for Island Development.
- Almeida, P. d., & Silva, P. D. (2011). Timing and future consequences of the peak of oil production. *Futures*(43(2011)), 1044-1055.
- Alofa Tuvalu. (2014). Biogas - what a blast! : Alofa Tuvalu.
- Alwang, J., Siegel, P. B., & Jorgensen, S. L. (2001). *Vulnerability: A view from different disciplines*. Washington D.C.: The World Bank.
- Arce, A. (2003). Value contestations in community interventions: Community development and sustainable livelihoods approaches. *Community Development*, 38(3 (July 2003)), 199-212.
- Arvizu, D., Balaya, P., Cabeza, L. F., Hollands, K. G. T., Jäger-Waldau, A., Kondo, M., . . . Zilles, R. (2011). Direct Solar Energy. In O. Edenhofer, R. Pichs-Madruga, Y. Sokona, K. Seyboth, P. Matschoss, S. Kadner, T. Zwickel, P. Eickemeier, G. Hansen, S. Schlömer, & C. von Stechow (Eds.), *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation*. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.
- Arvizu, D., Bruckner, T., Chum, H., Edenhofer, O., Estefen, S., Faaij, A., . . . Zwickel, T. (2011). Technical Summary. In O. Edenhofer, R. Pichs-Madruga, Y. Sokona, K. Seyboth, P. Matschoss, S. Kadner, T. Zwickel, P. Eickemeier, G. Hansen, S. Schlömer, & C. von Stechow (Eds.), *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation*. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.
- Ashley, C., & Carney, D. (1999). *Sustainable livelihoods: Lessons from early experience*. London: Department for International Development.
- Ashton, T. S. (1968). *The Industrial Revolution 1760-1830* (Revised ed.). Oxford: Oxford Paperbacks University Series.
- Bairoch, P., & Kozul-Wright, R. (1996). *Globalization myths: Some historical reflections on integration, industrialization and growth in the world economy*. Geneva: United Nations Conference on Trade and Development (UNCTAD)
- Bajracharya, D. (1983). Deforestation in the food/fuel context: Historical and political perspectives from Nepal. *Mountain Research and Development*, 3(3 (Aug., 1983)), 227-240.
- Banyan. (2011). And not a drop to drink. Retrieved 01/08/2012, from <http://www.economist.com/blogs/banyan/2011/10/south-pacifics-water-crisis>
- Bardi, U. (2009). Peak oil: The four stages of a new idea. *Energy*(34 (2009)), 323-326.
- Barker, J. C. (1994). Home alone: The effects of out-migration on Niuean elders' living arrangements and social supports. *Pacific Studies*, 17(3 (September 1994)).
- Barker, J. C. (2000). Hurricanes and socio-economic development on Niue Island. *Asia Pacific Viewpoint*, 41(2 (August 2000)), 191-205.
- Barnes, D. F., & Floor, W. M. (1996). Rural energy in developing countries: a challenge for economic development. *Annual Review of Energy and the Environment*, 21, 497-530.
- Barnett, A. (2001). Looking at household energy provision in a new way: The sustainable livelihoods approach. *Boiling Point*, Spring 2001(46).
- Barnett, J. (2008). The effect of aid on capacity to adapt to climate change: insights from Niue. *Political Science*, 60(1 (June, 2008)), 31-45.
- Barnett, J., & Ellemor, H. (2007). Niue after Cyclone Heta. *The Australian Journal of Emergency Management*, 22(1 (February 2007)), 3-4.

- Batiwala, S. (1995). Energy as an obstacle to improved living standards. In J. Goldemberg & T.B. Johansson (Eds.), *Energy as an Instrument for Socio-Economic Development*. New York: United Nations Development Programme.
- Baumann, P. (2000). *Sustainable livelihoods and political capital: Arguments and evidence from decentralisation and natural resource management in India*. London: Overseas Development Institute.
- BBC News. (2011). Australia, New Zealand in airlift to drought-hit Tuvalu. Retrieved 01/08/2012, from <http://www.bbc.co.uk/news/world-asia-pacific-15210568>
- Bebbington, A. (1999). Capitals and capabilities: A framework for analyzing peasant viability, rural livelihoods and poverty. *World Development*, 27(12), 2021-2044.
- Bedford, R., Macdonald, B., & Munro, D. (1980). Population estimates for Kiribati and Tuvalu, 1850-1900: review and speculation. *The Journal of the Polynesian Society*, 89(2), 199-246.
- Berger, M. T., & Beeson, M. (1998). Lineages of liberalism and miracles of modernisation: The World Bank, the East Asian trajectory and the international development debate. *Third World Quarterly*, 19(3 (Sep., 1998)), 487-504.
- Bertram, G., & Watters, R. F. (1984). *New Zealand and its small island neighbours: A review of New Zealand policy toward the Cook Islands, Niue, Tokelau, Kiribati and Tuvalu*. Wellington: Institute of Policy Studies, Victoria University of Wellington.
- Bertram, G., & Watters, R. F. (1985). The MIRAB Economy in South Pacific microstates. *Pacific Viewpoint*, 26(3), 497-519.
- Bloom, D. E., & Canning, D. (2000). The health and wealth of nations. *Science*, 287, 1208-1209.
- Bloom, D. E., Zaidi, A. K. M., & Yeh, E. (2005). The demographic impact of biomass fuel use. *Energy for Sustainable Development*, IX(3 (Sep., 2005)), 40-48.
- Borovnik, M. (2009). Transnationalism of merchant seafarers and their communities in Kiribati and Tuvalu. In H. Lee & S. T. Francis (Eds.), *Migration and transnationalism - Pacific perspectives* (pp. 143-157). Canberra: The Australian National University
- Bourdieu, P. (1986). The forms of capital. In J. Richardson (Ed.), *Handbook of theory and research for the sociology of education* (pp. 15-29). Westport, CT: Greenwood.
- Bowers, B. (1988). Social benefits of electricity. *IEE Proceedings*, 135(5 (May, 1988)), 291-296.
- Brenchley, J. L. (1873). *Jottings during the cruise of HMS Curacoa among the South Sea Islands in 1865*. In T. F. Ryan (Ed.), *Palagi views of Niue: Historical literature 1774 - 1899*. Auckland: Auckland University Bindery.
- British Library. (2012). *Gilbert and Ellice Islands Colony: Administrative history*. (EAP/AF/001). London: British Library Retrieved from http://bl.uk/about/policies/endangeredarch/pdf/gande_islandscol.pdf.
- Broadberry, S. N. (1998). How did the United States and Germany overtake Britain? A sectoral analysis of comparative productivity levels, 1870-1990. *The Journal of Economic History*, 58(2 (Jun., 1998)), 375-407.
- Brohman, J. (1995). Universalism, Eurocentrism, and ideological bias in development studies: from modernisation to neoliberalism. *Third World Quarterly*, 16(1), 121-140.
- Cabraal, R. A., Barnes, D. F., & Agarwal, S. G. (2005). Productive uses of energy for rural development. *Annual Review of the Environment and Resources*, 30(1), 117-144.
- Cahn, M. (2002). *Sustainable livelihoods approach: Concept and practice*. Paper presented at the 3rd Biennial Conference of the International Development Studies Network of Aotearoa, Massey University, Palmerston North.
- Cameron, R. (1985). A new view of European industrialization. *The Economic History Review*, 38(1 (Feb., 1985)), 1-23.
- Carney, D. (1998). Implementing the sustainable livelihoods approach. In D. Carney (Ed.), *Sustainable rural livelihoods: What contribution can we make?* (pp. 3-23). London: Department for International Development (DFID).
- Carney, D. (2003). *Sustainable livelihoods approaches: Progress and possibilities for change*. London: Department for International Development (DFID).
- Carr, E. R. (2013). Livelihoods as intimate government: Reframing the logic of livelihoods for development. *Third World Quarterly*, 34(1), 77-108.
- Cecelski, E. (2000). *Enable equitable access to rural electrification: Current thinking and major activities in energy, poverty and gender*. Washington DC: Asia Alternative Energy Unit, The World Bank.

- Cecelski, E. (2005). *Energy, development and gender: Global correlations and causality*. Leusden, The Netherlands: ENERGIA International Network on Gender and Sustainable Energy.
- CEDOL. (2014). *Education in Tuvalu*. Retrieved 18 February 2014, from <http://www.cedol.org/pacific/tuvalu/>
- Chambers, K., & Chambers, A. (2001). *Unity of heart*. Prospect Heights, Illinois: Waveland Press Inc.,
- Chambers, R. (1983). *Rural development: Putting the last first*. London: Longman.
- Chambers, R. (1986). *Sustainable livelihoods: An opportunity for the World Commission on Environment and Development*. Brighton: Institute of Development Studies at the University of Sussex.
- Chambers, R. (1994). Participatory rural appraisal (PRA): Challenges, potentials and paradigms. *World Development*, 22(10), 1437 - 1454.
- Chambers, R. (2007). *Poverty research: Methodologies, mindsets and multidimensionality*. Brighton: Institute of Development Studies at the University of Sussex.
- Chambers, R., & Conway, G. R. (1991). *Sustainable rural livelihoods: practical concepts for the 21st century*. Brighton: Institute of Development Studies, University of Sussex.
- Chapman, T. (1976). *The decolonisation of Niue*. Wellington: Victoria University Press and New Zealand Institute of International Affairs.
- Chapman, T. (1982). Modern times. In T. Chapman & e. al (Eds.), *Niue: a history of the island* (pp. 133-139). Suva: University of the South Pacific and the Government of Niue.
- Chapman, T., & et al. (1982). *Niue: A history of the island*. Alofi: University of the South Pacific and the Government of Niue.
- Chaturvedi, P. (2004). Biomass - The fuel of the rural poor in developing countries. In R. Sims (Ed.), *Bioenergy options for a cleaner environment* (pp. 161-181). Amsterdam Elsevier.
- Chen, H., Zhu, T., Krott, M., Calvo, J. F., Ganesh, S. P., & Makato, I. (2013). Measurement and evaluation of livelihood assets in a sustainable forest commons governance. *Land Use Policy*, 30, 908-914.
- Cherni, J. A. (2004). *Renewable energy for sustainable rural livelihoods*. London: Imperial College
- Cherni, J. A., Dwyer, I., Henao, F., Jaramillo, P., Smith, R., & Olalde-Font, R. I. (2007). Energy supply for sustainable rural livelihoods. A multi-criteria decision-support system. *Energy Policy*(35 (2007)), 1493-1504.
- Chum, H., Faaij, A., Moreira, J., Berndes, G., Dhamija, P., Dong, H., . . . Pingoud, K. (2011). Bioenergy. In O. Edenhofer, R. Pichs-Madruga, Y. Sokona, K. Seyboth, P. Matschoss, S. Kadner, T. Zwickel, P. Eickemeier, G. Hansen, S. Schlömer, & C. von Stechow (Eds.), *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation*. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.
- Cloin, J. (2005). Coconut Oil as a Biofuel in Pacific Islands. *Refocus*(July/August 2005), 45-48.
- Cole and Dias. (2012). *Activity completion report: Biogas for sustainable rural livelihoods: Kerinci, Jambi Province*. Wellington: Cole and Dias Ltd (for New Zealand Ministry of Foreign Affairs and Trade).
- Cole, P. (2007). *The role of renewable energy in the achievement of sustainable livelihoods in rural South-East Asia and the South Pacific*. (Master of Philosophy), Massey University, Palmerston North.
- Colonial Office. (1961). *Gilbert and Ellice Islands Colony: Report for the years 1958 and 1959*. London: Her Majesty's Stationery Office.
- Colonial Office. (1968). *Gilbert and Ellice Islands Colony: Biennial Report 1966 and 1967*. London: Her Majesty's Stationery Office.
- Connell, J. (2003). Losing ground? Tuvalu, the greenhouse effect and the garbage can. *Asia Pacific Viewpoint*, 44(2 (August 2003)), 89-107.
- Connell, J. (2007). 'The best island on the Globe': constantly constructing tourism in Niue. *Australian Geographer*, 38(1), 1-13.
- Connell, J. (2008). Niue: Embracing a culture of migration. *Journal of Ethnic and Migration Studies*, 34(6), 1021-1040.
- Connell, J. (2013). *Islands at risk? Cheltenham and Northampton, Massachusetts*: Edward Elgar.
- Connell, J., & Brown, R. P. C. (2005). *Remittances in the Pacific: An overview*. Manila: Asian Development Bank.
- Connell, J., & Lea, J. (2001). *Urbanisation in the island Pacific: Towards sustainable development*. London and New York: Routledge.
- Constitution of Tuvalu (1986).

- Cook Islands Administration. (1922). Cook and other islands- Report to both Houses of the General Assembly. Wellington: New Zealand Government.
- Cook Islands Administration. (1926). Cook and other islands- Report to both Houses of the General Assembly. Wellington: New Zealand Government.
- Cook Islands Administration. (1929). Cook and other islands- Report to both Houses of the General Assembly. Wellington: New Zealand Government.
- Cook Islands Administration. (1932). Cook and other islands- Report to both Houses of the General Assembly. Wellington: New Zealand Government.
- Cook, J. (1774). The journals of Captain James Cook on his voyages of discovery. In T. F. Ryan (Ed.), *Palagi views of Niue: Historical literature 1774 - 1899*. Auckland: Auckland University Bindery.
- Cook, J. (1974). The journals of Captain James Cook on his voyages of discovery. In T. F. Ryan (Ed.), *Palagi views of Niue: Historical literature 1774 - 1899*. Auckland: Auckland University Bindery.
- Crafts, N. F. R. (1985). *British economic growth during the Industrial Revolution*. Oxford: Oxford University Press.
- Crafts, N.F.R. (1997a). The Human Development Index and changes in standards of living: Some historical comparisons. *European Review of Economic History* (1), 299-322
- Crafts, N.F.R. (1997b). Some dimensions of the 'Quality of Life' during the British Industrial Revolution. *The Economic History Review, New Series*, 50(4 (Nov. 1997)), 617-639.
- Crafts, N. F. R. (2002). The Human Development Index 1870-1999: Some revised estimates. *European Review of Economic History*, 6, 396-405.
- Crafts, N. F. R. (2004). Steam as a general purpose technology: A growth accounting perspective. *The Economic Journal*(114 (April)), 338-351.
- Crafts, N. F. R., & Mills, T. C. (2004). Was 19th century British growth steam-powered?: The climacteric revisited. *Explorations in Economic History*(41 (2004)), 156-171.
- Crawley, W. (2014). *Niue Island : Power system investigation*. (Master of Technology Research paper), Massey University, Palmerston North.
- Critchell, J. T., & Raymond, J. (1912). *A history of the frozen meat trade*. London: Constable.
- David, C. M. (1913). *Funafuti - or three months on a coral island: an unscientific account of a scientific expedition*. London: Sir Isaac Pitman & Sons Ltd.
- Davies, F. R. J. (1969). The New Zealand contribution to education in the Pacific. In A. Ross (Ed.), *New Zealand's record in the Pacific Islands in the Twentieth Century* (pp. 271-299). Auckland: Longman Paul Limited.
- De Vries, J. (1994). The Industrial Revolution and the industrious revolution. *The Journal of Economic History*, 54(2 (Jun., 1994)), 249-270.
- Department of Island Territories. (1955). *Reports of Niue and the Tokelau Islands to the House of Representatives*. . Wellington: New Zealand Government Printer.
- Department of Island Territories. (1956). *Reports of Niue and the Tokelau Islands to the House of Representatives*. Wellington: New Zealand Government Printer.
- Department of Island Territories. (1964). *Reports of Niue and the Tokelau Islands to the House of Representatives*. Wellington: New Zealand Government Printer.
- Department of Island Territories. (1966). *Reports of Niue and the Tokelau Islands to the House of Representatives*. Wellington: New Zealand Government Printer.
- Department of Island Territories. (1971). *Reports of Niue and the Tokelau Islands to the House of Representatives*. Wellington: New Zealand Government Printer.
- Department of Island Territories. (1972). *Reports of Niue and the Tokelau Islands to the House of Representatives*. . Wellington New Zealand Government Printer.
- Department of Island Territories. (1974). *Reports of Niue and the Tokelau Islands to the House of Representatives*. Wellington New Zealand Government Printer.
- Devine, W. D., Jr. . (1983). From shafts to wires: Historical perspective on electrification. *The Journal of Economic History*, XLIII(2 (JUN., 1983)), 347-372.
- DFID. (1999a). *Sustainable Livelihoods Guidance Sheets: 1: Introduction*. London: Department for International Development (DFID).
- DFID. (1999b). *Sustainable Livelihoods Guidance Sheets: 2: Framework*. London: Department for International Development (DFID).

- DFID. (1999c). Sustainable Livelihoods Guidance Sheets: 4: Methods. London: Department for International Development (DFID).
- DFID. (2002). Energy for the poor. London: Department for International Development (DFID).
- DFID. (2011). Who we are and what we do. Retrieved 17/02/2011, from <http://www.dfid.gov.uk/About-DFID/Quick-guide-to-DFID/Who-we-are-and-what-we-do/>
- Dornan, M. (2012). Renewable energy targets in the Pacific: Why are unrealistic targets adopted?
- Dornan, M., & Jotzo, F. (2012). Small states, high oil prices: The risk mitigation benefits of renewable technologies in the Pacific.
- Dorward, A., Anderson, S., Clark, S., Keane, B., & Moguel, J. (2001). Asset functions and livelihood strategies: A framework for pro-poor analysis, policy and practice ADU Working Paper 01/01. Wye, Ashford, Kent: Imperial College Wye,.
- Duckworth, J. (2002). Custom, law and practice in Tuvalu. Washington D.C.: International Center for Not-for-profit Law.
- Dyner, I., Alvarez, C., & Cherni, J. (2005). Energy contribution to sustainable rural livelihoods in developing countries: A system dynamics approach.
- EECA. (2010). Power from the people: A guide to micro-generation. Wellington: The Energy Efficiency and Conservation Authority.
- EECA. (2012). Solar water heating. from www.energywise.govt.nz/how-to-be-energy-efficient/your-house/hot-water/solar-water-heating
- Ekins, P. (1993). 'Limits to Growth' and 'sustainable development': grappling with ecological realities. *Ecological Economics*(8), 269-288.
- Electricity Commission. (2008). Market design review options paper: Briefing document. Wellington: Electricity Commission.
- Eltawil, M. A., & Zhao, Z. (2010). Grid-connected photovoltaic power systems: Technical and potential problems-A review. *Renewable and Sustainable Energy Reviews*(14 (2010)), 112-129.
- Empower Consultants. (2006). Niue electricity generation study: Report for the Ministry of Foreign Affairs and Trade. Wellington: Empower Consultants Ltd.
- Empower Consultants. (2009). Tuvalu Electricity Corporation -Loss reduction programme Stage 2: Report for the Ministry of Economic Development. Wellington: Empower Consultants Ltd.
- Erskine, J. E. (1853). Journal of a cruise among the islands of the western Pacific. In T. F. Ryan (Ed.), *Palagi views of Niue: Historical literature 1774-1899*. Auckland: Auckland University Bindery.
- ESCAP. (2010). Draft country review paper; Tuvalu. Implementation in Asia and the Pacific of the Brussels Programme of Action for the Least Developed Countries for the Decade 2001-2010: progress made, obstacles encountered and the way forward. Bangkok: Economic and Social Commission for Asia and the Pacific (ESCAP).
- ESMAP. (2004). The impact of energy on women's lives in rural India.: Joint UNDP/World Bank Energy Sector Management Assistance Programme (ESMAP).
- Etuata, I., & Tanaki, P. (1982). The wisdom of Niue. In T. Chapman (Ed.), *Niue: A history of the island* (pp. 97-102). Suva: University of the South Pacific and the Government of Niue.
- EU. (2007). Niue-European Community EDF 10: Country strategy paper and national indicative programme 2008-2013 European Union.
- EU. (2010). REP-5 Support to the Energy Sector in Five ACP Pacific Island Countries Retrieved 25/06/2013, from <http://www.rep5.eu/>
- Europa. (2006). EU relations with Niue 7 August 2006, from http://ec.europa.eu/comm/development/body/country/country_home_en.cfm?cid=nu&status=new
- Faanui, S. (1983). Travellers and workers. In H. Laracy (Ed.), *Tuvalu: A history* (pp. 121-126). Suva: University of the South Pacific and Government of Tuvalu.
- Farrington, J. (2001). Sustainable livelihoods, rights and the new architecture of aid. *ODI Natural Resource Perspectives*(69 (June 2001)).
- Fifita, S. (1999). Review of the Tuvalu Solar Electric Cooperative Society (SOPAC Technical Report) (F. S. Development and Economic Policy Division, Trans.). Suva: South Pacific Forum
- Firth, S. (2000). The Pacific Islands and the globalization agenda. *The Contemporary Pacific*, 12(1 (Spring 2000)), 178-192.
- Fisk, E. K. (1978). *The island of Niue: Development or dependence for a very small nation*. Canberra: Australian National University, Development Studies Centre.

- Freeman, M. (1984). The Industrial Revolution and the regional geography of England: A comment. *Transactions of the Institute of British Geographers*, 9(4), 507-512.
- Gill, W. (1871). *Gems from the coral islands*. In T. F. Ryan (Ed.), *Palagi views of Niue: Historical literature 1774 - 1899*. Auckland: Auckland University Bindery.
- Goldemberg, J., & Johansson, T. B. (1995). Overview. In J. Goldemberg & T. B. Johansson (Eds.), *Energy as an instrument for socio-economic development*. New York: United Nations Development Programme.
- Goss, J., & Lindquist, B. (2000). Placing movers: An overview of the Asian-Pacific migration system. *The Contemporary Pacific*, 12(2), 385-414.
- GOV.UK. (2013). Department for International Development. Retrieved 26/04/2013, from www.gov.uk/government/organisations/department-for-international-development
- Government of Kiribati. (2012). *Kiribati development plan 2012-2015*. Tarawa: Government of Kiribati.
- Government of Niue. (1979). *Niue National Development Plan 1980 to 1985*. Alofi: Government of Niue.
- Government of Niue. (2002). *Niue: Household income and expenditure survey*. Alofi: Government of Niue.
- Government of Niue. (2003). *Halavaka ke he Monuina- Niue Integrated Strategic Plan – 2003 - 2008*. Alofi: Government of Niue.
- Government of Niue. (2004). *Poverty in Niue: the analysis*. Alofi: Government of Niue.
- Government of Niue. (2005a). *Niue national energy action plan*. Alofi: Government of Niue and the Pacific Island Energy Policy and Strategic Action Planning Project (PIEPSAP).
- Government of Niue. (2005b). *Niue national energy policy*. Alofi: Government of Niue and the Pacific Island Energy Policy and Strategic Action Planning Project (PIEPSAP).
- Government of Niue. (2008). *Niue population profile: Based on 2006 census of population and housing*. Noumea, New Caledonia: Niue Economics, Planning, Development & Statistics Unit and the SPC Statistics and Demography Programme.
- Government of Niue (2009a). *National integrated strategic plan 2009 - 2013*. Alofi: Government of Niue.
- Government of Niue (2009b). *Niue Statistics*. Alofi, Niue: Economic, Planning, Development and Statistics Unit.
- Government of Niue (2010a). *Niue Population Estimate 2010*. Alofi: Economic, Planning, Development and Statistics Unit.
- Government of Niue (2010b). *Tau Tala Niue*. Alofi, Niue: Niue Public Relations Office.
- Government of Niue. (2011). *Niue census of population and households 2011*. Alofi: Economic, Planning, Development and Statistics Unit.
- Government of Niue (2012a). *Niue*. Retrieved 11/07/12., from www.niuegov.com
- Government of Niue (2012b). *Niue's joint national action plan for disaster risk management and climate change (JNAP)*. Alofi: Government of Niue and Applied Geoscience & Technology Division, Secretariat of the Pacific Community.
- Government of Niue (2012c). *Statistical release: Niue merchandise trade 2009, 2010 and 2011*. Alofi: Economic, Planning, Development and Statistics Unit.
- Government of Niue. (2013). *Niue's government and politics*. Retrieved 25 March 2013, from <http://www.niuegov.com/>
- Government of the Cook Islands. (2010). *National Sustainable Development Plan*. Avarua: Government of the Cook Islands.
- Government of Tokelau. (2010). *Tokelau National Strategic Development Plan 1 July 2010 – 30 June 2015*. Apia: Office of the Council for Ongoing Government.
- Government of Tuvalu. (1962). *Tuvalu Lands Code*. Funafuti: Government of Tuvalu.
- Government of Tuvalu. (2005). *Te Kakeega II: National Strategy for Sustainable Development 2005-2015*. Funafuti: Government of Tuvalu.
- Government of Tuvalu. (2009). *Te Kakeega II- Kakeega Matrix Rebuilt*. Funafuti: Government of Tuvalu.
- Government of Tuvalu. (2010). *Household income and expenditure survey 2010*. Funafuti: Government of Tuvalu
- Government of Tuvalu. (2011a). *Tuvalu National Strategic Action Plan for climate change and disaster risk management*. Funafuti: Government of Tuvalu.
- Government of Tuvalu. (2011b). *Tuvalu: Millennium Development Goals. Progress report 2010/2011* (D. o. P. a. Budget, Trans.). Funafuti.

- Government of Tuvalu. (2012a). Basic information and electoral history. Retrieved 11/07/12, from www.tuvaluislands.com/gov_info.htm
- Government of Tuvalu. (2012b). Enetise Tutumau 2012-2020: Master plan for renewable electricity and energy efficiency in Tuvalu. Funafuti: Government of Tuvalu/Tuvalu Electricity Corporation.
- Government of Tuvalu. (2012c). Tuvalu national strategic action plan for climate change and disaster risk management 2012 - 2016. Funafuti: Government of Tuvalu.
- Government of Tuvalu, & TEC. (2013). Resettlement policy framework: Funafuti airport and road, Tuvalu aviation investment and Tuvalu energy sector development projects. Funafuti: Government of Tuvalu
- Hall, T. (2009). Niue - the Hall report. Wellington: Ministry of Foreign Affairs and Trade.
- Hamilton-Peach, J., & Townsley, P. (2003). An IFAD sustainable livelihoods framework. Rome: International Fund for Agricultural Development.
- Hassall, G., Kaitani, M., Tipu, F., & Wainikesa, L. (2011). Comparative study on local government and traditional governance systems interaction in Pacific Island countries (S. o. G. a. D. S. Governance Program, Trans.). Suva: University of the South Pacific (USP).
- Havinden, M., & Meredith, D. (1993). Colonialism and development: Britain and its tropical colonies, 1850-1960. London and New York: Routledge.
- Heyn, J. A. (2003). Migration and development on Niue Island. (Master of Science), University of Montana.
- Hicks, J., & Allen, G. (1999). A century of change: Trends in UK statistics since 1900. London: House of Commons Library.
- Hjertholm, P., & White, H. (2004). Survey of foreign aid: History, trends and allocation. Copenhagen: Institute of Economics, University of Copenhagen.
- Hood, T. H. (1863). Notes of a cruise in HMS Fawn in the Western Pacific in the year 1862. In T. F. Ryan (Ed.), *Palagi views of Niue: Historical literature 1774 - 1899*. Auckland: Auckland University Bindery.
- Horne, C. S. (1894). *The story of the L.M.S. 1795 - 1895*. London: London Missionary Society.
- Huck, P. (1995). Infant mortality and living standards of English workers during the Industrial Revolution. *The Journal of Economic History*, 55(3 (Sep. 1995)), 528-550.
- Humphrey, W. S., & Stanislaw, J. (1979). Economic growth and energy consumption in the UK, 1700-1975. *Energy Policy*, 7(1 (Mar., 1979)), 29-42.
- Hunt, C. (2003). Economic globalisation impacts on Pacific marine resources. *Marine Policy*, 27 (2003) 79-85.
- ICDE. (2014). Country profile - Tuvalu. Retrieved 18 February 2014, from http://www.icde.org/projects/regulatory_frameworks_for_distance_education/country_profiles/tuvalu/
- IDS. (2003). *Energy, poverty and gender: A review of the evidence and case studies in rural China*. Brighton: The Institute of Development Studies, the University of Sussex for the World Bank.
- IEA. (2013). *World energy outlook 2013*. London: International Energy Agency.
- ILO. (2010). *Decent work country programme: Tuvalu*. Geneva: International Labour Organization.
- Irving, R. J. (1978). The profitability and performance of British Railways, 1870-1914. *The Economic History Review*, 31(1 (Feb., 1978)), 46-66.
- Isaka, M., Mofor, L., & Wade, H. (2013a). *Renewable energy opportunities and challenges in the Pacific Islands region: Niue*. Abu Dhabi: International Renewable Energy Association (IRENA).
- Isaka, M., Mofor, L., & Wade, H. (2013b). *Renewable energy opportunities and challenges in the Pacific Islands region: Tuvalu*. Abu Dhabi: International Renewable Energy Association (IRENA).
- Isala, T. (1983). Secession and independence. In H. Laracy (Ed.), *Tuvalu: A history* (pp. 153-181). Suva: University of the South Pacific and Government of Tuvalu.
- ITDG. (2002). *Sustainable energy for poverty reduction: An action plan*. Rugby and London: Intermediate Technology Development Group, Greenpeace International.
- IUCN. (1980). *World conservation strategy: Living resource conservation for sustainable development*. Gland, Switzerland: International Union for Conservation of Nature and Natural Resources, United Nations Environment Programme, World Wildlife Fund.
- Jasek-Rysdahl, K. (2001). Applying Sen's capabilities framework to neighborhoods: Using local asset maps to deepen our understanding of well-being. *Review of Social Economy*, 59(3), 313-329.
- Kaly, U. (2013). *Solar power installations on Nanumaga, Nanumea, Niutao, Vaitupu and Funafuti, Tuvalu: Preliminary environmental assessment report (PEAR)/Environmental and social impact*

- assessment (ESIA). Wellington: Tuvalu Electricity Corporation and New Zealand Ministry of Foreign Affairs and Trade.
- Kammen, D. M., Bailis, R., & Herzog, A. V. (2002). *Clean energy for development and economic growth: Biomass and other renewable energy options to meet energy and development needs in poor nations*. New York: UNDP, Kingdom of Morocco, GEF.
- Kapadia, K. (2004). *Productive uses of renewable energy: A review of four Bank-GEF projects*. Washington DC: The World Bank.
- Kieskamp, P. (2003). *Investing in renewable energy projects: experiences at ADB*. Paper presented at the ASEM Green IPP Network Third Regional Workshop, ECN, Amsterdam, The Netherlands.
- Kim, S.-K., Jeon, J.-H., Cho, C.-H., Kim, E.-S., & Ahn, J.-B. (2009). Modeling and simulation of a grid-connected PV generation system for electromagnetic transient analysis *Solar Energy*, (83 (2009)), 664-678.
- King, B., McVey, M., & Simmons, D. (2000). A societal marketing approach to national tourism planning: evidence from the South Pacific. *Tourism Management*(21), 407-416.
- King, J. (1909). *W. G. Laws of Savage Island and New Guinea*. In T. F. Ryan (Ed.), *Palagi views of Niue: Historical literature 1774 - 1899*. Auckland: Auckland University Bindery.
- Koch, G. (1961). *The material culture of Tuvalu*. Suva: Institute of Pacific Studies, University of the South Pacific.
- Kofe, L. (1983a). Old time religion. In H. Laracy (Ed.), *Tuvalu: A history* (pp. 29-34). Suva: University of the South Pacific and Government of Tuvalu.
- Kofe, L. (1983b). Palagi and pastors. In H. Laracy (Ed.), *Tuvalu: A history* (pp. 29-34). Suva: University of the South Pacific and Government of Tuvalu.
- Komlos, J. (1998). Shrinking in a growing economy? The mystery of physical stature during the Industrial Revolution. *The Journal of Economic History*, 58(3 (September, 1998)), 779-802.
- Krantz, L. (2001). *The sustainable livelihoods approach to poverty reduction*. Stockholm: Swedish International Development Cooperation Agency (SIDA).
- Kumitau, V., & Hekau, M. (1982). Origins of the Niue people. In T. Chapman & e. al (Eds.), *Niue: A history of the island* (pp. 83-90). Suva: The University of the South Pacific and the Government of Niue.
- Landes, D. S. (1994). What room for accident in history?: Explaining big changes by small events. *The Economic History Review, New Series*, 47(4 (Nov., 1994)), 637-656.
- Laracy, H. (1983). *Tuvalu: a history*. Suva: University of the South Pacific and Government of Tuvalu.
- Lélé, S., M. . (1991). Sustainable development: A critical review. *World Development*, 19(6), 607-621.
- Lenzen, M., Krishnapillai, M., Talagi, D., Quintal, J., Quintal, D., Grant, R., . . . Murray, J. (2014). Cultural and socio-economic determinants of energy consumption on small remote islands. *Natural Resources Forum*(38), 27-46.
- Leunig, T. (2005). *Time is money: A re-assement of the passenger social savings from Victorian British railways*. London: LSE Research Online.
- Lewis, A., Estefen, S., Huckerby, J., Musial, W., Pontes, T., & Torres-Martinez, J. (2011). Ocean Energy. In O. Edenhofer, R. Pichs-Madruga, Y. Sokona, K. Seyboth, P. Matschoss, S. Kadner, T. Zwickel, P. Eickemeier, G. Hansen, S. Schlömer, & C. von Stechow (Eds.), *IPCC Special Report on Renewable Energy Sources and Climate change Mitigation*. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.
- Lincoln International. (2002). *Niue study on the maintenance of a "living community"*. Lincoln, Canterbury, New Zealand: Lincoln University.
- Loeb, E. M. (1924). The shaman of Niue. *American Anthropologist*, 26 (New Series)(3 (Jul.-Sep. 1924)), 393-402.
- Loeb, E. M. (1926). *History and traditions of Niue*. Honolulu: Bernice P. Bishop Museum.
- Lovett, R. (1899). *The history of the London Missionary Society 1795 - 1895* (Vol. 1). Oxford: Oxford University Press.
- Macdonald, B. (1971). *Policy and practice in an atoll territory: British rule in the Gilbert and Ellice Islands, 1892 - 1970*. (Doctor of Philosophy), Australian National University, Canberra.
- Macdonald, B. (1975). *The future of the Gilbert and Ellice Islands*. New Zealand Institute of International Affairs.
- Macdonald, B. (1982). *Cinderellas of the Empire*. Canberra: Australian National University Press.

- Maddison, A. (1995). *Monitoring the world economy 1820-1930*. Paris: Organisation for Economic Cooperation and Development.
- MBIE. (2013). *Energy in New Zealand 2013*. Wellington: New Zealand Government.
- McCreary, J. R., & Boardman, D. W. (1965). *Some impressions of social change in the Gilbert and Ellice Islands*. Wellington: Victoria University of Wellington.
- McMichael, P. (1996). Globalization: Myths and realities! *Rural Sociology*, 61(1), 25-55.
- McNamara, K. E., & Lisimoni-Togahai, B. (2012). "Our kids don't want to eat taro anymore": Exploring cultural shift challenges for Niue in a climate-changed and global world. Suva: The University of the South Pacific.
- Meadows, D. H., Meadows, D. L., Randers, J., & Behrens, W. W. (1972). *The limits of growth: A report for the Club of Rome's project on the predicament of mankind*. New York: Universe Books.
- MED. (2012). *New Zealand energy data file 2012*. Wellington: Ministry of Economic Development.
- MFAT. (2008). *Country information paper – Niue*. Retrieved 25 January 2009, from www.mfat.govt.nz
- MFAT. (2011). *Country information paper – Niue*. Retrieved 4 July 2011, 2011, from www.mfat.govt.nz
- MFAT. (2012). *New Zealand Aid Programme: Strategic plan 2012-2015*. Wellington.
- MFAT. (2013). *The New Zealand Aid Programme*. Retrieved 26/04/2013, from www.aid.govt.nz/about-aid-programme
- MFAT. (2014a). *Country information paper - Samoa*. Retrieved 4 June 2014, from www.mfat.govt.nz
- MFAT. (2014b). *Country information paper - Tokelau*. Retrieved 4 June 2014, from www.mfat.govt.nz
- MFAT. (2014c). *Country information paper - Tuvalu*. Retrieved 4 June 2014, from www.mfat.govt.nz
- MFAT. (2014d). *Country information paper - Niue*. Retrieved 4 June 2014, from www.mfat.govt.nz
- Millward, R., & Bell, F. N. (1998). Economic factors in the decline of mortality in late nineteenth century Britain. *European Review of Economic History*(2), 263-288.
- Milne, S. (1992). Tourism development in Niue. *Annals of Tourism Research*, 19(3), 565-569.
- Ministry of Social Welfare. (2012). *Koe fakatupuolamoui he tau magafaoa Niue - a Niuean conceptual framework for addressing family violence*. Wellington: New Zealand Government.
- Mitcham, C. (1995). The concept of sustainable development: its origins and ambivalence. *Technology in Society*, 17(3), 311-326.
- Modi, V., McDade, S., Lallement, D., & Saghir, J. (2006). *Energy services for the Millennium Development Goals*. New York: Energy Sector Management Assistance Programme, United Nations Development Programme, UN Millennium Project and World Bank.
- MOFA. (2009). *PALM 5 Islander's Hokkaido Declaration Annex 1: "Pacific Environment Community"*. Retrieved 13 August 2013, from http://www.mofa.go.jp/region/asia-paci/palm/palm5/dec_annex1.html
- Molina, G. G., & Purser, M. (2010). *Human development trends since 1970: A social convergence story*. New York: United Nations Development Programme (UNDP).
- Morse, S., McNamara, N., & Acholo, M. (2009) *Sustainable livelihoods approach: A critical analysis of theory and practice*. Geographical paper No. 189. Reading: University of Reading.
- Moser, C. O. N. (1998). The asset vulnerability framework: Reassessing urban poverty reduction strategies. *World Development*, 26(1), 1-19.
- Moss, F. J. (1889). Through atolls and islands in the Great South Sea. In T. F. Ryan (Ed.), *Palagi views of Niue: Historical literature 1774 - 1899*. Auckland: Auckland University Bindery.
- Munro, D. (1987). The lives and times of resident traders in Tuvalu: an exercise in history from below. *Pacific Studies*, 10(2 -March 1987), 73.
- Murray, A. W. (1863). *Missions in Western Polynesia*. In T. F. Ryan (Ed.), *Palagi views of Niue: Historical literature 1774-1899*. Auckland: Auckland University Bindery.
- Murray, W. E. (2001). The second wave of globalisation and agrarian change in the Pacific Islands. *Journal of Rural Studies*, 17, 135-148.
- Murray, W. E. (2004). Globalise or perish? Threats to the sustainability of Niue's agro-export sector. In J.P.Terry & W.E.Murray (Eds.), *Niue Island: Geographic perspectives on the Rock of Polynesia* (pp. 243-256). Paris: International Scientific Council for Island Development (INSULA).
- Najam, A., & Cleveland, C. J. (2003). Energy and sustainable development at global environmental summits: An evolving agenda. *Environment, Development and Sustainability*, 5, 117-138.
- Narayan, D., & Cassidy, M. F. (2001). A dimensional approach to measuring social capital: Development and validation of a social capital inventory. *Current Sociology*, 49(2), 59 - 102.

- New Zealand Government. (1966). Niue Act 1966: Public Act 1966 No 38. Wellington: New Zealand Government Printing Office.
- New Zealand Government. (1968). Niue Amendment Act (No 2) 1968: Public Act 1968 No 132. Wellington: New Zealand Government Printing Office.
- New Zealand Government. (1974). Niue Constitution Act 1974: Act 42 of 1974 (NZ) Wellington: New Zealand Government Printing Office.
- New Zealand Government. (2011). Tourism holds the key to growth in Niue. Retrieved 23 August 2011, from <http://beehive.govt.nz/release/tourism-holds-key-growth-niue>
- Newton, W. F. (1967). The early population of the Ellice Islands. *The Journal of the Polynesian Society*, 76(2), 197-204.
- Nia, N. (1983). Niutao. In H. Laracy (Ed.), *Tuvalu: A history* (pp. 58-65). Suva: University of the South Pacific and Government of Tuvalu.
- Njie, N.-I. (1995). Energy's role in deforestation and land degradation. In J. Goldenberg & T. B. Johansson (Eds.), *Energy as an Instrument for Socio-Economic Development. Part I: Energy and Sustainability*. New York: United Nations Development Programme (UNDP).
- Norton, A., & Foster, M. (2001). *The potential of using sustainable livelihoods approaches in poverty reduction strategy papers*. London: Overseas Development Institute.
- NPC. (2013). Niue energy profile. Alofi: Niue Power Corporation.
- O'Brien, P. K. (1997). Intercontinental trade and the development of the Third World since the Industrial Revolution. *Journal of World History*, 8(1), 75-133.
- O'Brien, T. (1983). Genesis. In H. Laracy (Ed.), *Tuvalu: A history* (pp. 13-18). Suva: University of the South Pacific and Government of Tuvalu.
- Ölz, S., Sims, R., & Kirchner, N. (2007). *Contribution of renewables to energy security*. Paris: International Energy Agency (IEA).
- Oughton, E., & Wheelock, J. (2003). A capabilities approach to sustainable household livelihoods. *Review of Social Economy*, 61(1), 1 - 22.
- P. Smith, Bustamante, M., Ahammad, H., Clark, H., Dong, H., Elsidig, E. A., . . . Tubiello, F. (2014). Agriculture, Forestry and Other Land Use (AFOLU). In O. Edenhofer, R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. v. Stechow, T. Zwickel, & J. C. Minx (Eds.), *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, United Kingdom and New York, NY, USA.: Cambridge University Press.
- Pachauri, S., & Spreng, D. (2003). *Energy use and energy access in relation to poverty*. Zurich: Centre for Energy Policy and Economics, Swiss Federal Institutes of Technology.
- Pacific Islands Forum. (2012). Niue benefits from USD4m PEC Fund contribution. Retrieved 13 August 2013, from <http://www.forumsec.org/pages.cfm/newsroom/press-statements/2012/niue-benefits-from-usd4m-pec-fund-contribution.html?printerfriendly=true>
- Panapa, T. (2012). *Ethnographic research on meanings and practices of health in Tuvalu: A community report*. Auckland: Department of Anthropology, The University of Auckland.
- Pape, S. (1983). Nui. In H. Laracy (Ed.), *Tuvalu: A history* (pp. 71-78). Suva: University of the South Pacific and Government of Tuvalu.
- Parsons, R. (1968). Self-determination and political development in Niue. *The Journal of the Polynesian Society*, 77(3 (September, 1968)), 242-262.
- Pasteur, K. (2001). *Tools for sustainable development: Policy analysis*. Brighton: Institute of Development Studies.
- Patton, M. Q. (2001). *Qualitative research and evaluation methods* (3 ed.). Thousand Oaks, London, New Delhi: Sage Publications.
- PCCSP. (2011). *Current and future climate of Tuvalu*. Funafuti: Tuvalu Meteorological Service/ Australian Government.
- Percy Smith, S. (1983). *Niue: The islands and its people*. Suva: University of the South Pacific.
- PIFS. (2012). *Pacific regional MDGs tracking report 2012*. Suva: Pacific Islands Forum Secretariat (PIFS).
- PIFS. (2013). *Pacific regional MDGs tracking report 2013*. Suva: Pacific Islands Forum Secretariat (PIFS).
- PINA. (2013). EU Ambassador for the Pacific presents his credentials to Tuvalu Government. Retrieved 17 February 2014, from <http://www.pina.com.fj/>

- Pipeline Magazine. (2014). UAE lends green energy help to Pacific islands. Retrieved 5 August 2014, from <http://www.pipelineme.com/news/regional-news/2014/01/uae-lends-green-energy-help-to-pacific-islands/>
- Pirnia, P. (2010). *Development effectiveness: Aligning aid with effective development*. Wellington: Council for International Development.
- Platt, D. C. M. (1968). Economic factors in British policy during the "new imperialism". *Past & Present*(39 (Apr., 1968)), 120-138.
- Pomeranz, K. (2000). *The Great Divergence: China, Europe, and the making of the modern world economy*. Princeton: Princeton University Press.
- Pooley, C. G., & Turnbull, J. (2000). Modal choice and modal change: the journey to work in Britain since 1890. *Journal of Transport Geography*(8 (2000)), 11-24.
- Powles, G. (1992). *Changing Pacific Island constitutions: Methods and philosophies*. Wellington: Victoria University of Wellington.
- Pritchett, L. (1997). Divergence, big time. *The Journal of Economic Perspectives*, 11(3 (Summer 1997)), 3-17.
- Rakodi, C. (1999). A capital assets framework for analysing household livelihood strategies: Implications for policy *Development Policy Review*, 17 (1999), 315-342.
- Rakodi, C. (2002). A livelihoods approach - conceptual issues and definitions. In C. Rakodi & T. Lloyd-Jones (Eds.), *Urban livelihoods: a people centred approach to reducing poverty*. Sterling VA: Earthscan.
- Ramani, K. V., & Heijndermans, E. (2003). *Energy, poverty and gender: A synthesis*. Washington D.C.: The International Bank for Reconstruction and Development / The World Bank.
- Reef Shipping. (2012). Shipping Schedule. Retrieved 31/07/2012 from <http://www.reefship.co.nz/site/reefshipping/files//NEW%20ZEALAND%20SCHEDULE.pdf>
- Resture, S. A. (2010). *Te maama pala: Continuity and change in coping with Tuberculosis in Tuvalu*. (Masters of Arts in History), University of Auckland, Auckland.
- Rex, L., & Vivian, Y. (1982). New Zealand period. In T. Chapman & et al (Eds.), *Niue: a history of the island* (pp. 127-131). Suva: The University of the South Pacific and the Government of Niue.
- Richardson, P. (2009). Governing the Outer Islands: decentralisation in Kiribati and Tuvalu. *Commonwealth Journal of Local Governance*(2 (January 2009)), 120-126.
- Ridgway Capital Projects. (2008). *Study into the establishment of a renewable energy & energy efficiency unit at the Tuvalu Electricity Corporation*. Christchurch: Ridgway Capital Projects Ltd.
- Rist, G. (1997). *The history of development*. London: Zed Books.
- Roberts, R. G. (1958). Te atu Tuvalu: A short history of the Ellice Islands. *The Journal of the Polynesian Society*, 67(4), 394-423.
- Rostow, W. W. (1956). The take-off into self-sustained growth. *The Economic Journal*, 66(261 (Mar., 1956)), 25-48.
- Ryan, T. F. (1984). *Palagi views of Niue: Historical literature 1774 - 1899*. Auckland: Auckland University Bindery.
- Samuelu, L. (1983). Land. In H. Laracy (Ed.), *Tuvalu: A history* (pp. 35-40). Suva: University of the South Pacific and Government of Tuvalu.
- Sanday, H., & Lloyd, C. R. (1993). Biomass gasifiers in the Pacific. *Renewable Energy*, 3(2/3), 145-151.
- Sapoaga, E. (1983). Post-war development. In H. Laracy (Ed.), *Tuvalu: A history* (pp. 146-152). Suva: University of the South Pacific and Government of Tuvalu.
- Scoones, I. (1998). *Sustainable rural livelihoods: A framework for analysis*. Brighton: Institute of Development Studies, University of Sussex.
- Scoones, I. (2009). Livelihoods perspectives and rural development. *The Journal of Peasant Studies*, 36(1 (Jan., 2009)), 171-196.
- Scott, D. (1993). *Would a good man die?* Auckland: Hodder and Stroughton and Southern Cross Books.
- Sen, A. (1984). *Resources, values and development*. Cambridge, Mass.: Harvard University Press.
- Sen, A. (1985). *Commodities and capabilities*. Oxford: Oxford University Press.
- Sen, A. (1993). Capability and well-being. In M. C. Nussbaum & A. Sen (Eds.), *The quality of life* (pp. 30-54). Oxford: Clarendon Press.
- Sen, A. (1999). *Development as freedom*. New York: Alfred A. Knopf.

- Sen, A. (2008). Capability and well-being. In D. M. Hausman (Ed.), *The philosophy of economics* (pp. 270-293). Cambridge: Cambridge University Press.
- Shell. (2009). The millennium development goals. Shell in society. Retrieved 23 July 2009, from www.shell.com/home/content/responsible_energy/society/millennium_development_goals/mdg_1/millennium_development_goals1_000407.html
- Shivakoti, G., & Shrestha, S. (2009). Analysis of livelihood asset pentagon to assess the performance of irrigation systems. *Water International*, 30(3), 356-362.
- Shlomowitz, R., & Munro, D. (1992). The Ocean Island (Banaba) and Nauru labour trade 1900-1940. *Journal de la Société des océanistes*, 94(1), 102-117.
- Sihotang, L. (2009). The Global Economic Crisis impact on Tuvalu seafarers' remittances: the story of Tangata's family. Retrieved 3/02/2014, from www.pacific.one.un.org/index.php
- Simmons, C. (1985). De-Industrialization, industrialization and the Indian economy, c. 1850-1947 *Modern Asian Studies*, 19(3), 593-622.
- Simpson, R., Ratukalou, V., & Alefaio, S. (2012). Adaptive capacity in Funafuti and Lofeagai communities, Tuvalu. Suva: University of the South Pacific/ Australian Aid.
- Sims, R. E. H., & El Bassam, N. (2003). Bioenergy and resources. In R. E. H. Sims (Ed.), *Bioenergy options for a cleaner environment*: Elsevier Ltd.
- Skinner, H. D. (1951). Some aspects of the history of Polynesian material culture: The Macmillan Brown Lectures, 1946. *The Journal of the Polynesian Society*, 60(1 (March, 1951)), 40-46.
- Solesbury, W. (2003). Sustainable livelihoods: A case study of the evolution of DFID policy. London: Overseas Development Institute.
- SOPAC. (2007a). National integrated water resource management: diagnostic report Sustainable integrated water resources and wastewater management in Pacific island countries. Suva: Pacific Islands Applied Geoscience Commission (SOPAC)
- SOPAC. (2007b). National integrated water resources management diagnostic report - Tuvalu. Suva: South Pacific Applied Geoscience Commission (SOPAC).
- SPC (2012a). Niue country energy sector indicator profile 2009. Suva: Energy Programme, Economic Development Division, Secretariat of the Pacific Community (SPC).
- SPC (2012b). Tuvalu country energy sector indicator profile 2009. Suva: Energy Programme, Economic Development Division, Secretariat of the Pacific Community (SPC).
- SPC. (2013). Augmentation of rainwater harvesting in Niue Alofi: Secretariat of the Pacific Community (SPC).
- Stanley, B. (1990). *The Bible and the flag*. Leicester, England: APOLLOS.
- Suarez, C. E. (1995). Energy needs for sustainable human development. In J. Goldemberg & T. B. Johansson (Eds.), *Energy as an instrument for socio-economic development*. New York: United Nations Development Programme, .
- Szreter, S. (1988). The importance of social intervention in Britain's mortality decline c1850 - 1914: A re-interpretation of the role of public health. *Social History of Medicine*(1), 1-37.
- Szreter, S. (1999). Rapid economic growth and "the four Ds" of disruption, deprivation, disease and death: public health lessons from nineteenth - century Britain for twenty-first century China? *Tropical Medicine and International Health*, 4(2 (February, 1999)).
- Tafaaki, P. (1983). The old order. In H. Laracy (Ed.), *Tuvalu: A history* (pp. 19-29). Suva: University of the South Pacific and Government of Tuvalu.
- Tafatu, O., & Tukuitoga, I. J. (1982). Developments to annexation. In T. Chapman et al (Ed.), *Niue: a history of the island*. (pp. 121-126). Suva: University of the South Pacific and the Government of Niue.
- Tagupa, W. E. H. (1983). MacDonald, Barrie. Cinderellas of the empire: towards a history of Kiribati and Tuvalu. *Journal de la Société des océanistes*, 39(76), 129 - 130.
- Tait, M. (2004, 8 January 2004). Niue damage not as bad as first reports indicated say MFAT. *New Zealand Herald*.
- Takada, M., & Charles, N. A. (2007). Energizing poverty reduction - A review of the energy-poverty nexus in poverty reduction strategy papers. New York: United Nations Development Programme (UNDP).
- Talagi, F. (1982). Early European contacts. In T. Chapman et al (Ed.), *Niue: a history of the island* (pp. 111-120). Suva: University of the South Pacific and the Government of Niue.
- Telavi, M. (1983). War. In H. Laracy (Ed.), *Tuvalu: A history*. Suva: University of the South Pacific and Government of Tuvalu.

- Temin, P. (1997). Two views of the British Industrial Revolution. *The Journal of Economic History*, 57(1 (March, 1997)), 63-82.
- Teo, N. P. (1983). Colonial rule. In H. Laracy (Ed.), *Tuvalu: A history* (pp. 127-140). Suva: University of the South Pacific and Government of Tuvalu.
- The Jet. (2014). European Union powers up Tuvalu. 28 March 2014. Retrieved 5 May 2014, from <http://thejetnewspaper.com/2014/03/28/european-union-powers-up-tuvalu/>
- Thomson, B. (1901). Nova et vetera: Diseases resulting from the contact of alien races. *British Medical Journal*, 923.
- Thurn, E. I. (1915). European influence in the Pacific, 1513-1914. *The Geographical Journal*, 45(4 (April 1915)), 301-322.
- Tipps, D. C. (1973). Modernization theory and the comparative study of societies: A critical perspective. *Comparative Studies in Society and History*, 15(2 (March, 1973)), 199-226.
- Tisdell, C. (2002). Globalisation, development and poverty in the Pacific Islands. *International Journal of Social Economics*, 29(12), 902-922.
- Tisdell, C., & Fairbairn, T. I. (1983). Development problems and planning in a resource-poor Pacific country: The case of Tuvalu (D. o. Economics, Trans.). Newcastle N.S.W.: University of Newcastle.
- Tomen, M., & Jemelkova, B. (2003). Energy and economic development: An assessment of the state of knowledge. Discussion Paper 03-13. Washington DC: Resources for the Future.
- Truman, H. S. (1949). Truman's Inaugural Address. Retrieved 5 October 2010, from http://www.trumanlibrary.org/whistlestop/50yr_archive/inagural20jan1949.htm
- Turbott, I. G. (1949). Diets, Gilbert and Ellice Islands colony. *Journal of the Polynesian Society*, 58(1), 36-46.
- Turner, G. (1856). Nineteen years in Polynesia. In T. F. Ryan (Ed.), *Palagi views of Niue: Historical literature 1774 - 1899*. Auckland: Auckland University Bindery.
- Tuvalu Central Statistics Department. (2008). *Biennial Statistical Report*. Funafuti: Government of Tuvalu.
- Tuvalu Central Statistics Department. (2013). *2012 Population & Housing Census: Preliminary analytical report*. Funafuti: Government of Tuvalu.
- UNCTAD. (2013). *The least developed countries report 2013*. Geneva: United Nations Conference on Trade and Development.
- UNDP. (1990). *Human development report*. New York: United Nations Development Programme.
- UNDP. (1999). *Human development report 1999*. New York: Oxford University Press for the United Nations Development Programme.
- UNDP. (2010). *International human development indicators*. Retrieved 1 March 2011, from <http://hdr.undp.org/en/data/trends/>
- UNDP. (2011). *UNDP and environment and energy*. Retrieved 17/02/2011, from <http://www.undp.org/energyandenvironment/>
- United Nations. (1992). *Conference on environment and development*. Rio de Janeiro, Brazil: United Nations Development Programme.
- United Nations. (2000). *United Nations Millennium Declaration*. New York: General Assembly, United Nations.
- United Nations. (2012). *Future we want - outcome document*. Retrieved 7 August 2014, from <http://sustainabledevelopment.un.org/futurewewant.html>
- United Nations. (2014). *Introduction to the proposal of the Open Working Group for Sustainable Development*. New York, NY.: United Nations Department of Economic and Social Affairs, Division for Sustainable Development
- Urry, J. (2013). *Societies beyond oil*. London: Zed Books.
- Veltman, M. F. M. (1980). *The population of the Gilbert and Ellice Islands, 1931-1973*. Groningen, The Netherlands: Geographical Institute, Groningen State University.
- Vilitama, H. (1982). Traditional politics. In T. Chapman & et al (Eds.), *Niue: A history of the island* (pp. 91-96). Suva: The University of the South Pacific and the Government of Niue.
- Waddams Price, C. (2000). Better energy services, better energy sectors - and links with the poor Energy services for the world's poor (pp. 26-33). Washington DC: Energy Sector Management Assistance Programme (ESMAP), The World Bank.

- Wade, H. (2005a). Niue National Report Pacific Regional Energy Assessment 2004, Pacific Island Renewable Energy Project (PIREP) (Vol. 8). Apia, Samoa: Secretariat of the Pacific Regional Environmental Programme (SPREP).
- Wade H. (2005b). Tuvalu National Report Pacific Regional Energy Assessment 2004, Pacific Island Renewable Energy Project (PIREP) (Vol. 15). Apia, Samoa: Secretariat of the Pacific Regional Environmental Programme (SPREP).
- Walsh, K. J. E., McInnes, K. L., & McBride, J. L. (2012). Climate change impacts on tropical cyclones and extreme sea levels in the South Pacific — A regional assessment *Global and Planetary Change*(80-81 (2012)), 149-164.
- Wang, L., Weller, C. L., Jones, D. D., & Hannab, M. A. (2009). Contemporary issues in thermal gasification of biomass and its application to electricity and fuel production. *Renewable and Sustainable Energy Reviews*(13), 594-604.
- WCED. (1987). *Our common future: Report of the World Commission on the Environment and Development*. New York: Oxford University Press.
- Webber, L. M., & Ison, R. L. (1995). Participatory rural appraisal design: Conceptual and process issues. *Agricultural Systems*(47 (1995)), 107-131.
- West, B. J., Jensen, C. J., Westendorf, J., & L.D.White. (2006). A safety review of noni fruit juice. *Journal of Food Science*, 71(8).
- White, R. C. (1964). *Economic survey of Niue Island*. Noumea, New Caledonia: South Pacific Commission.
- WHO. (2013a). Global health observatory: Niue country profile. Retrieved 25/06/2013, from www.who.int/gho/countries/niu/country_profiles/en/
- WHO. (2013c). Global health observatory: Tuvalu country profile. Retrieved 25/06/2013, from www.who.int/gho/countries/tuv/country_profiles/en/
- Wilkinson, R. (2002). *The impact of energy infrastructure projects on poverty: A sustainable livelihoods analysis*. London: Department for International Development (DFID).
- Williams, J. (1838). A narrative of missionary enterprises in the South Sea Islands. In T. F. Ryan (Ed.), *Palagi views of Niue: Historical literature 1774-1899*. Auckland: Auckland University Bindery.
- Wilson, S. D. (1969). The record in the Cook Islands and Niue 1901-1945. In A. Ross (Ed.), *New Zealand's record in the Pacific Islands in the Twentieth Century*. Auckland: Longman Paul Limited
- Woodruff, A. (2007). *An economic assessment of renewable energy options for rural electrification in Pacific Island countries* Apia: Pacific Islands Applied Geoscience Commission (SOPAC).
- Woods, J., Hemstock, S., & Burnyeat, W. (2006). Bio-energy systems at the community level in the South Pacific: Impacts and monitoring. *Mitigation and Adaptation Strategies for Global Change*(11), 469-500.
- World Bank. (1968). *The World Bank, IDA and IFC: Policy and operations*. Washington DC: The World Bank.
- World Bank. (1971). *Electric power- sector working paper*. Washington DC: The World Bank.
- World Bank. (1975). *Annual Report 1975*. Washington DC: The World Bank.
- World Bank. (1980). *World Development Report*. Washington DC: The World Bank.
- World Bank. (1992). *World Development Report 1992*. Washington DC: The World Bank.
- World Bank. (2001). *The World Bank Group's energy program: Poverty reduction, sustainability and selectivity*. Washington DC: Energy and Mining Sector Board, The World Bank Group.
- World Bank. (2010). *World Bank history*. Retrieved 6 October 2010, from <http://web.worldbank.org/WBSITE/EXTERNAL/EXTABOUTUS/EXTARCHIVES>
- World Bank. (2011). *Sustainable development*. Retrieved 17/02/2011, from [worldbank.org WBSITE/EXTERNAL/TOPICS/EXTSDNET/0,,menuPK:4812133~pagePK:6488506](http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTSDNET/0,,menuPK:4812133~pagePK:6488506)
- World Bank. (2012). *Tuvalu*. Retrieved 11/07/12, from <http://data.worldbank.org/country/tuvalu>
- World Bank. (2013a). *New World Bank support for island nation of Tuvalu*. 17 February 2014, from <http://www.worldbank.org/en/news/press-release/2013/11/22/world-bank-support-island-nation-tuvalu>
- World Bank. (2013c). *The World Bank - about us*. Retrieved 26/04/2013, from <http://web.worldbank.org/WBSITE/EXTERNAL/EXTABOUTUS/0,,pagePK:50004410~piPK:36602~theSitePK:29708,00.html>
- Wrigley, E. A. (1962). The supply of raw materials in the Industrial Revolution. *The Economic History Review (New Series)*, 15(1), 1 - 16.

BIBLIOGRAPHY

- WSSD. (2002). *World Summit on Sustainable Development (Johannesburg) - Plan of implementation* New York: United Nations.
- Young, J. (1993). Sailing to Levuka: the cultural significance of the island schooners in the late 19th century. *The Journal of Pacific History*, 28(1), 36-52.

APPENDIX 1: QUESTION PORTFOLIOS

NIUE FIELD VISITS

Introduction using information sheet. Explain what I am doing and that I would like to ask some questions so that I can understand a little more about life in Niue. Explain that the interview is confidential and if the participant does not want to answer any question they do not need to.

1. Your occupation?
2. (If working) Tell me about your job?
3. How many people live in your house? Temporary/permanent?
4. What electrical equipment do you have in your house? Example- fridge, freezer, tv, etc.
5. Do you have access to the internet?
6. What do you use for cooking? Example – electricity, kerosene, LPG. How much each month? Are there ever shortages of supply?
7. Does your household have a car (or cars) or a motorbike? How much petrol do you use?
8. If energy became in short supply what would you choose to do? For example:
 - Use wood for cooking?
 - Stop using your car or motor bike?
 - Move to away from Niue?
9. If participant is over 40:
 - When you were young, did you have electricity in your house? If not, what did you use for light?
 - For cooking, what did you use? Example – kerosene, wood, coconut shell. Collect or pay?
 - Because you had no fridge or freezer, did you eat different food?
10. Can you remember getting electricity? What did you like best?
11. Have you lived or travelled outside of Niue? If so, where and for how long?
12. If participant has lived elsewhere, what did they like about living there? And not like?
13. What do you do in your spare time?
14. What is your favourite food?
15. Are you aware of the Tourism Project and what are your views?

TUVALU FIELD VISITS

Introduction using information sheet. Explain what I am doing and that I would like to ask some questions so that I can understand a little more about life in Tuvalu. Explain that the interview is completely confidential and if the participant does not want to answer any question they do not need to.

1. Your occupation?
2. Your home island?
3. How many people live in your house?
4. What electrical equipment do you have in your house? Example- fridge, freezer, tv, etc.
5. What do you use for cooking? Example – electricity, kerosene, LPG, wood. How much each month?
Are there ever shortages of supply?
6. Does your household have a car (or cars) or a motorbike? How much petrol do you use?
7. If energy became in short supply, what would you choose to do? For example:
 - Use wood for cooking?
 - Stop using your car or motor bike?
 - Move to away from Tuvalu?
8. If participant is over 40:
 - When you were young, did you have electricity in your house? If not, what did you use for light?
 - For cooking, what did you use? Example – kerosene, wood, coconut shell.
 - Because you had no fridge or freezer, did you eat different food?
 - Can you remember getting electricity? What did you like best?
9. Have you travelled outside of Tuvalu? If so, where and for how long?
10. If participant has lived elsewhere, what did they like about living there? And not like?
11. (If working) Tell me about your job?
12. What do you do in your spare time?
13. What is your favourite food?
14. Are you aware of Tuvalu's plan to become 100% renewable energy?

APPENDIX 2: SUSTAINABLE LIVELIHOODS ANALYSIS

LIVELIHOOD ASSET AND ENERGY PROFILES

The following tables set out the analysis used to determine the value of livelihood capitals and the associated energy factors used to develop the livelihood pentagons shown in Chapter 6.

The process used in the analysis is as follows:

1. Each of the five capitals is divided into elements as shown in Table 10 (Chapter 6).
2. Each element is evaluated and allocated an asset value in terms of the contribution of that element to the capital. The value is out of 10 with 10 indicating high value and zero no value. In some cases, while the asset value may be high in terms of quality, the abundance may be limited or the ability of the community to access the element may be restricted or constrained and in such cases, the asset value is reduced. The valuation is intended to provide an indication of the capital values and in qualitative terms can be classified as follows:

Value range	Classification
9 – 10	Very strong
7 – 8	Strong
5 – 6	Moderate
3 – 4	Weak
1 – 2	Very weak

3. The arithmetic averages of the elements of a capital are calculated and these are used to develop asset pentagons for each of the four historical eras.
4. An energy factor is allocated to each capital to indicate the magnitude of the link between the capital and energy. The capital can be a source of energy or a user of energy or a combination of the two. A factor of 10 indicates a strong link while 0 indicates little or no link. It is important to note that the value attributed to an energy factor is not related to the value of the corresponding capital. For example, in contemporary era Tuvalu, physical capital is judged as “moderate” but is almost completely reliant on energy and therefore an energy factor of 10 is allowed.
5. The energy factors are shown in the form of a livelihoods energy pentagon for each era.
6. The references are to the relevant section in the text; for example, Chapter 5: 5.3 indicates that the subject is discussed in Chapter 5, section 5.3.

Table 22: Livelihood Asset Analysis – Niue: Pre-palagi Era
(ref Chapter 4: 4.3)

HUMAN CAPITAL	Examples	Asset value	Average	Energy factor	Commentary
"skills, knowledge, ability to labour and good health"					
Knowledge - traditional and formal	Fishing, farming, traditional healing	10			Traditional knowledge strong and vital
Pool of people with appropriate skills and knowledge and "ability to labour".	Sufficient human resource available	10			Pool of labour sufficient to meet needs
Good health	Effective access to health service	4			Totally reliant on traditional healers. Policy of isolation apparently successful.
			8.00	0.00	Energy factor minimal.
NATURAL CAPITAL					
"natural resource stocks from which resource flows and services useful for livelihoods are derived"					
Land	Agriculture/horticulture, housing.	6			1. Based on extended family ownership - subject to conflict
Sea and foreshore	Seafood gathering, fishing	7			2. Cultivation difficult owing to rocky nature of Niue. Good access - but possibly subject to conflict
Forests	Forest products - wood for construction, coconuts, fuel	8			1. Small population means that access is possible for most people although conflict may have limited access. 2. Use of native timbers for construction; coconuts used for drinking, some traditional foods and for woodfuel.
Indigenous energy sources- biomass, wind, sun, ocean.	Cooking fuel, electricity generation.	9			1. Biomass in the form of woodfuel used extensively and readily available. 2. Solar and wind energy may have been used on a limited basis - drying food, propelling canoes/fishing boats.

APPENDIX 2

NATURAL CAPITAL – continued	Examples	Asset value	Average	Energy factor	Commentary
Indigenous energy sources- biomass, wind, sun, ocean.	Cooking fuel, electricity generation.	9			1. Biomass in the form of woodfuel used extensively and readily available. 2. Solar and wind energy may have been used on a limited basis - drying food, propelling canoes/fishing boats.
Fresh water	Drinking water, irrigation.	4			Reliant on rainfall for growing of crops and supply of coconuts for drinking water
			6.80	10.00	Energy factor - woodfuel resource essential for cooking of food.
FINANCIAL CAPITAL					
"the financial resources that people use to achieve livelihood objectives"					
Cash inflows	Wages/salaries, payment for services, remittances, rents, welfare payments	0			Non-existent
PHYSICAL CAPITAL					
"the basic infrastructure and producer goods needed to support livelihoods"					
Affordable transport	Cars, motorcycles, bicycles, air services, shipping services and associated physical infrastructure (eg roads, airports).	0			Non-existent
Shelter	Housing	5			Simple housing constructed from poles with thatch-style roofs and fronds for walls.
Water supply	Tanks or aquifer	0			Effectively non-existent
Sanitation and waste disposal	Septic tanks, rubbish collections	0			Non-existent
Home appliances	Refrigerators, cooking appliances	0			Non-existent
Energy supply and infrastructure	Electricity generation, gas, transport fuels	0			Non-existent.

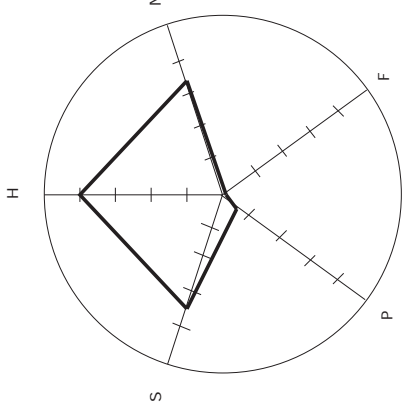
APPENDIX 2

PHYSICAL CAPITAL - continued	Examples	Asset value	Average	Energy factor	Commentary
Communication systems	Telecommunications, internet, radio, TV	0			Non-existent.
			0.71	0	Energy factor minimal.
SOCIAL CAPITAL					
"the social resources upon which people draw in pursuit of their livelihood objectives"					
Networks	Working together to achieve common goals through social, community or political action.	5			Due to strong hierarchal structure within magafaoa. political capital is limited
Relationships	Extended family or village relationships; international connections	10			Magafaoa vital for survival.
Memberships	Membership of formal or semi-formal groups or organisations with common goals/objectives.	6			From time to time, appointment of supreme chief or patuiki to avoid warfare between magafaoa. Need for unity within magafaoa to repel attacks from other magafaoa or from Tongans or Samoans.
International links	Political or economic relationships with other countries	NA			Non-existent
			7.00	0	Energy factor minimal.

PRE-PALAGI NIUE- SUMMARY

SUMMARY - ASSET VALUES

HUMAN CAPITAL	8.00
NATURAL CAPITAL	6.80
FINANCIAL CAPITAL	0.00
PHYSICAL CAPITAL	0.71
SOCIAL CAPITAL	7.00



SUMMARY - ENERGY FACTORS

HUMAN CAPITAL	0.00
NATURAL CAPITAL	10.00
FINANCIAL CAPITAL	0.00
PHYSICAL CAPITAL	0.00
SOCIAL CAPITAL	0.00

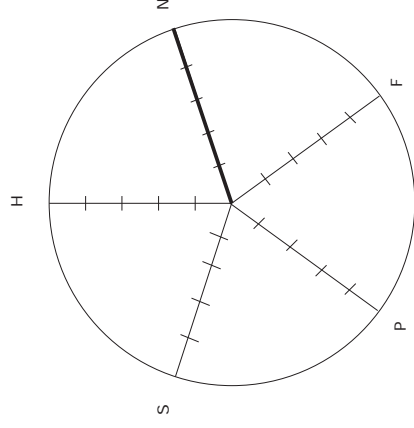


Table 23: Livelihood Asset Analysis – Niue: Trader and Missionary Era
(ref Chapter 4: 4.4)

HUMAN CAPITAL	Examples	Asset value	Average	Energy Factor	Commentary
"skills, knowledge, ability to labour and good health"					
Knowledge - traditional and formal	Fishing, farming, traditional healing	10			Traditional knowledge strong and vital
Pool of people with appropriate skills and knowledge and "ability to labour".	Sufficient human resource available	10			Pool of labour sufficient to meet needs
Good health	Effective health service	3			Very basic health services provided by LMS but new diseases introduced by visitors
			7.67	0.00	Energy factor minimal.
NATURAL CAPITAL					
"natural resource stocks from which resource flows and services useful for livelihoods are derived"					
Land	Agriculture/horticulture, housing.	7			1. Based on extended family ownership. - reduced conflict. 2. Cultivation difficult owing to rocky nature of Niue.
Sea and foreshore	Seafood gathering, fishing	8			Good access - reduced conflict
Forests	Forest products - wood for construction, coconuts	8			1. Small population means that access is possible for most people although land ownership may have restricted access to extended family members. 2. Use of native timbers for construction; coconuts used for drinking, some traditional foods and for woodfuel.

APPENDIX 2

NATURAL CAPITAL – continued	Examples	Asset value	Average	Energy Factor	Commentary
Indigenous energy sources- biomass, wind, sun, ocean.	Cooking fuel, electricity generation.	9			1. Biomass in the form of woodfuel used extensively and readily available. 2. Solar and wind energy may have been used on a limited basis - drying food, propelling canoes/fishing boats.
Fresh water	Drinking water, farming.	5			Mainly reliant on stored rainwater and vulnerable to drought.
FINANCIAL CAPITAL			7.4	10	Energy factor - woodfuel resource essential for cooking of food.
"the financial resources that people use to achieve livelihood objectives"					
Cash inflows	Wages/salaries, payment for services, remittances, rents, welfare payments	2			1. Heavy reliance of subsistence activities (such as bush gardens and fishing) 2. Some wages from working overseas. 3. Income from selling produce and handicrafts.
PHYSICAL CAPITAL			2.00	1.00	Energy factor - some reliance on transport if working overseas
"the basic infrastructure and producer goods needed to support livelihoods"					
Affordable transport	Cars, motorcycles, bicycles, air services, shipping services and associated physical infrastructure (eg roads, airports).	2			1. Shipping services available for passengers and cargo - some steam ships at times.
Shelter	Housing	7			Improved housing but still some vulnerability to cyclones..
Water supply	Tanks or aquifer	0			No piped or tank water supply.
Sanitation and waste disposal	Septic tanks, rubbish collections	0			No evidence of any form of sanitation system or organised refuse collection.

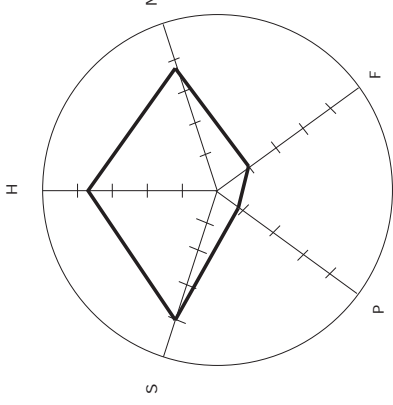
APPENDIX 2

PHYSICAL CAPITAL - continued	Examples	Asset value	Average	Energy Factor	Commentary
Home appliances	Refrigerators, cooking appliances	1			1. Most households cooked on woodfires - may have been some iron utensils 2. Kerosene lamps probably used for lighting by missionaries and some wealthier households..
Energy supply and infrastructure	Electricity generation, gas, transport fuels	3			1. Woodfuel used extensively. 2. Kerosene used for lighting.
Communication systems	Telecommunications, internet, radio, TV	0			Non-existent
					Energy factors: 1. Transport becoming important with some steamship services. 2. Some use of kerosene for lighting probable
SOCIAL CAPITAL					
"the social resources upon which people draw in pursuit of their livelihood objectives"					
Networks	Working together to achieve common goals through social, community or political action.	6			1. Village communities with local fono with representation on "national" fono. However, real power laid with the LMS 2. Much reduced conflict between magafaafa. 3. Young men (mainly) travelling to work overseas exposed to "bad ways".
Relationships	Extended family or village relationships	9			Extended family and village communities important. - possibly reduced by exposure to "bad ways". High level of participation in the Ekalesia.
Memberships	Membership of formal or semi-formal groups or organisations with common goals/objectives.	9			Non-existent
International links	Supportive political or economic relationships with other countries	NA			Energy factor minimal.
			8.00	0.0	

TRADER AND MISSIONARY NIUE - SUMMARY

SUMMARY - ASSET VALUES

HUMAN CAPITAL	7.67
NATURAL CAPITAL	7.80
FINANCIAL CAPITAL	2.00
PHYSICAL CAPITAL	1.86
SOCIAL CAPITAL	8.00



SUMMARY - ENERGY FACTORS

HUMAN CAPITAL	0.00
NATURAL CAPITAL	10.00
FINANCIAL CAPITAL	2.00
PHYSICAL CAPITAL	2.00
SOCIAL CAPITAL	0.00

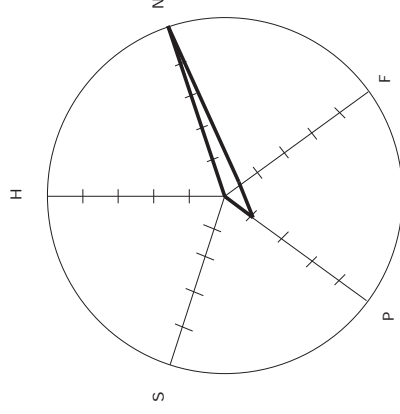


Table 24: Livelihood Asset Analysis – Niue: Colonial Era (to 1950s)
(ref Chapter 4: 4.5)

HUMAN CAPITAL	Examples	Asset value	Average	Energy Factor	Commentary
"skills, knowledge, ability to labour and good health"					
Knowledge - traditional and formal	Fishing, farming, effective and relevant education system; traditional knowledge; informal - radio, TV, internet.	9			1. Traditional knowledge strong with some formal education 2. Some opportunities for scholarships to secondary schools in New Zealand. 3. Lack of opportunity to apply gained knowledge in Niue
Pool of people with appropriate skills and knowledge and "ability to labour".	Sufficient human resource available	9			1. Pool of semi- and unskilled labour available. Economy largely subsistence with opportunity to work in coconut and banana plantations.
Good health	Effective health service	6			Limited health service available from hospital.. Energy factors:
			8	5.00	1. Transport of people and goods now significant - impacts on education and health services' 2. Probable that hospital had diesel generator to enable adequate treatment.
NATURAL CAPITAL					
"natural resource stocks from which resource flows and services useful for livelihoods are derived"					
Land	Agriculture/horticulture, housing.	7			1. Land access restricted to extended families; very difficult to buy and sell land with Land Code based on traditional extended family ownership. 2. Cultivation difficult owing to rocky nature of Niue.

APPENDIX 2

NATURAL CAPITAL continued	Examples	Asset value	Average	Energy Factor	Commentary
Sea and foreshore	Seafood gathering, fishing	8			Small population means little or no restrictions on access for fishing or gathering.
Forests	Forest products - wood for construction, coconuts	8			<p>1. Small population means that access is possible for most people although land ownership may restrict access to extended family members.</p> <p>2. Appears to be limited use of native timbers for construction; coconuts used for drinking, some traditional foods and for woodfuel.</p>
Indigenous energy sources- biomass, wind, sun, ocean.	Cooking fuel, electricity generation.	9			1. Biomass in the form of woodfuel used extensively and readily available.
Access to water	Drinking water, farming.	4			<p>1. Mainly reliant on stored rainwater and vulnerable to drought.</p> <p>2. Wells in place at the Hospital and Public Works and rationed supplies available for household use during drought..</p>
			7.20	10.00	<p>Energy factors:-</p> <p>1. Natural capital is an important source of energy as woodfuel.</p> <p>2. Motorised transport (cars, trucks, fishing boats) used to access natural capital resource becoming more important.</p>
FINANCIAL CAPITAL					
"the financial resources that people use to achieve livelihood objectives"					
Cash inflows	Wages/salaries, payment for services, remittances, rents, welfare payments	3.50			<p>1. Heavy reliance of subsistence activities (such as bush gardens and fishing)</p> <p>2. Wages/salaries typically from working on plantations plus income from selling produce and handicrafts. Income increasingly used by 1950 for imported foods and goods.</p> <p>3. Some income from working overseas.</p>

APPENDIX 2

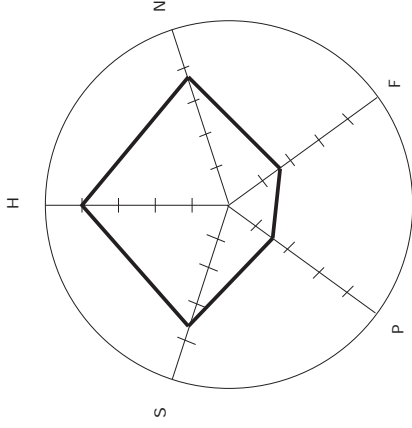
FINANCIAL CAPITAL continued	Examples	Asset value	Average	Energy Factor	Commentary
PHYSICAL CAPITAL					
"the basic infrastructure and producer goods needed to support livelihoods"					
Affordable transport	Cars, motorcycles, bicycles, air services, shipping services and associated physical infrastructure (eg roads, airports).	3			1. Very low level of motor vehicle ownership - government and Ekalesia. Weekly trucks from villages to markets on Saturdays. 2. Monthly shipping service - very limited port facilities and vulnerable to bad weather. 3. High dependency on foot and bicycles.
Shelter	Housing	7			"Traditional houses" vulnerable to cyclones (until 1960s/70s)
Water supply	Tanks or aquifer	4			No piped water supply.
Sanitation and waste disposal	Septic tanks, rubbish collections	1			It is possible that houses of government officials will have been provided with septic tanks.
Home appliances	Refrigerators, cooking appliances	3			1. Most households cooked on woodfires
Energy supply and infrastructure	Electricity generation, gas, transport fuels	4			1. Woodfuel still used extensively. 2. Kerosene used for lighting. 3. Electricity supply limited to government facilities - hospital, radio station. 4. Petrol and diesel used for motor transport.
Communication systems	Telecommunications, internet, radio, TV	2			1. Radio station in place providing telegraph services to New Zealand and elsewhere.. 2. Radio station provided with diesel generator.

PHYSICAL CAPITAL continued	Examples	Asset value	Average	Energy Factor	Commentary
			3.43	7.00	Energy factors: 1. Fuel imports increased. 2. Reliance on imported fuel increasing - transport (land and sea), communications, water supply (pumping at hospital and PWD), health services, household lighting (kerosene).
SOCIAL CAPITAL					
"the social resources upon which people draw in pursuit of their livelihood objectives"					
Networks	Ability to work with others with common objectives to achieve outcomes through community or political action	5			1. Village communities with local fono with representation on "national" fono. However, real power laid with the Resident Commissioner. 2. Increased mobility through motorised transport (although limited) and shipping services improving connectivity and awareness of the outside world.
Relationships	Extended family or village relationships	9			Extended family and village communities important..
Memberships	Membership of formal or semi-formal groups or organisations with common goals/objectives.	8			High level of participation in the Ekalesia.
International links	Supportive political or economic relationships with other countries	7			Increasing level of development programmes implemented by New Zealand.
			7.25	1.00	Energy factor- increased mobility

COLONIAL NIUE - SUMMARY

SUMMARY - ASSET VALUES

HUMAN CAPITAL	8.00
NATURAL CAPITAL	7.20
FINANCIAL CAPITAL	3.50
PHYSICAL CAPITAL	3.43
SOCIAL CAPITAL	7.25



SUMMARY - ENERGY FACTORS

HUMAN CAPITAL	5.00
NATURAL CAPITAL	10.00
FINANCIAL CAPITAL	2.00
PHYSICAL CAPITAL	7.00
SOCIAL CAPITAL	1.00

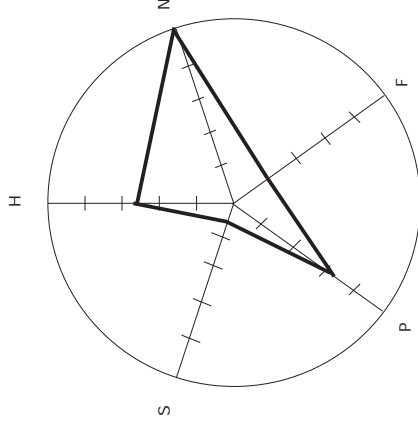


Table 25: Livelihood Asset Analysis – Niue: Contemporary Era
(Ref Chapter 4: 4.6)

HUMAN CAPITAL	Examples	Asset value	Average	Energy Factor	Commentary
"skills, knowledge, ability to labour and good health"					
Knowledge - traditional and formal	Fishing, farming, effective and relevant education system; traditional knowledge; informal - radio, TV, internet.	8			<ol style="list-style-type: none"> 1. Traditional knowledge strong amongst older Niueans but some indications that young people may not be so interested. 2. General view of informants suggests satisfaction with system although evidence of teacher recruitment problems at times. 3 Reasonable access to tertiary education at USP and New Zealand. 4. Lack of opportunity to apply gained knowledge in Niue.
Pool of people with appropriate skills and knowledge and "ability to labour".	Ranges from skilled technicians/professionals to unskilled/semi-skilled.	3			<ol style="list-style-type: none"> 1. Reasonably well educated workforce but lack of pool of labour across full range is a major problem. Lack of opportunity to apply gained knowledge in Niue
Good health	Effective health service	8			<ol style="list-style-type: none"> 1. Health services good with hospital providing range of services from GP to secondary hospital level and dentistry. 2. Access to services is good but at times, lack of key medical practitioners can result in some services being curtailed. 3. Requirement for specialist (tertiary) treatment generally requires patient to travel to New Zealand (funded by government).

HUMAN CAPITAL - continued	Examples	Asset value	Average	Energy Factor	Commentary
			6.33	8	Energy factors: 1. Health services:: high dependency on electricity for biomedical equipment, specialist lighting, refrigeration. 2. Education: formal education relies on electronic media such as computers and access to internet at school, USP "satellite" and at home. Internet and TV enable informal education through connectivity. 3. All elements rely on access to motorised transport including air services (eg travel for education purposes and medical treatment)
NATURAL CAPITAL					
"natural resource stocks from which resource flows and services useful for livelihoods are derived"					
Land	Agriculture/horticulture, housing.	8			1. Small population means that land is available for (mainly subsistence) agriculture. 2. It is very difficult to buy and sell land with Land Code based on traditional extended family ownership. 3. Cultivation difficult owing to rocky nature of Niue.
Sea and foreshore	Seafood gathering, fishing.	9			1. Small population means little or no restrictions on access.
Forests	Forest products - wood for construction, coconuts	8			1. Small population means that access is possible for most people although land ownership may restrict access to extended family members. 2. Appears to be limited use of native timbers for construction; coconuts used for drinking, some traditional foods and for woodfuel.

APPENDIX 2

NATURAL CAPITAL - continued	Examples	Asset value	Average	Energy Factor	Commentary
Indigenous energy sources- biomass, wind, sun, ocean.	Cooking fuel, electricity generation.	8			1. Biomass in the form of woodfuel readily available but use is limited, typically for family events. 2. Solar energy now used for electricity generation. High capital cost involved means that this has to be funded by ODA (EU and Japan). 3. Solar water heating widespread (EU funding) 4. Future expansion of use of indigenous energy sources will require further significant funding from overseas donors.
Access to water	Drinking water, farming, commercial processes	8			1. Good supply of high quality water from fresh water lens under the island. 2. From time to time, drought can be a problem for agriculture.
			8.33	10	Energy factors:- 1. Natural capital is an important source of energy - biomass, solar and potentially wind. 2. Motorised transport (cars, trucks, fishing boats) used to access natural capital resources.
FINANCIAL CAPITAL					
"the financial resources that people use to achieve livelihood objectives"					
Cash inflows	Wages/salaries, payment for services, remittances, rents, welfare payments	7			1. Unemployment is low (ref 2011 census). 2. Wages/salaries generally sufficient for day to day expenditure although some families rely on bush gardens to reduce food bill. No poverty reported. 3. Government main employer. 4. Remittances not a major factor.

APPENDIX 2

FINANCIAL CAPITAL – continued	Examples	Asset value	Average	Energy Factor	Commentary
					Energy factors: 1. Employment relies on electricity for lighting, computers, machinery and (in some cases) air conditioning/refrigeration.
			7.00	7	2. People reliant on motor vehicles to travel to and from workplace.
PHYSICAL CAPITAL					
"the basic infrastructure and producer goods needed to support livelihoods"					
Affordable transport	Cars, motorcycles, bicycles, air services, shipping services and associated physical infrastructure (eg roads, airports).	8			1. High level of motor vehicle ownership. 2. Adequate shipping services but occasional delays cause inconvenience 3. Weekly air service; increased frequency would have benefits eg more tourist visits, easier access for technicians and others travelling from New Zealand. 4. Reasonable network of sealed roads although maintenance required. 5. Airport adequate. 6. Port basic and vulnerable to bad weather.
Shelter	Housing	8			1. Most people well housed. 2. Houses generally well maintained. 3. Houses generally "cyclone resistant".
Water supply	Tanks or aquifer	8			1. Most houses provided with piped water supply pumped from aquifer. 2. Plan to supplement with rain-water tanks

APPENDIX 2

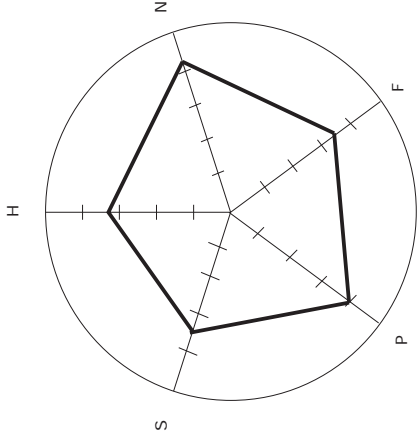
PHYSICAL CAPITAL - continued	Examples	Asset value	Average	Energy Factor	Commentary
Sanitation and waste disposal	Septic tanks, rubbish collections	8			<ol style="list-style-type: none"> 1. Most houses, government buildings and commercial premises provided with septic tanks. 2. Maintenance of septic tanks unknown. Reportedly, no problems in respect to contamination of aquifer. 3. Some form of regular refuse collection in place.
Home appliances	Refrigerators, cooking appliances	8			<ol style="list-style-type: none"> 1. High level of home appliance ownership.
Energy supply and infrastructure	Electricity generation, gas, transport fuels	9			<ol style="list-style-type: none"> 1. Near 100% connection to mains electricity. Supply is reliable. 2. LPG supplies understood to be reliable. 3. Petrol and diesel supplies reliable although might be "tight" from time to time due to shipping delays.
Communication systems	Telecommunications, internet, radio, TV	7			<ol style="list-style-type: none"> 1. Good access to local and international telephone services. 2. Good access to internet (although reported slow). 3. Reasonable radio and TV services (local and Sky). Local radio and TV provide international news services.
			8.00	10	<p>Energy factors:</p> <ol style="list-style-type: none"> 1. Physical capital major source of energy. 2. All elements rely on energy supply except possibly sanitation- eg water pumping (electricity), transport (petrol, diesel, kerosene), home appliances (electricity, LPG), communications (electricity)

APPENDIX 2

SOCIAL CAPITAL	Examples	Asset value	Average	Energy Factor	Commentary
"the social resources upon which people draw in pursuit of their livelihood objectives"					
Networks	Working together to achieve common goals through social, community or political action.	8.5			<ol style="list-style-type: none"> 1. Small community with day to day access to politicians and members of village councils. 2. People tend to be articulate and willing to express views. 3. Socialising - bars, rugby club, cricket competitions provide useful opportunities to share views. 4. On a national basis, strong political capital in the form of constitutional relationship with New Zealand guaranteeing economic support.
Relationships	Extended family or village relationships.	6			<ol style="list-style-type: none"> 1. Village centre of community life. 2. Extended family important but possibly influence is waning 3. Modern communication systems can contribute to maintaining relationships with absent family members. 4. Some need for transport.
Memberships	Membership of formal or semi-formal groups or organisations with common goals/objectives.	7			Church is the most commonly mentioned formal/ semi-formal group and has major influence.
International links	Supportive political or economic relationships with other countries	8.5			Constitutional relationship with New Zealand; ODA from EU and Japan in energy sector
			7.50	5	Energy factors: <ol style="list-style-type: none"> 1. People reliant on motor vehicles to travel to and from community, social and church activities. 2. Communication services important in maintaining networks and relationships. (telephone, internet (email, Skype, Facebook etc)

CONTEMPORARY NIUE – SUMMARY

SUMMARY- ASSET VALUES	
HUMAN CAPITAL	6.33
NATURAL CAPITAL	8.33
FINANCIAL CAPITAL	7.00
PHYSICAL CAPITAL	8.00
SOCIAL CAPITAL	7.50



SUMMARY - ENERGY FACTORS	
HUMAN CAPITAL	8.00
NATURAL CAPITAL	10.00
FINANCIAL CAPITAL	7.00
PHYSICAL CAPITAL	10.00
SOCIAL CAPITAL	5.00

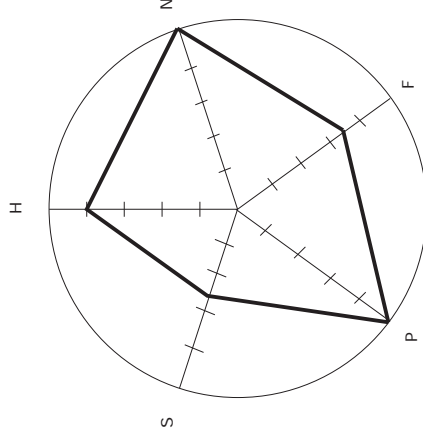


Table 26: Livelihood Asset Analysis – Tuvalu: Pre-palagi Era
(Ref Chapter 5: 5.3)

HUMAN CAPITAL	Examples	Asset value	Average	Energy factor	Commentary
"skills, knowledge, ability to labour and good health"					
Traditional knowledge	Fishing, farming, traditional healers	10			Traditional knowledge strong and critical.
Pool of people with appropriate skills and knowledge and "ability to labour".	Sufficient human resource available	10			Pool of labour sufficient to meet needs
Good health	Effective access to health service	4			Reliant on traditional healers
			8.00	0.00	Energy factor minimal.
NATURAL CAPITAL					
"natural resource stocks from which resource flows and services useful for livelihoods are derived"					
Land	Agriculture/horticulture, housing.	7			1. Based on extended family ownership - some conflict. 2. Cultivation difficult owing to shallow and poor soils
Sea and foreshore	Seafood gathering, fishing	10			Good access.
Forests	Forest products - wood for construction, coconuts, fuel	9			1. Good access. 2. Access necessary for gathering woodfuel.
Indigenous energy sources- biomass, wind, sun, ocean.	Cooking fuel, electricity generation.	9			1. Biomass in the form of woodfuel used extensively and readily available. 2. Solar and wind energy may have been used on a limited basis - drying food, propelling canoes/fishing boats.
Fresh water	Drinking water, farming.	5			1. Reliant on rainfall for growing of crops and supply of coconuts for drinking water 2. Some wells or water holes.
			8.00	10.00	Energy factor - woodfuel resource essential for cooking of food.

APPENDIX 2

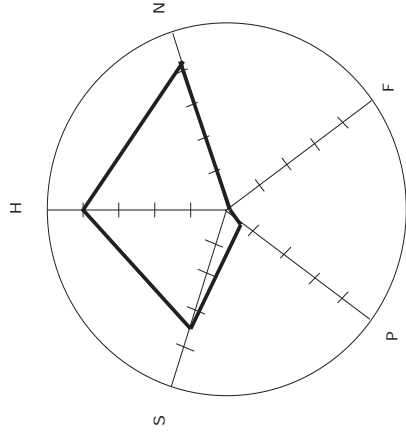
FINANCIAL CAPITAL	Examples	Asset value	Average	Energy factor	Commentary
"the financial resources that people use to achieve livelihood objectives"					
Cash inflows	Wages/salaries, payment for services, remittances, rents, welfare payments	0			Non-existent
PHYSICAL CAPITAL					
"the basic infrastructure and producer goods needed to support livelihoods"					
Affordable transport	Cars, motorcycles, bicycles, air services, shipping services and associated physical infrastructure (eg roads, airports).	0			Non-existent
Shelter	Housing	5			Simple housing constructed from poles with thatch roofs with walls lined with fronds.
Water supply	Tanks or aquifer	0			Non-existent
Sanitation and waste disposal	Septic tanks, rubbish collections	0			Non-existent
Home appliances	Refrigerators, cooking appliances	0			Non-existent
Energy supply and infrastructure	Electricity generation, gas, transport fuels	0			Non-existent.
Communication systems	Telecommunications, internet, radio, TV	0			Non-existent.
			0.71	0	Energy factor minimal.
SOCIAL CAPITAL					
"the social resources upon which people draw in pursuit of their livelihood objectives"					
Networks	Working together to achieve common goals through social, community or political action.	5			Due to strong hierarchal structure within island communities political capital was limited.
Relationships	Extended family or village relationships.	10			Vital for survival.

SOCIAL CAPITAL continued	Examples	Asset value	Average	Energy factor	Commentary
Memberships	Membership of formal or semi-formal groups or organisations with common goals/objectives.	7			Strong island communities/clans - need for unity to repel invaders from other islands.
International links	Supportive political or economic relationships with other countries.				
			7.33	0	Energy factor minimal.

PRE-PALAGI TUVALU - SUMMARY

SUMMARY - ASSET VALUES

HUMAN CAPITAL	8.00
NATURAL CAPITAL	8.00
FINANCIAL CAPITAL	0.00
PHYSICAL CAPITAL	0.71
SOCIAL CAPITAL	7.33



SUMMARY - ENERGY FACTORS

HUMAN CAPITAL	0.00
NATURAL CAPITAL	10.00
FINANCIAL CAPITAL	0.00
PHYSICAL CAPITAL	0.00
SOCIAL CAPITAL	0.00

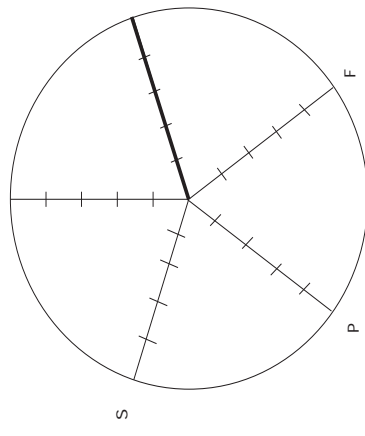


Table 27: Livelihood Asset Analysis – Tuvalu: Trader and Missionary Era
(Ref Chapter 5: 5.4)

HUMAN CAPITAL	Examples	Asset value	Average	Energy Factor	Commentary
"skills, knowledge, ability to labour and good health"					
Traditional knowledge	Fishing, farming, healing	10			1. Traditional knowledge strong 2. Low dependency on energy supply.
Pool of people with appropriate skills and knowledge and "ability to labour".	Sufficient human resource available	10			Pool of labour sufficient to meet needs
Good health	Effective health service	2			Very basic health services provided by LMS but new diseases introduced by visitors
			7.33	0.00	Energy factor minimal.
NATURAL CAPITAL					
"natural resource stocks from which resource flows and services useful for livelihoods are derived"					
Land	Agriculture/horticulture, housing.	7			1. Based on extended family ownership. 2. Cultivation difficult owing to shallow and poor soils
Sea and foreshore	Seafood gathering, fishing	9			Good access.
Forests	Forest products - wood for construction, coconuts	8			Good access.
Indigenous energy sources- biomass, wind, sun, ocean.	Cooking fuel, electricity generation.	9			1. Biomass in the form of woodfuel used extensively and readily available. 2. Solar and wind energy may have been used on a limited basis - drying food, propelling canoes/fishing boats.

APPENDIX 2

NATURAL CAPITAL continued	Examples	Asset value	Average	Energy Factor	Commentary
Fresh water	Drinking water, farming.	5	7.6	10	1. Reliant on rainfall for growing of crops and supply of coconuts for drinking water 2. Some wells or water holes. Energy factor - woodfuel for cooking of food.
FINANCIAL CAPITAL					
"the financial resources that people use to achieve livelihood objectives"					
Cash inflows	Wages/salaries, payment for services, remittances, rents, welfare payments	1.5			1. Heavy reliance of subsistence activities (growing crops, fishing) 2. Some wages from working overseas - but limited. 3. Income from selling produce and handicrafts. Energy factor - some reliance on transport if working overseas
PHYSICAL CAPITAL					
"the basic infrastructure and producer goods needed to support livelihoods"					
Affordable transport	Cars, motorcycles, bicycles, air services, shipping services and associated physical infrastructure (eg roads, airports).	2			1. Shipping services available for passengers and cargo - some steam ships at times.
Shelter	Housing	5			Simple housing constructed from poles with thatch-style roofs with walls lined with coconut fronds. No piped or tank water supply .
Water supply	Tanks or aquifer	0			No evidence of any form of sanitation system or organised refuse collection.
Sanitation and waste disposal	Septic tanks, rubbish collections	0			1. Most households cooked on woodfires - may have been some iron utensils 2. Kerosene lamps probably used for lighting by missionaries and some wealthier households.
Home appliances	Refrigerators, cooking appliances	1			1. Woodfuel used extensively. 2. Kerosene used for lighting.
Energy supply and infrastructure	Electricity generation, gas, transport fuels	3			

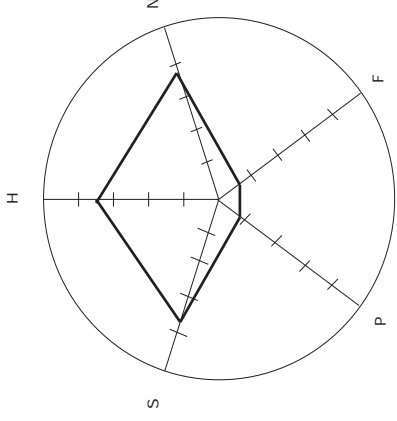
APPENDIX 2

PHYSICAL CAPITAL continued	Examples	Asset value	Average	Energy Factor	Commentary
Communication systems	Telecommunications, internet, radio, TV	0	1.57	2.0	Non-existent Energy factors: 1. Transport becoming important with some steamship services. 2. Some use of kerosene for lighting probable
SOCIAL CAPITAL					
"the social resources upon which people draw in pursuit of their livelihood objectives"					
Networks	Working together to achieve common goals through social, community or political action.	5			Power of aiki reduced and replaced by island councils (faupule) set up by LMS - but real power laid with the LMS
Relationships	Extended family or village relationships.	10			Extended family relationships remain important..
Memberships	Membership of formal or semi-formal groups or organisations with common goals/objectives.	8			High level of participation in church activities.
International links	Supportive political or economic relationships with other countries.	NA			Non-existent
			7.67	0.0	Energy factor minimal.

TRADER AND MISSIONARY TUVALU ERA - SUMMARY

SUMMARY - ASSET VALUES

HUMAN CAPITAL	7.33
NATURAL CAPITAL	7.60
FINANCIAL CAPITAL	1.50
PHYSICAL CAPITAL	1.57
SOCIAL CAPITAL	7.67



SUMMARY - ENERGY FACTORS

HUMAN CAPITAL	0.00
NATURAL CAPITAL	10.00
FINANCIAL CAPITAL	1.00
PHYSICAL CAPITAL	2.00
SOCIAL CAPITAL	0.00

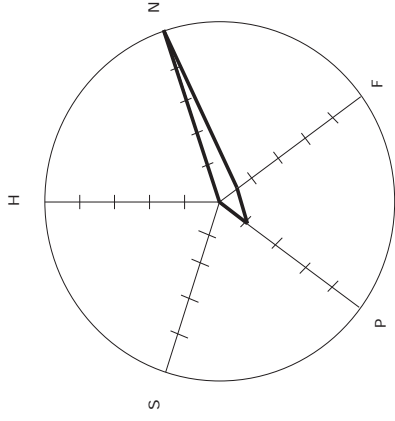


Table 28: Livelihood Asset Analysis – Tuvalu: Colonial Era (to 1950s)
(Ref Chapter 5: 5.5)

HUMAN CAPITAL	Examples	Asset value	Average	Energy Factor	Commentary
"skills, knowledge, ability to labour and good health"					
Knowledge - traditional and formal	Fishing, farming, effective and relevant education system; traditional knowledge; informal - radio, TV, internet.	9			1. Traditional knowledge strong with some limited formal education 2. Lack of opportunity to apply gained knowledge in Tuvalu
Pool of people with appropriate skills and knowledge and "ability to labour".	Sufficient human resource available	9			Pool of semi- and unskilled labour available. Economy largely subsistence with opportunity to work in coconut and banana plantations.
Good health	Effective health service	5			Limited health service available from hospital in Funafuti. Reliance on traditional healers.
			7.67	5.00	Energy factors: 1. Transport of people and goods now significant - impacts on education and health services' 2. Probable that hospital had diesel generator to enable adequate treatment.
NATURAL CAPITAL					
"natural resource stocks from which resource flows and services useful for livelihoods are derived"					
Land	Agriculture/horticulture, housing.	6			1. Land is available for (mainly subsistence) agriculture. 2. Cultivation difficult owing to shallow and poor soils 3. It was very difficult to buy and sell land with Land Code based on traditional extended family ownership. Possibly starting to be an issue in Funafuti with inward migration.

APPENDIX 2

NATURAL CAPITAL - continued	Examples	Asset value	Average	Energy Factor	Commentary
Land - continued					4. Damage and permanent loss of land from airfield construction during Second World War.
Sea and foreshore	Seafood gathering, fishing.	9			Small population means little or no restrictions on access for fishing or gathering.
Forests	Forest products - wood for construction, coconuts	9			1. Access is possible for most people although land ownership may restrict access to extended family members. 2. Appears to be limited use of native timbers for construction; coconuts used for drinking, some traditional foods and for woodfuel.
Indigenous energy sources- biomass, wind, sun, ocean.	Cooking fuel, electricity generation.	9			1. Biomass in the form of woodfuel used extensively and readily available. 2. Solar and wind energy may have been used on a limited basis - drying food, propelling canoes/fishing boats.
Fresh water	Drinking water, farming.	4			1. Mainly reliant on stored rainwater and vulnerable to drought. 2. Some wells or water holes in most islands.
			7.40	10.00	Energy factors:- 1. Natural capital is an important source of energy as woodfuel. 2. Motorised transport (trucks, fishing boats) used to access natural capital resources becoming more important.

APPENDIX 2

FINANCIAL CAPITAL	Examples	Asset value	Average	Energy Factor	Commentary
"the financial resources that people use to achieve livelihood objectives"					
Cash inflows	Wages/salaries, payment for services, remittances, rents, welfare payments	4.5	4.50	5.00	<ol style="list-style-type: none"> 1. Heavy reliance of subsistence activities (such as bush gardens and fishing) 2. Wages/salaries typically from working on plantations. Income also from working in Banaba and Nauru. Income increasingly used by 1950 for imported foods and goods. 3. Energy supply not a direct factor but relevant for travel, transport of goods and produce. Energy factors: sea transport now vital for employment in Banaba and Nauru
PHYSICAL CAPITAL					
"the basic infrastructure and producer goods needed to support livelihoods"					
Affordable transport	Cars, motorcycles, bicycles, air services, shipping services and associated physical infrastructure (eg roads, airports).	2			<ol style="list-style-type: none"> 1. Very low level of motor vehicle ownership - government and Ekalesia 2. Inter-island shipping service and international via Kiribati- limited port facilities other than in Funafuti.. 3. High dependency on foot and bicycles. 4. Airstrips on Funafuti, Nanumea and Nukufetau (only Funafuti remained in service post-war).
Shelter	Housing	6			<ol style="list-style-type: none"> 1. Most people adequately well housed but vulnerable to cyclones.
Water supply	Tanks or aquifer	2			<ol style="list-style-type: none"> 1. No piped water supply. 2. Reliant on rainwater storage and groundwater.
Sanitation and waste disposal	Septic tanks, rubbish collections	1			<ol style="list-style-type: none"> It is possible that houses of government officials will have been provided with septic tanks.

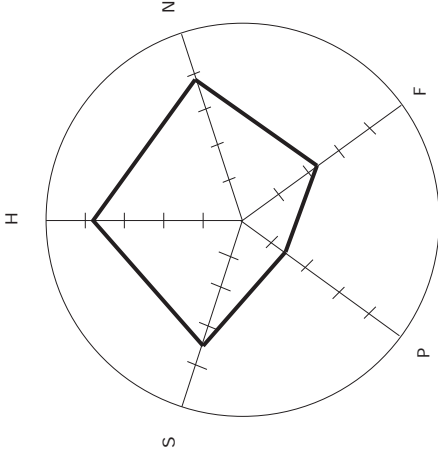
APPENDIX 2

PHYSICAL CAPITAL - continued	Examples	Asset value	Average	Energy Factor	Commentary
Home appliances	Refrigerators, cooking appliances	3			<ol style="list-style-type: none"> 1. Most households cooked on woodfires 2. Kerosene lamps widely used for lighting. 2. Kerosene used for lighting. 3. Electricity supply limited to government facilities - hospital, radio station. 4. Petrol and diesel used for the limited motor transport.
Communication systems	Telecommunications, internet, radio, TV	3			<ol style="list-style-type: none"> 1. Radio station in place providing telegraph services 2. Radio station provided with diesel generator.
SOCIAL CAPITAL					
"the social resources upon which people draw in pursuit of their livelihood objectives"					
Networks	Working together to achieve common goals through social, community or political action.	6			Island communities with local kaupule to run day to day affairs. LMS still had major influence with infrequent visits from colonial authorities. Some requirement for travel.
Relationships	Extended family or village relationships.	9			Extended family and island communities important..
Memberships	Membership of formal or semi-formal groups or organisations with common goals/objectives.	8			High level of participation in the Ekalesia. Some requirement for travel.
International links	Supportive political or economic relationships with other countries.	4			Some increase in development support from Britain.
			6.75	1.00	Energy factor- minimal; possibly some benefits from improved inter-island shipping?

COLONIAL TUVALU – SUMMARY

SUMMARY - ASSET VALUES

HUMAN CAPITAL	7.67
NATURAL CAPITAL	7.40
FINANCIAL CAPITAL	4.50
PHYSICAL CAPITAL	2.86
SOCIAL CAPITAL	6.75



SUMMARY - ENERGY FACTORS

HUMAN CAPITAL	5.00
NATURAL CAPITAL	10.00
FINANCIAL CAPITAL	5.00
PHYSICAL CAPITAL	7.00
SOCIAL CAPITAL	1.00

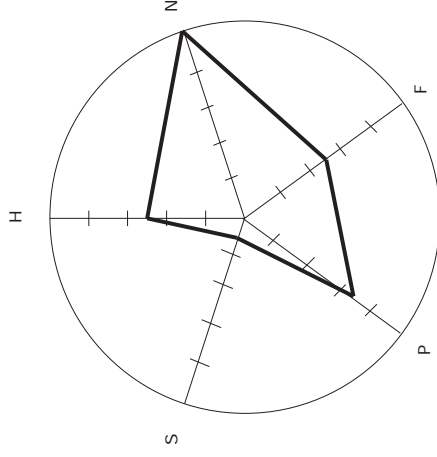


Table 29: Livelihood Asset Analysis – Tuvalu: Contemporary Era
(Ref Chapter 5: 5.6)

HUMAN CAPITAL	Examples	Asset value	Average	Energy factor	Commentary
"skills, knowledge, ability to labour and good health"					
Knowledge - traditional and formal	Fishing, farming, effective and relevant education system; traditional knowledge; informal - radio, TV, internet.	8			<ol style="list-style-type: none"> 1. Traditional knowledge strong amongst older Tuvaluans. 2. Indications are that quality of education may not always be adequate. 3. Access to secondary level can a problem for people on Outer Islands and in poor households. 4. Reasonable access to tertiary education at USP and New Zealand . 5. Lack of opportunity to apply gained knowledge in Tuvalu.
Pool of people with appropriate skills and knowledge and "ability to labour".	Ranges from skilled technicians/ professionals to unskilled/semi-skilled.	5			Lack of skilled labour across full range is a major problem.
Good health	Effective health service	6			<ol style="list-style-type: none"> 1. Health services fair in Funafuti with hospital providing range of services from GP to secondary hospital level (at times) and dentistry. At times, lack of key medical practitioners can result in some services being curtailed. 2. Health services on Outer Islands limited with services provided by nurses in health centres. Some reliance on traditional healers. 3. Crowded nature of Funafuti presents risks to health particularly associated with poor sanitation and housing.

HUMAN CAPITAL - continued	Examples	Asset value	Average	Energy factor	Commentary
			6.33	8.00	<p>Energy factors:-</p> <ol style="list-style-type: none"> 1. Health services:: high dependency on electricity for biomedical equipment, specialist lighting, refrigeration. 2. Education: formal education relies on electronic media such as computers and access to internet at school, USP "satellite" and at home. Internet enables informal education through connectivity. 3. All elements rely on access to motorised transport including air services (eg travel for education (from Outer Islands, Motufoua, USP etc) purposes and medical treatment)
NATURAL CAPITAL					
"natural resource stocks from which resource flows and services useful for livelihoods are derived"					
Land	Agriculture/horticulture, housing.	6			<ol style="list-style-type: none"> 1. Access major problem in overcrowded Funafuti. 2. It is very difficult to buy and sell land with Land Code based on traditional extended family ownership. Issue in Funafuti where families from Outer Islands have to rent.
Sea and foreshore	Fishing and seafood gathering	9			<ol style="list-style-type: none"> 1. Fish an important component in the diet. Availability of fish to purchase or access to resource does not appear to be an issue. 2. Some dependence on energy supply (eg fuel for fishing boats) but limited.
Forests	Forest products - wood for construction, coconuts	6			<ol style="list-style-type: none"> 1. Access major problem in overcrowded Funafuti. 2. Appears to be limited use of native timbers for construction; coconuts used for drinking, some traditional foods and for woodfuel.

APPENDIX 2

NATURAL CAPITAL - continued	Examples	Asset value	Average	Energy factor	Commentary
Indigenous energy sources- biomass, wind, sun, ocean.	Cooking fuel, electricity generation.	8			<ol style="list-style-type: none"> 1. Biomass in the form of woodfuel extensively used for certain types of cooking.. 2. Solar energy now used for electricity generation. High capital cost involved means that this has to be funded by ODA (eg NZ, EU, Russia and Japan). 3. Future expansion of use of indigenous energy sources will require further funding from overseas donors.
Fresh water	Drinking water, farming, commercial processes	5			<ol style="list-style-type: none"> 1. Heavy reliance on rain water storage.. 2. Ground water resources increasing contaminated in Funafuti. 3. Vulnerability to drought mitigated on Funafuti by use of desalination plant..
			6.80	10.00	<p>Energy factors:-</p> <ol style="list-style-type: none"> 1. Natural capital is an important source of energy - biomass, solar and potentially wind. 2. Motorised transport (cars, trucks, fishing boats) used to access natural capital resources. 3. Water supply in Funafuti from desalination plant dependent on electricity.

APPENDIX 2

FINANCIAL CAPITAL	Examples	Asset value	Average	Energy factor	Commentary
"the financial resources that people use to achieve livelihood objectives"					
Cash inflows	Wages/salaries, payment for services, remittances, rents, welfare payments	5			<ol style="list-style-type: none"> 1. Some unemployment/underemployment . 2. About 25% of population below "basic needs poverty line" 3. Government main employer. 4. Remittances from seafarers have been of importance but are reducing..
			5.00	6.00	<p>Energy factors:</p> <ol style="list-style-type: none"> 1. Employment relies on electricity for lighting, computers, machinery and (in some cases) air conditioning/refrigeration. 2. People reliant on motor vehicles to travel to and from workplace.
PHYSICAL CAPITAL					
"the basic infrastructure and producer goods needed to support livelihoods"					
Affordable transport	Cars, motorcycles, bicycles, air services, shipping services and associated physical infrastructure (eg roads, airports).	7			<ol style="list-style-type: none"> 1. High level of motor vehicle ownership. (mainly motor cycles) 2. Adequate shipping services from overseas but inter-island services is unreliable. Major issue for Outer Islands. 3. Twice-weekly air service to/from Funafuti; constrained capacity can cause inconvenience. 4. Airport barely adequate - upgrade project underway. 5. Funafuti port adequate.
Shelter	Housing	6			<ol style="list-style-type: none"> 1. Some very poor housing in Funafuti.. 2. Houses generally considered <u>not</u> to be "cyclone resistant".

APPENDIX 2

PHYSICAL CAPITAL - continued	Examples	Asset value	Average	Energy factor	Commentary
Water supply	Piped supply, community tanks, desalination plant.	4			<ol style="list-style-type: none"> 1. No piped system - almost total reliance on rain water storage tanks. 2. Desalination plant in Funafuti but not on Outer Islands.
Sanitation and waste disposal	Septic tanks, rubbish collections	3			<ol style="list-style-type: none"> 1. Near complete reliance on septic tanks or pit latrines. 2. Maintenance of septic tanks unknown but reportedly poor. 3. Some form of refuse collection in place in Funafuti but not particularly effective - involves energy use.
Home appliances	Refrigerators, cooking appliances	7			<ol style="list-style-type: none"> 1. Reasonable level of home appliance ownership. 2. High dependency on electricity for appliances. Access issue in Outer Islands where electricity only available for 18 hours or less (factor applied). 3. High reliance on LPG for cooking but people revert to woodfuel if necessary.
Energy supply and infrastructure	Electricity generation, gas, transport fuels	9			<ol style="list-style-type: none"> 1. About 94% connection to mains electricity. Supply is reliable in Funafuti but <24 hours in Outer Islands. 2. Occasional shortages of LPG 3. Petrol and diesel supplies reliable although reportedly diesel supply can become low in the Outer Islands. 4. Electricity about 95% reliant on imported diesel.
Communication systems	Telecommunications, internet, radio, TV	6			<ol style="list-style-type: none"> 1. Fair access to local and international telephone services. Limited access in Outer Islands. 2. Fair access to internet - but limited to Kaupele offices in some Outer Islands. 3. Limited radio and Sky TV services.

PHYSICAL CAPITAL - continued	Examples	Asset value	Average	Energy factor	Commentary
			6.00	10.00	<p>Energy factors:</p> <ol style="list-style-type: none"> 1. Physical capital major source of energy. 2. All elements rely on energy supply except possibly sanitation- eg water pumping (electricity), transport (petrol, diesel, kerosene), home appliances (electricity, LPG), communications (electricity)
SOCIAL CAPITAL					
"the social resources upon which people draw in pursuit of their livelihood objectives"					
Networks	Working together to achieve common goals through social, community or political action.	7.5			<ol style="list-style-type: none"> 1. Political framework set up under Falekaupule Act 1997 aims for local participation in decision making. 2. Survey in 2012 suggested that people in Funafuti may not see themselves as having a strong voice? 3. On a national basis, the government has obtained international support by bringing attention to the risk of inundation due to sea level rising as a result of global risk.
Relationships	Extended family or village relationships.	7			<ol style="list-style-type: none"> 1. Home island community strong even amongst "expatriates" in Funafuti. 2. Extended family remains important .
Memberships	Membership of formal or semi-formal groups or organisations with common goals/objectives.	7			<ol style="list-style-type: none"> 1. Church is the most commonly mentioned formal/ semi-formal group and has major influence.
International links	Supportive political or economic relationships with other countries.	7			<p>Significant level of ODA from range of countries and agencies</p>

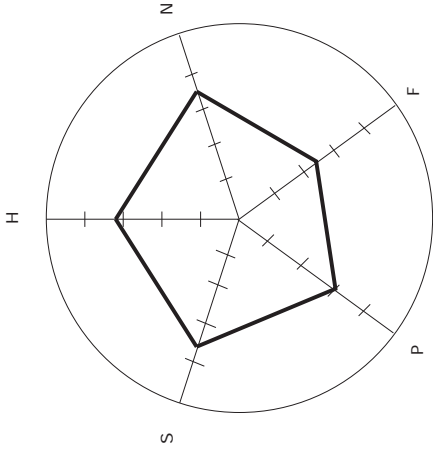
APPENDIX 2

SOCIAL CAPITAL continued	Examples	Asset value	Average	Energy factor	Commentary
			7.13	7.00	<p>Energy factors:</p> <ol style="list-style-type: none"> 1. People reliant on motor vehicles to travel to and from community, social and church activities. 2. Reliance on inter-island shipping services for maintaining family contact. 3. Communication services important in maintaining networks and relationships. (telephone, internet (email, Skype, Facebook etc). Particularly relevant to seafarers and families.

**CONTEMPORARY TUVALU -
SUMMARY**

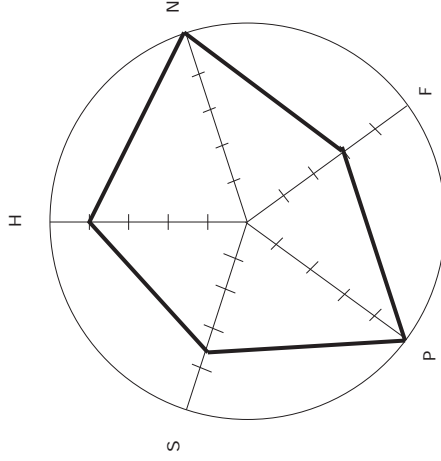
SUMMARY - ASSET VALUES

HUMAN CAPITAL	6.33
NATURAL CAPITAL	6.80
FINANCIAL CAPITAL	5.00
PHYSICAL CAPITAL	6.00
SOCIAL CAPITAL	7.13



SUMMARY - ENERGY FACTORS

HUMAN CAPITAL	8.00
NATURAL CAPITAL	10.00
FINANCIAL CAPITAL	6.00
PHYSICAL CAPITAL	10.00
SOCIAL CAPITAL	7.00



APPENDIX 3: SUSTAINABLE LIVELIHOODS ANALYSIS – THE ENERGY DEPRIVED SCENARIO

LIVELIHOOD ASSET AND ENERGY PROFILES

Tables 30 and 31 set out the analysis used to determine the value of livelihood capitals and the associated energy factors used to develop the livelihood pentagons shown in Chapter 7.

The process used in the analysis is as follows:

Each of the five capitals is divided into elements as shown in Table 10 (Chapter 6).

1. Each element is evaluated and allocated an asset value in terms of the contribution of that element to the capital. The value is out of 10 with 10 indicating high value and zero no value. In some cases, while the asset value may be high in terms of quality, the abundance may be limited or the ability of the community to access the element may be restricted or constrained and in such cases, the asset value is reduced. The valuation is intended to provide an indication of the capital values and in qualitative terms can be classified as follows:

Value range	Classification
9 – 10	Very strong
7 – 8	Strong
5 – 6	Moderate
3 – 4	Weak
1 – 2	Very weak

The valuation is made in the context of the contemporary era and as a result, an asset value may be lower than that allocated in a previous era for a similar asset.

2. The arithmetic averages of the elements of a capital are calculated and these are used to develop asset pentagons for each of the four historical eras.
3. An energy factor is allocated to each capital to indicate the magnitude of the link between the capital and energy. The capital can be a source of energy or a user of energy or a combination of the two. A factor of 10 indicates a strong link while 0 indicates little or no link
4. The energy factors are shown in the form of a livelihoods energy pentagon.

Table 30: Livelihood Asset Analysis – Niue: Energy-Deprived Scenario
(Ref Chapter 7: 7.2.1)

HUMAN CAPITAL	Examples	Asset value	Average	Energy Factor	Commentary
"skills, knowledge, ability to labour and good health"					
Knowledge - traditional and formal	Fishing, farming, effective and relevant education system; traditional knowledge; informal - radio, TV, internet	8			<ol style="list-style-type: none"> 1. Traditional knowledge will become increasingly important. 2. Dependency on energy supply will reduce - greater use of bicycles and government owned trucks. 3. Formal education will become limited with much reduced access to tertiary education. 4. Opportunity to apply gained knowledge in Niue further reduced. 5. Lack of electricity at home will reduce access to internet. 6. Potential risk of children being withdrawn from formal education to work in food production or for household income purposes.
Pool of people with appropriate skills and knowledge and "ability to labour".	Ranges from skilled technicians/professionals to unskilled/ semi-skilled.	3			<ol style="list-style-type: none"> 1. Lack of fuel for motor vehicles will make travel to and from work difficult with reliance on government vehicles or bicycles. 2. Reduced air services will limit further access to overseas professional and technical capability.
Good health	Effective health service	6			<ol style="list-style-type: none"> 1. Health services will be maintained to some degree but recruitment and retention of medical staff will be even more difficult. Potential risk of increased infant and maternal mortality and to other vulnerable categories (elderly and chronically ill).

HUMAN CAPITAL - continued	Examples	Asset value	Average	Energy Factor	Commentary
Good health - continued	Effective health service - continued				<p>2. Ability for patients to travel to New Zealand for specialist treatment may become more difficult with reduced air services.</p> <p>3. Visits by specialists from New Zealand may not be possible as a result of reduced air services.</p> <p>4. Location of hospital means that most people have to travel some distance to the hospital which may delay treatment.</p> <p>Energy factors:-</p> <p>1. Health services: remain dependent on electricity for biomedical equipment, specialist lighting, refrigeration.</p> <p>2. Education: formal education will continue to rely on electronic media such as computers and access to internet at school but on reduced scale.</p> <p>3. All elements rely on access to motorised transport.</p>
NATURAL CAPITAL					
"natural resource stocks from which resource flows and services useful for livelihoods are derived"					
Access to land	Agriculture/horticulture, housing.	9	5.67	8	<p>1. Small population means that land is available for (mainly subsistence) agriculture.</p> <p>2. It is very difficult to buy and sell land with Land Code based on traditional extended family ownership - increased reliance on land increases potential for disputes.</p> <p>3. Cultivation difficult owing to rocky nature of Niue.</p>
Access to fisheries	Seafood gathering, fishing.	9			Small population means little or no restrictions on access for fishing or gathering. Lack of fuel for fishing boats may present a problem in some cases?

APPENDIX 3

NATURAL CAPITAL - continued		Examples	Asset value	Average	Energy Factor	Commentary
Access to forests	Forest products - wood for construction, coconuts	9				<ol style="list-style-type: none"> 1. Small population means that access is possible for most people although land ownership may restrict access to extended family members. 2. Native timbers available for construction; coconuts used for drinking, some traditional foods and for woodfuel. 3. Will become increasingly important..
Indigenous energy sources- biomass, wind, sun, ocean.	Cooking fuel, electricity generation.	9				<ol style="list-style-type: none"> 1. Biomass in the form of woodfuel will become a critical resource. 2. Solar (PV) plant not able to be used in present configuration. 3. Solar water heating already widespread
Access to water	Drinking water, farming, commercial processes	5				<ol style="list-style-type: none"> 1. Good supply of high quality water from fresh water lens under the island but availability will be reduced due to electricity rationing. 2. Drought will continue to be a problem for agriculture.
				8.20	10	<p>Energy factors:-</p> <p>Although not able to access natural energy resources to full potential - eg PV - woodfuel is a critical livelihood resource. Lack of motorised transport could impact on access to natural capital.</p>
FINANCIAL CAPITAL						
"the financial resources that people use to achieve livelihood objectives"						
Cash inflows	Wages/salaries, payment for services, remittances, rents, welfare payments	3				<ol style="list-style-type: none"> 1. Employment opportunities will reduce substantially.
				3.00	5	<p>Energy factors:</p> <p>Reliance on government transport for employment.</p>

APPENDIX 3

PHYSICAL CAPITAL	Examples	Asset value	Average	Energy Factor	Commentary
"the basic infrastructure and producer goods needed to support livelihoods"					
Affordable transport	Cars, motorcycles, bicycles, air services, shipping services and associated physical infrastructure (eg roads, airports).	5			<ol style="list-style-type: none"> 1. Motor vehicle operation limited to government owned trucks or pick-up trucks that will provide some public transport for goods and people. Bicycles will become common mode of personal transport. 2. Reduced shipping services supplying essential goods. 3. Reduced air service (monthly?)
Shelter	Housing	8			<ol style="list-style-type: none"> 1. Most people well housed. 2. Houses generally well maintained. 3. Houses generally "cyclone resistant". 4. Housing not heavily dependant on energy supply.
Water supply	Tanks or aquifer	5			<ol style="list-style-type: none"> 1. Piped supply from pumped system no longer available. Increased reliance on rain water storage. 2. Some access to water lens will be possible using hand pumps or wind-driven or PV powered pumps.
Sanitation and waste disposal	Septic tanks, rubbish collections	5			<ol style="list-style-type: none"> 1. Most houses, government buildings and commercial premises provided with septic tanks. 2. Maintenance of septic tanks unknown. Reportedly, no problems in respect to contamination of aquifer. 3. Some form of regular refuse collection in place. 4. Limited dependence only on energy supply.
Home appliances	Refrigerators, cooking appliances	8			<ol style="list-style-type: none"> 1. While there is a high level of home appliance ownership, lack of household electricity will mean that these cannot be used. 2. Woodfuel will replace LPG and electricity for cooking.

APPENDIX 3

PHYSICAL CAPITAL - continued	Examples	Asset value	Average	Energy Factor	Commentary
Energy supply	Electricity, gas, transport fuels	2			1. Electricity supply will become unavailable or severely curtailed to households. 2. LPG supplies will cease. 3. Petrol and diesel supplies will be available for essential government services only.
Communication systems	Telecommunications, internet, radio, TV	5			1. Satellite communication services will continue using the limited electricity supply available.. 2. Local radio station will continue and will be available on battery powered radios. Television services will cease. 3. Landline telephone may cease. Mobile phone system may remain in service - this may enable continued internet access through 'smart phone' if recharging facilities available.
			5.43	5.00	Energy factors:- While energy supply in the form of diesel and petrol will become very limited, the importance of the supply remains high.
SOCIAL CAPITAL					
"the social resources upon which people draw in pursuit of their livelihood objectives"					
Networks	Working together to achieve common goals through social, community or political action.	9			Possibility that adverse circumstances will result in increased cooperation and community participation in mitigation activities.
Relationships	Extended family or village relationships.	7			1. Village relationships will become increasingly important. 2. Similarly, extended family links will become more important.
Memberships	Membership of formal or semi-formal groups or organisations with common goals/objectives.	8			Church will continue to have major influence.
International links	Supportive political or economic relationships with other countries	8.5			Relationship with New Zealand will continue to be relevant and important.

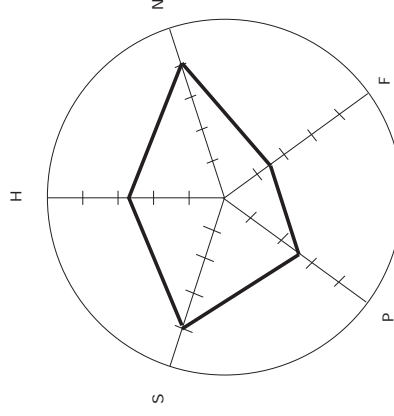
APPENDIX 3

SOCIAL CAPITAL - continued	Examples	Asset value	Average	Energy Factor	Commentary
			8.00	3	Energy factors:- 1. People will become more reliant on village for social activities reducing need to travel. 2. Access to limited communication services will be important particularly with reduced ability to travel locally or internationally

ENERGY DEPRIVED SCENARIO - NIUE

SUMMARY- ASSET VALUES

HUMAN CAPITAL	5.67
NATURAL CAPITAL	8.20
FINANCIAL CAPITAL	3.00
PHYSICAL CAPITAL	5.43
SOCIAL CAPITAL	8.00



SUMMARY - ENERGY FACTORS

HUMAN CAPITAL	8.00
NATURAL CAPITAL	10.00
FINANCIAL CAPITAL	5.00
PHYSICAL CAPITAL	5.00
SOCIAL CAPITAL	3.00

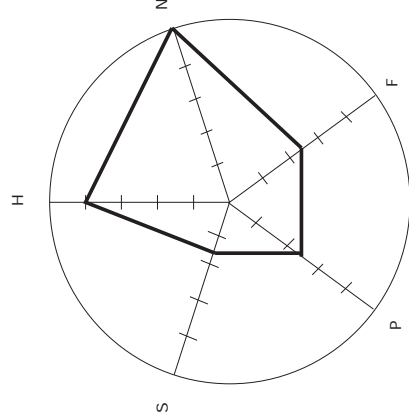


Table 31 : Livelihood Asset Analysis – Tuvalu: Energy-Deprived Scenario
(Ref Chapter 7: 7.2.2)

HUMAN CAPITAL	Examples	Asset value	Average	Energy Factor	Commentary
"skills, knowledge, ability to labour and good health"					
Knowledge - traditional and formal	Fishing, farming, effective and relevant education system; traditional knowledge; informal - radio, TV, internet.	8			<ol style="list-style-type: none"> 1. Traditional knowledge will become increasingly important. 2. Dependency on energy supply will reduce - greater use of bicycles and government owned trucks.. 3. Formal education will become limited with much reduced access to tertiary education. Possible risk to access to Motufoua secondary school in Vaitupu due to reduced shipping services. Potential for reduced school attendance if demand for child labour to help with food production increases due to reduced food imports. 4. Opportunity to apply gained knowledge in Tuvalu further reduced. 5. Lack of electricity at home will reduce ability for home study and access to internet from home will not be possible.
Pool of people with appropriate skills and knowledge and "ability to labour".	Ranges from skilled technicians/professionals to unskilled/ semi-skilled.	3			Lack of skilled labour across full range will continue to be a problem and worsened with reduced access to overseas professional and technical capability due to limited air services.
Good health	Effective health service	4			<ol style="list-style-type: none"> 1. Health services will be maintained to some degree but recruitment and retention of medical staff will be even more difficult. Potential risk of increased infant and maternal mortality and in other vulnerable categories. 2. Traditional healers will become increasingly used in Outer Islands if shipping services reduced.

HUMAN CAPITAL (continued)	Examples	Asset value	Average	Energy Factor	Commentary
Good health – continued	Effective health service - continued				<p>3. Public health risks from overcrowding in Funafuti could increase.</p> <p>4. Ability for patients to travel to Fiji for specialist treatment may become more difficult with reduced air services.</p>
			5.00	8.00	<p>Energy factors:-</p> <p>1. Health services: high dependency on electricity for biomedical equipment, specialist lighting, refrigeration will remain.</p> <p>2. Education: formal education will continue to rely on electronic media such as computers and access to internet at school.</p> <p>3. All elements rely on access to motorised transport including air services (eg travel for education (from Outer Islands, Motufoua, USP etc) purposes and medical treatment)</p>
NATURAL CAPITAL					
"natural resource stocks from which resource flows and services useful for livelihoods are derived"					
Access to land	Agriculture/horticulture, housing.	6			<p>1. Migration to Outer Islands could place stress on land resources mainly subsistence agriculture.</p> <p>2. Access to land in Funafuti extremely limited.</p> <p>3. It is very difficult to buy and sell land with Land Code based on traditional extended family ownership. Possible outward migration from Funafuti to "home" islands may relieve problem in Funafuti?</p>
Access to fisheries	Seafood	9			<p>1. Availability of fish to purchase or access to resource unlikely to be an issue.</p> <p>2. Lack of fuel for fishing boats may necessitate changes in fishing methods.</p>

APPENDIX 3

NATURAL CAPITAL - continued		Examples	Asset value	Average	Energy Factor	Commentary
Access to forests	Forest products - wood for construction, coconuts	5				<p>1. Access is possible for most people in Outer Islands but very limited in Funafuti. Migration to Outer Islands could result in some stress.</p> <p>2. Appears to be limited use of native timbers for construction; coconuts used for drinking, some traditional foods and for woodfuel.</p>
Indigenous energy sources- biomass, wind, sun, ocean.	Cooking fuel, electricity generation.	6				<p>1. Biomass in the form of woodfuel will become a critical resource. Unlikely to be adequate in Funafuti to meeting cooking needs.</p> <p>2. Solar (PV) plant not able to be used in present configuration in Funafuti but will be able to generate electricity in the Outer Islands</p>
Access to water	Drinking water, farming, commercial processes	4				<p>1. Almost total reliance on rain water storage tanks except some wells/springs in some Outer Islands.</p> <p>2. Desalination plant in Funafuti but not on Outer Islands;</p>
				6.00	10.00	<p>Desalination dependent on electricity and will not be available</p> <p>Energy factors:-</p> <p>Although not able to access natural energy resources to full potential - eg PV - woodfuel is a critical livelihood resource. Lack of fuel could impact on access to natural capital.</p>
FINANCIAL CAPITAL						
"the financial resources that people use to achieve livelihood objectives"						
Cash inflows	Wages/salaries, payment for services, remittances, rents, welfare payments	3				<p>1. Government operations may be reduced due to lack of electricity for air conditioning and computers. This could impact on wages/salaries.</p> <p>2. Increased importance of subsistence farming and fishing - some opportunity for sale of produce (mainly benefitting Outer Islands).</p>

APPENDIX 3

FINANCIAL CAPITAL continued	Examples	Asset value	Average	Energy Factor	Commentary
			3.00	5	3. Impact of reduced wages could flow through to small businesses/shops. Energy factors: Reliance on government transport for employment. and for transport of produce
PHYSICAL CAPITAL					
"the basic infrastructure and producer goods needed to support livelihoods"					
Affordable transport	Cars, motorcycles, bicycles, air services, shipping services and associated physical infrastructure (eg roads, airports).	4			1. Motor vehicle ownership severely reduced owing to lack of fuel availability. Reversion to bicycles will become common mode of personal transport likely. 2. Reduced shipping services supplying essential goods. 3. Reduced air service (monthly?)
Shelter	Housing	6			1. Some very poor housing in Funafuti. 2. Houses generally <u>not</u> "cyclone resistant". 3. Housing not dependent on energy supply.
Water supply	Tanks or aquifer	5			No piped system - almost total reliance on rain water storage tanks.
Sanitation and waste disposal	Septic tanks, rubbish collections	3			1. Near complete reliance on septic tanks or pit latrines. 2. Maintenance of septic tanks unknown but reportedly poor. Risk of becoming worse with reduced government services. 3. Some form of refuse collection in place in Funafuti but not particularly effective. Could cease owing to lack of fuel for vehicles.
Home appliances	Refrigerators, cooking appliances	8			1. While there is a high level of home appliance ownership, lack of household electricity will mean that these cannot be used. 2. Woodfuel will replace LPG and electricity for cooking.

APPENDIX 3

PHYSICAL CAPITAL continued		Examples	Asset value	Average	Energy Factor	Commentary
Energy supply		Electricity, gas, transport fuels	3			<ol style="list-style-type: none"> 1. Near 100% connection to mains electricity but supply will become unavailable or severely curtailed to households in Funafuti in particular. 2. PV generation will maintain power supply in Outer Islands but migration from Funafuti could stretch system capacity. 3. LPG supplies will cease. 3. Petrol and diesel supplies will be available for essential services only.
Communication systems		Telecommunications, internet, radio, TV	2	4.43	8.00	<ol style="list-style-type: none"> 1. Satellite communication services will continue using the limited electricity supply available. 2. Local radio station will continue and will be available on battery powered radios. Television services will cease. 3. Landline telephone may cease. Mobile phone system may remain in service - this may enable continued internet access through 'smart phone' in recharging facilities available. <p>Energy factors:- While energy supply in the form of diesel and petrol will become very limited, the importance of the supply remains high.</p>
SOCIAL CAPITAL						
"the social resources upon which people draw in pursuit of their livelihood objectives"						
Networks		Working together to achieve common goals through social, community or political action.	9			<ol style="list-style-type: none"> 1. Possibility that adverse circumstances will result in increased cooperation and community participation in mitigation activities.
Relationships		Extended family or village relationships.	8			<ol style="list-style-type: none"> 1. Home Island relationships will become critical as people in Funafuti seek support from their home islands. 2. Similarly, extended family links will become more important.

APPENDIX 3

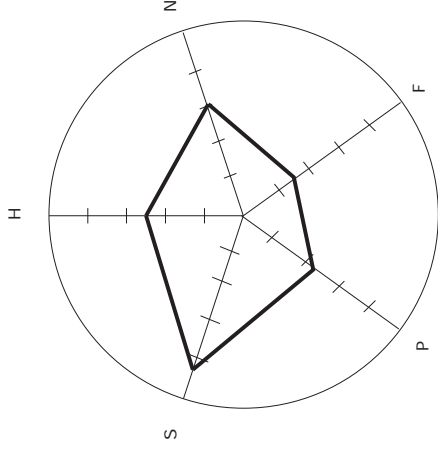
SOCIAL CAPITAL continued		Examples	Asset value	Average	Energy Factor	Commentary
Memberships		Membership of formal or semi-formal groups or organisations with common goals/objectives.	8			1. Church will continue to have major influence.
International links		Supportive political or economic relationships with other countries.	9			Support from neighbouring countries - New Zealand and Australia - and international community in general will become increasingly important.
				8.5	5	Energy factors: With reduced ability to travel between islands and to international destinations, communication services important in maintaining networks and relationships. (telephone, internet (email, Skype, Facebook etc)

APPENDIX 3

ENERGY DEPRIVED SCENARIO - TUVALU

SUMMARY:

HUMAN CAPITAL	5.00
NATURAL CAPITAL	6.00
FINANCIAL CAPITAL	3.00
PHYSICAL CAPITAL	4.43
SOCIAL CAPITAL	8.50



SUMMARY - ENERGY FACTORS

HUMAN CAPITAL	8.00
NATURAL CAPITAL	10.00
FINANCIAL CAPITAL	5.00
PHYSICAL CAPITAL	8.00
SOCIAL CAPITAL	5.00

