

Food System Transformation in Fiji: Exploring the Determinants of Diet Quality and Health Outcomes in Rural and Urban Households

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IV. Abstract

Rapid transformations of global agrifood systems, driven by technological change, trade liberalisation, foreign investment, urbanisation and rising middle-classes in developing countries have contributed to profound shifts in food production, and consumption. This shift is often referred to as the “nutrition transition”, which has had a subsequent effect on diet and health, with rising rates of obesity and non-communicable diseases (NCDs) currently observed across the world. Pacific Island Countries and Territories (PICTs) have the highest prevalence rates of adult obesity in the world. Fiji provides a unique context as one of the more developed and highest populated economies of all the PICTs. This thesis examined the determinants of diet quality and health outcomes in both rural and urban households in Fiji, with implications for wider PICTs.

In Fiji, agriculture generates income for approximately 65% of the total population, with many rural households specialising in subsistence agriculture. Agriculture influences nutrition through a number of pathways, directly through the production of subsistence food crops or animals, and indirectly through the sale of agricultural goods and therefore capacity to purchase food. Chapters 3 and 4 examine the impact of farm production diversity, modern market access, and women’s empowerment in household decision-making on dietary quality and health outcomes amongst rural households in Fiji using data from face-to-face surveys undertaken in 600 rural households. A household dietary diversity score was developed based on previous studies, and it was found that households who sell their produce to modern markets have greater diet diversity, and households who lived closer to modern food markets were less likely to eat traditional staple foods. In households where the female contributed to decision-making, the household was less likely to consume unhealthy foods.

Despite substantial economic growth, large inequalities remain in PICTs, and it is common to also see problems of underweight, stunting, and micronutrient deficiencies, signalling the “double burden” of undernutrition and obesity. Chapter 4 examines both adult and child health body mass index (BMI) outcomes in rural households. Regression analysis found that the consumption of home-grown produce had a significant effect in reducing child BMI-z and that households located further away from traditional food markets were more likely to experience child stunting. In households where the principal female contributed to agricultural household decision-making, there was a significant positive effect on adult BMI.

The modernising of food retail sectors has been most prominent in urban areas of PICTs. Chapter 5 explores the link between the food market environment and other socio-demographic influences on diet quality in urban households in Fiji, using data from a unique survey of 1000 urban households. A household’s diet diversity score was positively and significantly impacted by an increase in income, frequency of eating out and nutritional information use. Households who purchased a greater share of their food from modern food markets spent relatively less on purchasing healthy foods. A positive relationship between the principal female’s education and the consumption of healthy foods by the household was also found.

This thesis concludes with a number of policy insights for PICTs.

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...

IX. Abbreviations and Terminology

List of Abbreviations

ACIAR	Australian Centre for Agricultural Research
BMI	Body Mass Index
BMI z-score	Body Mass Index z-score
CVD	Cardiovascular Disease
FBOS	Fiji Bureau of Statistics
FJD	Fijian Dollars
GDP	Gross Domestic Product
GGI	Gender Gap Index
GII	Gender Inequality Index
HDDS	Household Dietary Diversity Score
LMIC	Low and middle-income countries
NCD	Non-communicable diseases
OECD	Organisation for Economic Cooperation and Development
ODI	Overseas Development Institute
PARDI	Pacific Agribusiness Research for Development Initiative
PICTs	Pacific Island Countries and Territories
FRTS	Fiji Retail Transformation Study
SIDS	Small Island Developing States
SIGI	Social Institutions and Gender Index
T2DM	Type II Diabetes Mellitus
UNDP	United Nations Development Programme
VCA	Value Chain Analysis
WEAI	Women's Empowerment in Agriculture Index
WHO	World Health Organisation
WTO	World Trade Organisation

Useful Terminology

Diet Quality	Refers to nutrient adequacy (i.e. a diet that meets requirements for energy and all essential nutrients).
Diet Diversity	The number of different foods or food groups consumed over a given reference period.
Gender Empowerment	Both sexes having equal power and control over their own lives.
Household Diet Diversity	The number of unique foods consumed by household members over a given period.
Household production diversity	The number of crop, livestock and fish species produced by the household (across the production seasons) in a year.
Noncommunicable disease	A medical condition or disease that is non-infectious and non-transmissible among people, and are typically of long duration and generally slow progression.
Nutrition Transition	The shift in dietary consumption and energy expenditure that coincides with economic, demographic and epidemiological changes.
Overweight/Obesity	Weight that is higher than what is considered as a healthy weight for a given height. Body Mass Index is used as a screening tool for overweight or obesity.
Stunting	Reduced rate in development, where the height for age value is less than two standard deviations of the WHO Child Growth Standards median.
Value Chain	The full range of activities such as design, production, marketing, distribution and support to the final consumer.

Chapter 1: Introduction

1.1. Background

1.1.1. Evolving food environments

Global agrifood systems are undergoing a rapid transformation. Technological change, trade liberalisation, foreign direct investment, urbanisation and rising middle-classes in developing countries, and globalising preferences and lifestyles are all factors that contribute to profound shifts in the way food is produced, processed, distributed and consumed (Qaim, 2017). Most notably, the food retail sector in many developing countries is modernising rapidly, with supermarkets replacing wet markets and traditional shops and grocery outlets (Reardon et al., 2003; Traill, 2006; Reardon and Timmer, 2012; Qaim, 2017).

Modernisation of the retail food sector is typically associated with changes in the types of food offered, prices, packaging sizes and shopping atmosphere. Although supermarkets are responsive to changing consumer preferences and lifestyles, offering the types of food that customers with rising incomes demand, it is likely that supermarkets do not only react to changing consumer preferences, but food retailers, manufacturers and marketers may also shape these preferences to some extent (Demmler et al., 2018).

There has been a marked increase in the incidence of obesity and diet-related non-communicable diseases (NCDs) worldwide. Well over two billion individuals are overweight or obese, and most countries face higher mortality from these nutrition-related NCDs than from undernutrition and infectious diseases (Popkin, 2017). The evolving agrifood landscape in developing countries has had a widespread effect on diet and health in these countries, with long-lasting implications for their economic growth and development. The globalisation of agri-food systems, most prominently, the rapid spread

of supermarkets and related factors changing the food environment (e.g. growth of western-style food outlets), may contribute to the observed nutrition transition and thus also to overweight, obesity and nutrition related non-communicable diseases (NCDs) (Demmler et al., 2017).

The shifts in diet are profound: major shifts in intake of less-healthy low-nutrient-density foods and sugary beverages, changes in away-from-home eating and snacking and rapid shifts towards very high levels of overweight and obesity among all ages along with, in some countries, high burdens of stunting. Diet changes have occurred in parallel to, and in two-way causality with, changes in the broad food system – the set of supply chains from farms, through midstream segments of processing, wholesale and logistics, to downstream segments of retail and food service (Popkin and Reardon, 2018).

1.1.2. Nutrition transition

Economic development is typically associated with profound changes in people's diets. Income growth, urbanisation, technological change, advances in food preservation, and advertising through mass media, all contribute to higher consumption of relatively energy-dense processed foods and beverages. These dietary shifts are often referred to as the "nutrition transition" (Drewnowski and Popkin, 1997; Popkin et al., 2012; Popkin, 2014;). The nutrition transition, with rising rates of obesity and non-communicable diseases, can be observed in all parts of the world. In developed countries, it started much earlier and unfolded gradually over a period of several decades. In many developing countries, the nutrition transition is now observed at accelerated pace (Qaim, 2017).

The nutrition transition specifically entails a shift from traditional diets composed of whole foods, such as pulses and whole grains, and that are low in animal-source foods, salt, and refined oils, sugars, and flours (Monteiro, 2009), to an energy-dense and nutrient poor diet, composed of refined carbohydrates, high fat intake, and processed foods (Bray

and Popkin, 1998, Drewowski, and Popkin 1997, Rivera et al., 2004, Pingali, 2007; Popkin et al., 2012, Popkin, 2017, Popkin and Reardon, 2018).

A positive effect of the nutrition transition includes improved dietary diversity through greater inclusion of non-traditional (often imported) foods, such as new type and varieties of fruits and vegetables. Additionally, as incomes increase, generally consumers increase the amount of protein in diet through increased consumption of foods such as eggs, cheese, milk, meat, and fish in some settings (Kearney, 2010; Popkin, 2012).

While the nutrition transition can have positive effects through increased dietary diversity, which can further lead to improved dietary quality through increasing consumption of important micro- and macro-nutrients, there are possible confounding negative implications too. For example, as part of household members having less-time for food preparation, they demand more convenience foods, which often require less preparation. Thus, retailers and food outlets begin to sell more processed ready-to-cook and ready-to-eat foods. These processed foods are and are typically energy dense, nutrient poor and grossly nutritionally inferior to non-processed foods (Monteiro, 2009; Monteiro et al., 2013; Moubarac et al., 2017; Cornwell et al., 2018).

Sugar, salt and fat consumption from processed foods has plateaued in high-income countries, but has rapidly increased in LMICs. Processed foods are manufactured and distributed in ways that encourage consumption. Added sugar, fat and salt are used along with other sophisticated ingredients and manufacturing products to produce 'hyper-palatable' products (Monteiro et al., 2013). Carbonated soft drinks, baked goods, and oils and fats have been found to be the most significant vectors for sugar, salt and fat respectively in Asian countries (Baker and Friel, 2014). Rising incomes and urbanisation, food industry marketing, changing family structures and workforce trends are all driving the demand for processed foods.

Processed foods have led to an overall sweetening of the global diet. Added sugars are a dietary driver of obesity worldwide, especially when consumed in beverages such as soft drinks, sweetened coffee and tea, juices, and alcoholic beverages (Hirotsu et al., 2015). In most low and middle-income countries (LMICs), sugar sweetened beverage sales are increasing (in daily calories per person) (Popkin and Hawkes, 2015; Baker and Friel, 2016) and represent an important source of caloric intake in many parts of the developing world.

1.1.3. Supermarkets and the nutrition transition

Changing retail environments may possibly speed up the nutrition transition. In developing countries, supermarkets and other modern retail outlets are spreading rapidly, urban consumers in particular, are increasingly buying their foods in supermarkets instead of wet markets and other traditional outlets (Timmer, 2009; Chege et al., 2015; Reardon et al., 2012, Reardon, Timmer and Minten, 2012). Compared with traditional retail formats, supermarkets tend to have a wider variety of processed and highly processed foods and drinks, often in larger packaging sizes and combined with special promotion campaigns (Hawkes, 2008, Timmer, 2009; Swinburn et al., 2011, Qaim 2017).

A number of studies have examined the association between supermarkets and dietary shifts in developing countries such as Latin America, China, Thailand, Indonesia, and Africa (Asfaw, 2008; Tessier et al., 2008; Asfaw, 2011; Zhang et al., 2012; Banwell et al., 2013; Kelly et al., 2014; Umberger et al., 2015; Toiba et al., 2015 Rischke et al., 2015; Demmler et al., 2017; Demmler et al., 2018). These studies have found some evidence to suggest that changes in food systems, particularly food markets (e.g. the ‘supermarket revolution’), have to some extent played a role in the diet and nutrition transition, in many cases supermarket purchase is associated with increased consumption of energy-dense, processed foods.

A recent study in Kenya confirmed that supermarkets contribute to increased consumption of highly processed foods, meats, dairy, and vegetable oils and a decreased consumption of unprocessed food items such as fresh vegetables and grains (Demmler et al., 2018). It was found that while traditional retailers also sell processed foods, the processed food items purchased in supermarkets seem to be of additional nature, in that, supermarket users purchase additional quantities of processed foods without necessarily reducing processed food purchases from traditional shops. The same study also found that shopping in supermarkets increases adult body mass index (BMI), these findings are consistent with Asfaw, 2008 and Kimenju et al., 2015; and Demmler et al., 2017. Overall, the study found that households who purchase food in supermarkets consume higher quantities of processed snacks, fats and oils, soft drinks, meat and fish, and processed grains and consume significantly lower quantities of vegetables and unprocessed grains. These differences in diets may contribute to increased overweight and obesity among supermarket buyers and thus to higher prevalence of nutrition related NCDs.

However, the obesity pandemic in developing countries cannot be attributed to the expansion of supermarkets alone. There are many factors that contribute to the nutrition transition, including socio-demographic changes, such as increasing disposable incomes, urbanisation more women entering the workforce have also played a role shifting food demand as well as diet quality and diet-related health (Popkin, 1999, 2006; Mendez et al., 2004; D’Hease et al., 2005; Pingali, 2007; and Asfaw, 2008).

1.1.4. Overweight and obesity – a global health crisis

The World Health Organisation (WHO) (2018) reported that in 2016, more than 1.9 billion adults aged 18 years and older were overweight, of these, over 650 million adults were obese. Overall, about 13% of the world’s adult population were obese and 39% of adults were overweight in 2016. Figure 1.1 below shows the prevalence of obesity

and overweight amongst adults based on WHO (2017) figures. The prevalence of overweight and obesity has also increased among children and adolescents, rising from 4% in 1975 to 18% in 2016. This trend is concerning, as childhood obesity is associated with a higher chance of obesity, premature death and disability in adulthood. The WHO (2018) notes that worldwide prevalence of obesity nearly tripled between 1975 and 2016.

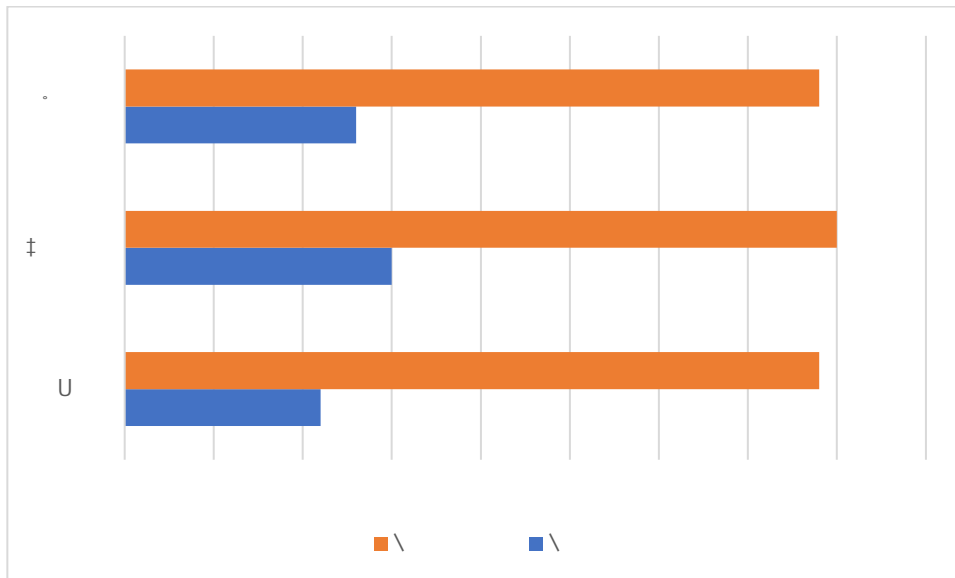


Figure 1.1. Prevalence of Global Adult Overweight and Obesity

Author's own diagram, based on (WHO, 2017) data.

Many studies suggest that raised BMI is a major risk factor for NCDs such as cardiovascular diseases; diabetes; musculoskeletal disorders and some cancers. Diabetes is rapidly emerging as a global health care problem that threatens to reach pandemic levels by 2030; the number of people with diabetes worldwide is projected to increase from 171 million in 2000 to 366 million by 2030. This increase will be most noticeable in developing countries, where the number of people with diabetes is expected to increase from 84 to 228 million (Hossain et al., 2007). It is important to note that unlike developed countries, where a majority of people with diabetes are older than 64 years of age, most people with diabetes in developing countries are in productive age groups (aged between

45-64) (Mira et al., 2010). Consequently, the serious cardiovascular complications of obesity and diabetes could overwhelm developing countries that are already straining under the burden of communicable diseases (Hossain et al., 2007; Tremmel et al., 2017).

Despite substantial economic growth, large inequalities remain in many LMICs, and it is common to see problems of underweight, stunting, and micronutrient deficiencies side by side with increasing rates of obesity (Popkin et al, 2012). While these countries continue to deal with the problems of infectious diseases and undernutrition, they are also experiencing a rapid upsurge in NCD risk factors such as obesity and overweight. This “dual burden” of undernutrition and obesity exists not only in countries and communities but in households and even in individuals, who may have excess adiposity along with micronutrient deficiencies, such as iron deficiency anaemia, or stunting and overweight (Doak et al., 2000; Popkin et al, 2012). Dual burden households are most common in countries undergoing the nutrition transition.

The prevalence of overweight and obesity in children in developing countries is showing an increasing trend with child overweight and obesity rates having increased significantly worldwide (Popkin 2006; Popkin and Reardon, 2018). Children in LMICs are more vulnerable to inadequate prenatal, infant, and young child nutrition. At the same time, these children are exposed to high-fat, high-sugar, high-salt, energy-dense, and micronutrient poor foods, which tend to be lower in cost but also lower in nutrient quality (WHO, 2018). In South America, overweight is widespread among children under five years old, particularly in Chile and Mexico (Rivera et al., 2014; UNICEF, 2014). In a study of BMI change among children, adolescents and young adults in South Africa, Sartorius et al., (2017) found a rapid rise in mean BMI in the six to 25 age band, with the highest risk among children eight to ten years of age.

Recent research suggests that many health problems related to poor infant feeding practices may be linked to food supply shifts described above (Popkin, 2017). Evidence suggests/indicates that large proportions of infants are fed sugar-sweetened beverages, savoury snacks, and many other types of highly processed nutrient-poor foods, even in the first six months of life (Rivera, Martorell and Gil, 2014; Kroker-Lobos et al., 2014, Tzioumis et al., 2014; Pries et al., 2016; Feeley et al., 2016).

The vast majority of undernourished children reside in LMICs (Black et al., 2003; FAO, 2017). With socioeconomic advancement and improved living conditions, these children are increasingly exposed to obesogenic environments outside of the womb. Importantly, adult obesity and cardiometabolic disease in LMICs may be influenced by the mismatch between conditions in early and later life (Ford et al., 2017). Therefore, the dual burdens of child undernutrition and adult overnutrition may exacerbate the risk of obesity and associated cardiometabolic disorders and is incredibly taxing on underdeveloped health systems (Ford et al., 2017).

The double burden of disease is a serious challenge, because malnutrition and stunted growth are often seen to coexist in children, thus, there is a need to eliminate undernutrition without increasing in obesity (Martorell et al., 2000). Most countries that still have a substantial burden of undernutrition and related diseases also have a substantial or emerging burden of overnutrition and related NCDs (Swinburn et al., 2011). Both these conditions need to be addressed together for several important reasons: foetal and infant undernutrition followed by adult over-nutrition has a double effect on the later burden of NCDs; the underlying drivers within the food system (e.g. food quality and distribution) are often common to both disorders; and NCDs cannot be ignored even while efforts to reduce undernutrition continue (Swinburn et al., 2011).

1.1.5. Urbanisation and obesity

Obesity is generally higher in urban compared with rural settings across LMICs (Popkin, 2012). While urbanisation is considered the prime driver for nutrition transition and the emergence of obesity, recently, an increase in obesity has been observed in rural areas of some developing countries (Chow et al., 2008; Zhai et al., 2017). As LMICs further urbanise and as the prevalence of overweight/obesity rises globally, the urban-rural obesity differential appears to be shrinking, largely owing to increases in overweight among rural populations (Ford et al., 2017). While overweight prevalence is increasing in both rural and urban areas, the rate of increase is higher in many rural populations. In a study of women of reproductive age, Jaacks et al. (2017) found that overweight was increasing at a greater rate in rural areas relative to urban areas in nearly half of LMICs. Sartorius et al. (2017) found prominent gains in the prevalence of obesity in children, adolescents and young adults in rural areas in South Africa. Popkin and Slining (2013) found greater annual increases in obesity in rural areas relative to urban areas in all regions of the world.

1.1.6. Agriculture and health outcomes

In recent years, the emphasis on agricultural policies to improve food and nutrition security has been driven by the increased recognition of the importance of agriculture for food security, dietary quality and nutrition (Carletto et al., 2015). Agriculture can influence nutrition through a number of pathways (Pinstrup-Andersen, 2013), primarily through the production of subsistence food crops or animals that the household consumes directly, as well as through the sale of agricultural goods that affect household income, and therefore food purchases and consumption (World Bank, 2007).

However, the impact of agriculture on nutrition is not limited to these two pathways. Women's empowerment in household decision-making plays an important role in shaping nutrition outcomes in smallholder farm households. A woman's control of

household income, affected in part by her ownership of farm output and the kind of income generated from that output (Kennedy and Cogill, 1987), affects the kind of purchases made with the income and the allocation of resources within households (Gillespie et al., 2012). Studies such as Jones et al., (2014) have found that diet diversity was significantly greater in households where women played a role in deciding how agricultural earnings were spent. Malapit et al., (2015) found that mothers with greater control over expenditures are more likely to have children with better long-term nutritional status.

Access to agricultural markets has also been found to impact household diet quality. Sibhatu et al., (2015) conducted a study using data from Indonesia, Kenya, Ethiopia and Malawi, which found that access to agricultural markets can have a greater positive effect on household diet quality than increased production diversity (Sibhatu et al., 2015). Studies examining the effects of commercialisation of agriculture on household diet quality have produced mixed results, with some finding that a move from staple to cash crops may have negative nutritional consequences on smallholder households (Von Braun and Kennedy, 1994; Ecker et al., 2011). Even where incomes are increased due to participation in modern market channels such as supermarkets, the effects on diet quality can be negative due to a higher likelihood of male control over revenues (Chege et al., 2015).

Smallholder farmers make up a large proportion of the undernourished people worldwide (Chege et al., 2015; Frelat et al., 2016). These households are largely reliant on agriculture for their livelihoods, as such, gaining a better understanding of the pathways between agriculture and nutrition could be critical in improving diet quality and health outcomes in rural households. As households are likely to consume a large share of the food products that they produce, greater diversity in agricultural production may

increase the availability of different types of food for household consumption (Hawkes and Ruel, 2008; Malapit et al., 2013). However, the relationship between the production diversity of farms and the quality of the diets of the households managing those farms have not been well-established (Jones et al., 2014). The linkages are complex and the results from various studies have been inconsistent (Carletto et al., 2015). Although, a number of recent studies have found a positive association between household production diversity and dietary diversity (Herforth, 2010; Jones et al., 2014; Kumar et al., 2015, Malapit et al., 2015), little is known about the extent of the relationship between production and diet diversity in the Pacific. Therefore, this PhD research provides insights into the relationship between production and diet diversity in Fijian smallholder farm households. In particular, examining the role that women's empowerment and market access plays within this context.

1.1.7. Pacific Island Countries and Territories – a region in the midst of a health crisis

The food environment of Pacific Island Countries and Territories (PICTs) has undergone a dramatic transformation since World War II. What was once traditionally a relatively healthy diet, based on large quantities of staple foods – roots, tubers, fruits, fresh fish and leafy greens, has been replaced by a diet high in meat, processed foods, sugar, and refined staples such as rice (Thaman and Clarke, 1983; Coyne, 2000; WHO, 2003; Thow et al., 2010; 2011, Snowden et al., 2013; Estieme et al., 2014; Waite, 2017). PICTs are amidst an epidemic of obesity and consequent chronic diseases (Hughes and Lawrence, 2005). NCDs are responsible for 75% of deaths and with indications that life expectancy in some PICTs is stagnating or declining due to NCDs, leaders in the Pacific have recognised the burden of NCDs as a human, social and economic crisis requiring urgent action (Snowdon and Thow, 2013).

In PICTs, a main catalyst driving dietary change is trade in food (Evans et al, 2001; Hughes and Lawrence, 2005; Thow and Snowdon, 2010). PICTs are particularly vulnerable to the effect of international trade and changes in the global economy (Thow et al., 2011) and are heavily dependent on imported food, and imported items such as fatty meats have been identified as a key contributor to diet-related disease (Foliaki and Pearce, 2003; Schultz, 2004). The burden of disease is further exacerbated by a food supply that encourages consumption from a limited ‘universal menu’ of goods and services (Hughes and Lawrence, 2005).

The Pacific remains the world region by far the most affected by obesity with the highest prevalence rates of adult obesity in the world (Abarca-Gómez et al., 2017). Table 1.1 below contains a list of the top ten countries with the highest prevalence of obesity in the world. All ten countries are PICTs. Such high obesity rates have tremendous public health implications. In some PICTs, the treatment costs of NCDs account for between 39% and 58% of health expenditure (Cheng, 2010). Another alarming trend is that childhood obesity has started to take on unseen dimensions (Helble and Francisco, 2017), with childhood obesity rates over 30% in Samoa and Wallis and Futuna, and overweight rates well above 50% for adolescents in the Cook Islands, Tonga, and Samoa. While there have been some efforts to prevent and control obesity and NCDs in the region, there has been slow progress in service delivery and equity, and challenges in addressing NCD’s at the primary, secondary and tertiary levels (Wate, 2017).

Table 1.1. Top 10 Countries in the world with the highest prevalence of obesity

Rank	Country	Percentage of Population Obese (%)
1	Nauru	61.0
2	Cook Islands	55.9
3	Palau	55.3
4	Marshall Islands	52.9
5	Tuvalu	51.6
6	Niue	50.0
7	Tonga	48.2
8	Samoa	47.3
9	Kiribati	46.0
10	Micronesia	45.8

Author's own elaboration, based on (World Atlas, 2018) data.

1.1.8. Fiji: A Pacific leader struggling under the weight of NCDs

In Fiji, 82% of all deaths are attributed to NCDs. Consequently, NCDs are contributing to rising health care costs and challenges to economic growth, as adults are affected during their most productive years. Fiji's steady transition from a traditional indigenous community lifestyle towards a more urban and western-orientated environment continues to drive the prevalence of NCDs (Morgan, 2015). Even though infectious diseases have declined, and health care has improved, NCDs have caused life expectancy to stagnate at a low 68 years (Hendriks et al., 2015). The severity of the obesity is even more urgent than in many high-income countries, because many obesity-related NCDs go untreated or poorly in Fiji. World Development Indicators show health expenditure per person in Fiji is low, at US\$177 among the lowest for PICTs. Health care funding largely comes from taxation revenue, but with a low tax base from a small pool of taxable income earners, the government's allocation resources are limited. As a result of political instability and coups, there have been high migration rates of health

professionals to neighbouring developed countries (Prasad, 2012; Morgan, 2015). Therefore, while addressing infrastructure is important and one aspect of dealing with the current health crisis, understanding the drivers of the NCD crisis are crucial in enabling the Fijian Government to develop policies around prevention.

In Fiji, a nutrition transition has occurred which has mirrored that widely experienced in PICTs - an increase in the consumption of cereals, animal fats and processed imported foods, with a corresponding decrease in the consumption of traditional root crops and other local food products (Saito, 1995, Hone, 2003, Vatucawaqa, 2012; Morgan, 2015). Fijians have tended to reduce their consumption of nutrient dense foods, such as taro, which have a high level of basic nutrients, relative to their level of calories. These nutrient dense foods, which were staple items in the traditional Fijian diet, have declined in dietary importance relative to calorie rich imported foods with low nutrient density, such as mutton and rice (Hone, 2003; Vatucawaqa, 2012; Morgan, 2015).

Fiji is fast becoming more modernised. Tourism and the infiltration of western media influences have brought enticements to unhealthy living. In particular, imported white rice and noodles are easier and cheaper to buy than locally grown indigenous sources of carbohydrates, such as plantains, bananas, and breadfruit (Morgan, 2015). Fijians are similarly abandoning traditional high starch diets and opting for processed foods that have a longer shelf life and cost less. The most recent Food Balance Sheet for Fiji in 2009 revealed that 68% of total calories consumed by Fijians come from imported food (Vatucawaqa, 2012). Snowdon et al., (2010) attribute the move away from traditional diets and a growing reliance on imported foods such as rice, meat products and sugary snacks as a major contributor to the increasing NCD problem in the Pacific.

Despite the current health crisis plaguing PICTs, little has been done to explore the determinants of diet quality and health. This PhD thesis aims to address the gap in the literature by examining the determinants of diet quality and health in Fiji. Fiji provides a unique context as one of the more developed and highest populated economies of all the PICTs. Based on current statistics, it is concerning to note that Fiji is on an upwards trajectory to join other PICTs such as Nauru, American Samoa and Tonga, who currently have the highest rates of obesity in the world (WHO, 2014; CIA, 2016). In Fiji between 2002 and 2012, the share of the population overweight or obese rose by 8%, from 59% to 67% (Ministry of Health Fiji, 2015). The unique ethnic mix of Fiji, comprising of two major ethnic groups iTauke (Indigenous Fijians, predominantly Melanesian with a Polynesian admixture) and Indo-Fijian (Fijians of Indian decent) provides an interesting setting and insights with respect to ethnic differentials. In a 2016 study, Lin et al., projected that obesity prevalence in 2020 in Fiji will be 34.0% and 60% in iTaukei men and women, and 11.4% and 31% in Indian men and women, respectively.

1.1.9. Food retail transformation in Fiji

Little is known about the extent of retail transformation in the Pacific and its subsequent effect on food consumption patterns. Fiji presents an interesting case study because its food retailing sector has developed in recent decades without the high level of foreign direct investment upon which other developing economies have relied (Johns et al., 2017). However, many of the other known drivers of food retail transformation including, urbanisation, rising urban income and changing consumer preferences are prevalent in Fiji. Supermarkets have taken over a significant percentage of food retail market share in Fiji. Johns et al., (2017) found that supermarkets have captured more than 50% of the market share in Fiji and 65% of their sample reported having patronised

a supermarket at least once a week. The study found that consumer preferences and changing urban household income were key drivers for food purchasing in Fiji.

While recent research has examined how supermarkets may influence dietary habits and nutrition of urban consumers (Asfaw, 2008; Tessier et al., 2008; Asfaw, 2011; Zhang et al., 2012; Banwell et al., 2013; Kelly et al., 2014; Umberger et al., 2015; Toiba et al., 2015 Rischke et al., 2015; Demmler et al., 2017; Demmler et al., 2018), these links have not been examined in Fiji, although a number of studies have looked at trade and food policy issues in the Pacific (Hone, 2003; Schultz, 2004; Hughes and Lawrence, 2005; Thow et al, 2010; Snowden et al, 2010; Snowden et al, 2011). Therefore, this thesis aims to address the gaps in the literature with respect to the influence of supermarkets on diet quality, looking specifically at urban and rural households in Fiji, with wider implications for PICTs.

1.1.10. The Fijian agricultural sector

As discussed earlier, globally, food systems are undergoing widespread transformation and this has been well documented across faster growing developing countries in Asia, Latin America and Africa (Pinstrup-Andersen, 2002; Reardon et al; 2000; Reardon et al, 2003). Some of the key drivers of the transformation include urbanisation and rising urban incomes as well as private sector investment (Reardon et al, 2004; Pingali, 2007; Hazell and Wood 2008; Godfray et al, 2010). Although increasing urbanisation and rising urban incomes have been documented in Fiji (Narsey, 2011), it has been subject to little private sector and foreign investment due to political instability and the economy is still recovering from the collapse of the sugarcane industry (Prasad, 2012).

The agricultural sector plays an important role in the Fiji Islands economy. Trade in domestically marketed food is an especially important source of cash income in the

rural economy in Fiji (Bammann, 2007). Agriculture generates income for approximately 65% of the total population (Hone et al., 2008; Ministry of Agriculture Fiji, 2009). However, the contribution of the agricultural sector to Gross Domestic Product (GDP) dropped significantly by 13.3% in 2009, a further 8.7% in 2010, slightly recovering in 2011 by 14.8 % (Fiji Bureau of Statistics, 2012).

The economic performance of rural enterprises in Fiji has suffered over time as a result of price volatility and long-run declining price trends for key commodities (in particular sugarcane), vulnerability to natural disasters, minimal private investment into the sector, inadequate infrastructure, marketing deficiencies, increasing input costs and disruption in land tenure arrangements for sugarcane growers (Hone et al., 2008; 2009 National Agricultural Census Report, Department of Agriculture Fiji, 2009). This has all occurred within a climate of intense political instability, notably the coups of 1987, 2000 and 2006, high levels of inflation, the devaluation of the Fijian dollar by 20% in 2009, and the demise of the sugar industry, one of Fiji's key agricultural exports. Subsequently Fiji has experienced decline in the level of economic development, increased levels of poverty, out-migration of thousands of skilled and professional people, and a large outflow of national savings (Prasad, 2012). The end result has been a crisis in the financial outlook for those dependent on the rural sector (Hone et al., 2008).

Before the 2006 coup, sugar cane production was forecast to increase to 4.1 million tonnes in 2008 and 2009 (Prasad, 2012). This projection was based on funding support from the European Union (EU) to restructure the sugar industry. After the 2006 coup Fiji lost the EU grant as it was found to have breached the Contonou Agreement (the Lome predecessor) and sugar cane production declined drastically to 2.3 million and 2.2 million tonnes in 2008 and 2009, respectively, in 2010 it declined to 1.8 million tonnes, and the forecast for 2011 was similar (Prasad, 2012).

The impending price decline of sugarcane due to reforms undertaken by the EU was the main catalyst which led to the fall of the sugar cane industry, however it was heavily underpinned by the inefficiency of the Fijian sugar mills, a lack of interest in sugar cane farming amongst the younger generations and the impasse over the land lease system (Prasad et al, 2008). Land tenure policy is one of the most contentious policy issues in Fiji (Kurer, 2001). The absence of secure individualised tenure to land, means that the land cannot be used as collateral for loans from commercial banks. As a result, the amount of credit available to the Fiji farming sector is sub-optimal (Duncan and Sing, 2009). Figure 1.2 is based on data from the most recent Agricultural Census in Fiji and shows the percentage of farms by land tenure in Fiji, the majority 65.4% are Mataqali arrangements. Mataqali represents direct arrangements with the customary land-owning groups, where land is owned collectively within the clan, tribe or family due to kinship ties.

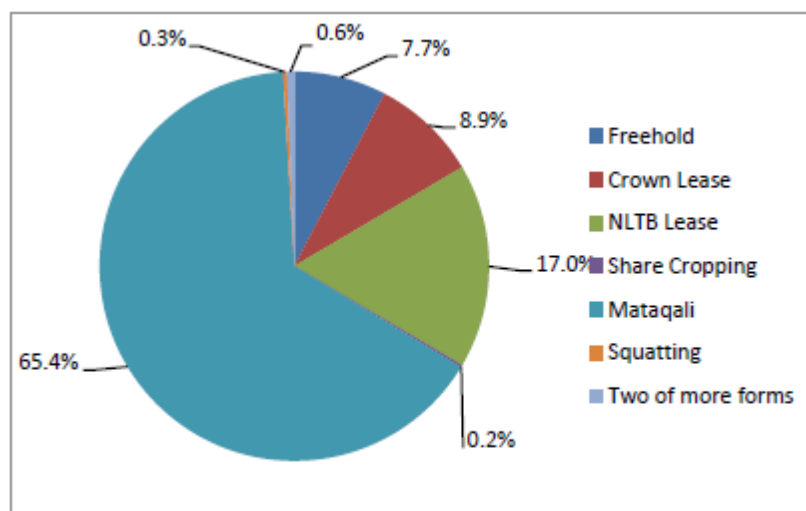


Figure 1.2. The percentage of farms by land tenure in Fiji

Source: Ministry of Agriculture Fiji, 2009, page 44.

Following the collapse of the sugar industry in 2006, non-sugar crop sectors have received a significant boost from the government. Rising global food prices have also put pressure on the Fijian government to implement policies such as an import-substitution

strategy to promote production for domestic consumption. Fiji's food import bill increased from approximately \$255 million in 2000 to approximately \$521 million in 2009 (Prasad, 2012). In 2010, the government allocated \$3.5 million in the 2010 revised budget to promote the production and export of papaya, taro, cassava, ginger, pulses and vegetables (Prasad, 2012). According to the Ministry of Agriculture (2009), the priority crops in Fiji are sugar, yaqona, dalo, rice, ginger, eggplant, cassava and tropical fruit. However, the profitability of crop farming has been affected by natural disasters, low prices, poor market access, pests and diseases, high transport costs and theft. Other issues involve the perishability of commodities, quarantine inspections and high production costs.

The agricultural sector in Fiji can be categorised broadly as comprising a commercial sector and a 'village' sector. The commercial sector is mainly made up of large corporate farming enterprises that employ professional managers and those owner-operator farming enterprises whose major activity is not production for subsistence. However, there are only a handful of corporate farming enterprises, primarily in the poultry industry. Larger-scale, commercial farmers have been operating in dairying, beef cattle and pig-raising and the growing of ginger, fresh vegetables and dalo. Most Fijian villagers have semi-subsistence livelihoods, producing a surplus for sale to meet education and health expenses as well as purchases of food and other expenses such as social and cultural obligations and entertainment (Duncan and Sing, 2009). There has been a large focus by successive governments on improving agricultural productivity in this sector and on increasing its commercialisation. These endeavours have, however, had very limited success (Duncan and Sing, 2009).

Based on the 2009 Census, there are 65,033 farms in Fiji (Ministry of Agriculture Fiji, 2009). This was a marked reduction of 32% less when compared with the 95,400

farms from the 1991 Census. The average size per farm also declined to 3.9 hectares from 6.2 hectares in 1991. Table 1.2 below shows the number of farms and total area under farms by actual land use and by size of farms at a national level in Fiji in 2009. The major factors noted for the decline by the Ministry of Agriculture Fiji (2009) are residential and industrial developments, a large number of farmers no longer farming (rural to urban drift), deregulation policies, low prices for crops and land tenure issues.

Table 1.2. The number of farms in Fiji by size

Size of Farm	Farms	% of Farms
< 1 ha	28 564	43.90%
1 up to 3 ha	17 203	26.50%
3 up to 5 ha	7 910	12.20%
5 up to 10 ha	6 915	10.60%
10 up to 20 ha	3 040	4.70%
20 up to 50 ha	990	1.50%
50 up to 100 ha	285	0.40%
100 ha or more	126	0.20%

Source: Ministry of Agriculture Fiji, 2009, page 33.

1.1.11. Evolving horticultural value chains in Fiji

Previous work has shown that modern retailers tend to capture the processed food category first (Minten and Reardon, 2008) before seeking additional growth in the fresh produce category (Brown, 2005; Neven et al., 2006). The ability of traditional outlets to maintain their hold on their fresh produce market share has been the subject of debate in the literature (Goldman et al., 2002; Neven et al., 2006). In dealing with the village agricultural sector in Fiji, one of the main difficulties experienced by government, private

middlemen, traders and processors is ensuring the continuity and quality of the supplies from village farmers. Duncan and Sing (2009) have attributed this to three main factors, first farmers' lack of respect for the contracts they make with traders, in that even when contracts are agreed upon, contractors often find that farmers sell the produce to someone else offering a higher. Second, the fact that village farmers usually have no commercial assets that they stand to lose as the result dishonouring contracts and therefore there is little possibility of recourse through the legal system. Finally, subsistence affluence has also been described as a major challenge in the Fijian agricultural sector, whereby communities are able to live comfortably by devoting only a few hours a week to food production and therefore have little incentive to respond to income generating opportunities.

1.2. Research Questions

This PhD research provides insights into the determinants of diet quality in both rural and urban households in Fiji, with implications for the wider PICTs. Such insights are critical for developing an appropriate policy response to deal with the current health epidemic plaguing this region. PICTs remain the world region most affected by obesity, with serious subsequent public health implications. Specifically, this thesis examines the following broad research questions:

- 1) What are the determinants of diet quality among rural agricultural households in Fiji?
- 2) What are the determinants of health outcomes in adults and children in rural agricultural households in Fiji?
- 3) What are the determinants of diet quality and healthy eating among urban households in Fiji?

The nutrition transition, which has occurred in PICTs has involved the abandonment of traditional and relatively healthy diets in favour of highly processed imported foods. Thus, this thesis examines the impact that modern food environments are having on diet quality in both rural and urban Fijian households. Noting that many factors are likely to contribute to a nutrition transition and its subsequent health outcomes, a number of relevant socio-demographic influences, including gender are also explored. Further, because the food environment context is different between rural and urban households, for rural smallholder farm households we examine the extent home production of nutrient dense foods such as fruits and vegetables, and access to food markets (for both selling produce and buying food), are influencing household diet quality and health outcomes.

The analyses presented in this thesis were developed based on empirical research that focused on both producers and consumers in Fiji. Farm households participating in horticultural value chains were selected as the focus of analysis in the rural smallholder farming household study, while the consumer study focused on urban food consumption patterns, particularly the role of supermarkets and other “modern” outlets. Two major studies form the basis of this project. Study 1, presented in Chapter 3 and Chapter 4, utilised data from ‘The Fiji Rural Horticultural Producer Survey’, a survey of 600 representative smallholder farming households which specialised in horticultural crops. The data collected for Study 1 as part of ‘The Fiji Rural Horticultural Producer Survey’ is analysed to examine the determinants of diet quality and health outcomes for *rural* Fijian smallholder farming households. Study 2 is presented in Chapter 5 and analyses data from ‘The Fiji Urban Consumer Survey’, a survey of 1,000 urban Fijian households, which explores the impact of modern retail outlets on diet quality for *urban* households.

1.3. The Structure of this Thesis

This thesis is a hybrid style, thesis by publication, whereby Chapters 3-5 of will be submitted as individual papers to relevant journals for publication. As such, all three chapters include detail regarding background issues, survey methods and data. The following paragraphs summarise the main outline and objectives of the Chapters 2-6 of this thesis.

Chapter 2 provides an overview of the Fiji Retail Transformation Study of which the data analysed in both Studies 1 and 2 are obtained from. This chapter outlines the questionnaire design and data collection process for both studies and includes a descriptive analysis of the data from both the Fiji Rural Horticultural Producers Survey and the Fiji Urban Consumer Survey.

Chapter 3 examines the determinants of diet quality among 509 of the rural agricultural households included in the data from the Fiji Rural Horticultural Producer Survey. This chapter provides an overview of relevant literature regarding the nutrition transition, specifically how market globalisation is changing food environments, particularly in developing countries. In this chapter, possible factors which may influence a *rural* household's food purchasing behaviour including socio-economic factors, gender empowerment and home production of nutrient dense foods such as fruit and vegetables are examined. This chapter explores the relationship between *rural* household dietary diversity and household production diversity. A series of regression equations are developed and analysed to examine the relationship between the factors listed above and various measures of healthy eating.

Chapter 4 analyses individual BMI data collected from the same 509 *rural* households in Chapter 3 to examine both adult and child diet-related health outcomes in rural Fijian farm households. This chapter provides an overview of the relevant literature regarding factors influencing BMI, and associated NCDs, including overweight and

obesity, with a focus on developing countries. In this chapter, the link between the food market environment, including access to traditional food markets; household expenditure on processed foods; the home production of nutrient dense foods such as fruit and vegetables; and socio-economic factors such as gender empowerment on health outcomes in rural agricultural households in Fiji is examined. Ordinary Least Square regressions are utilised to estimate the association between the factors listed above and adult and child health outcomes.

Chapter 5 examines the determinants of diet diversity and healthy eating among 1000 urban households in Fiji using data collected as part of the Fiji Urban Consumer Survey. This chapter provides an overview of the relevant literature regarding evolving global food environments, particularly in developing countries and the subsequent effects on diet quality and health. A household dietary diversity score was developed based on previous studies, and the share of total food expenditure on healthy food is used to measure household diet quality. This chapter explores the link between a range of socio-economic influences, location and food market choices on diet quality in urban households in Fiji. Multiple regression analysis is used to estimate the model of the share of expenditure on healthy food, and simultaneous multivariate Tobit regressions are used to estimate the share of expenditure on healthy and unhealthy food groups.

The final chapter of this thesis, **Chapter 6**, presents the main findings and policy implications of this research. The chapter provides a short summary of the main findings of Chapters 3 through 5 and outlines the limitations of the research and scope for future work. Implications of the findings are summarised and recommendations are offered for policy makers to assist in shaping future policy around these issues in Fiji and among PICTs.

Chapter 2: Methods and Descriptive Statistics

2.1. The Retail Transformation Study

This thesis contains analysis from data collected as part of the Fiji Retail Transformation Study (FRTS). The FRTS was undertaken as part of the Pacific Agribusiness Research for Development Initiative (PARDI), which was funded by the Australian Centre for International Agricultural Research (ACIAR) in 2010. PARDI was a multidisciplinary research programme aimed at improving agricultural livelihoods in a number of Pacific Island Countries and Territories, including Fiji, Kiribati, Samoa, Solomon Islands, Tonga and Vanuatu. PARDI included several Australian universities, Pacific government agencies, non-governmental organisations and the private sector on the respective islands where the research was carried out. The FRTS included both a Fiji Rural Horticultural Producer Survey and a Fiji Urban Consumer Survey. The aim of both of these surveys or studies was to gather data which allowed the research team to examine opportunities for improving fresh produce market chains, particularly for fresh fruits and vegetables. To our knowledge, this type of detailed analysis of an entire value chain has not been attempted in the Pacific before the FRTS.

The fresh produce market was selected as the focus of the value chain analysis not only because of the important role it plays in terms of providing access to healthy and nutrient dense food but because of the potential it has for improving development outcomes in Fiji where 65% of the population is involved in agriculture (Fiji Ministry of Agriculture, 2009). As noted in Chapter 1, the economic performance of the Fijian agricultural sector has suffered over the last decade, in particular due to the collapse of the sugarcane industry. Horticultural crops have been identified by the Fijian Government as the way forward for the agricultural sector with subsequent funding being allocated to

promote the production of key export horticultural crops. The potential for horticultural crops to improve livelihoods was one of the driving motivations behind the FRTS.

Value Chain Analysis (VCA) has been used extensively as a diagnostic tool for understanding and improving agribusiness chains (Simons et al, 2003; Taylor, 2005; Francis et al, 2008) and can be particularly useful in providing policy insights (Kaplinsky and Morris, 2001; Cattaneo et al, 2010). The FRTS was comprised of four major components in order to address the major points in the fruit and vegetable value chain, which are either driving or affected by structural change: (i) urban consumer households (The Fiji Urban Consumer Survey, discussed in this chapter and the empirical study presented in chapter 5); (ii) traditional and modern food retail outlets as well as chefs at hotels and resorts (food service or hospitality sector); (iii) horticultural traders; and (iv) horticultural producer households (The Fiji Rural Horticultural Producer Survey also discussed in this chapter and the empirical studies presented in chapters 3-4). The researcher was responsible for the design and implementation of the Fiji Rural Horticultural Producer Survey and the Fiji Urban Consumer Survey studies.

Prior to the producer and trader components being completed, a VCA was undertaken in relation to the traditional and modern food retail outlets as well as the consumer households in 2012. A number of interviews took place as part of the traditional and modern food retail outlet component. During the VCA, it was found that local producers sell directly either to middlemen or sell their produce directly to consumer municipal or smaller local markets. The hospitality or food service sector sources their produce either directly from the municipal markets or through middlemen traders or food processors. Produce is also exported through a number of larger urban traders and wholesalers. Figure 2.1 is a value chain diagram created by the author based on the information gathered through that value chain analysis process. On the left-hand side of

Figure 2.1, are the two sources of horticulture crops in Fiji, which are local producers and importers. It then demonstrates the various ways produce moves across the value chain, ultimately ending with consumers.

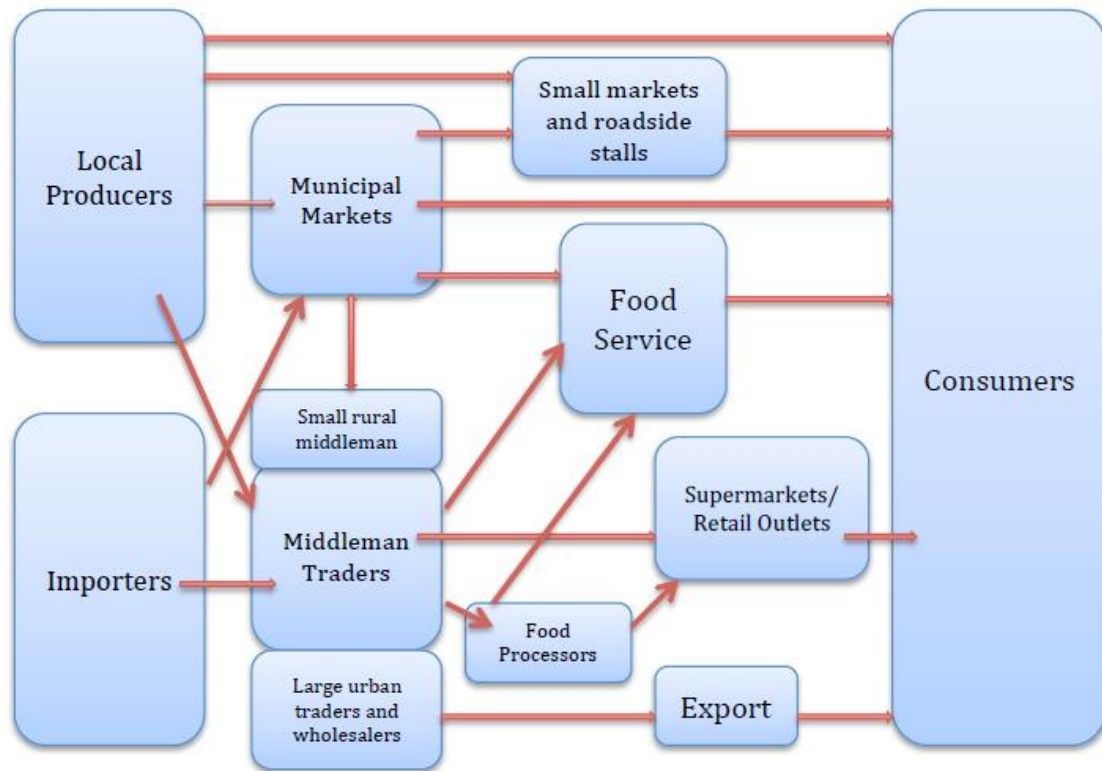


Figure 2.1. Map of Fiji horticultural value chain based on analysis completed as part of the FRTS.

Source: Author's Own Diagram

It has been well documented in the literature that smallholders cannot always meet the stringent requirements of modern retailers and food service businesses, this has widespread implications on local agriculture, food security and government policy (Boselie et al., 2003; Farina and Reardon, 2000; Hughes and Lawrence, 2005; Reardon et al., 2009). A number of insights were gained from the retail and consumer household component of the FRTS, which will have important implications for food security, health and nutrition and opportunities for local producers in Fiji as well as urban consumers.

2.2. Survey Data: Fiji Rural Horticultural Producer Survey

2.2.1. Sampling selection process

Fiji comprises 300 islands which are split into four Divisions with 15 Provinces (including Rotuma Island) that are divided into 86 Districts (see Figure 2.2 taken from the 2009 National Agricultural Census Report, Department of Agriculture Fiji). Fiji's total land area is 18,333 km², there are two major islands in Fiji – Vitu Levu (10,429 km²) and Vanua Levu (5,556 km²). The last agricultural census undertaken by the Fiji Ministry of Agriculture (2009), reported that there were 65,033 farms in Fiji. Vitu Levu was selected as the location for this research as it is the largest island in Fiji, and contains 70% of the Fijian population.

The Fiji Rural Horticultural Producer Survey sample selection process was led by our project partner the Fiji Ministry of Agriculture in close consultation with the PhD researcher and the supervisory team, as well as other members of the PARDI research team in March 2014. The sample of 600 rural households who grow horticultural crops on Vitu Levu was extracted from an existing list of 885 horticulture farmers collated by Ministry of Agriculture offices on Vitu Levu. This list had been collated from previous surveys undertaken by the Ministry of Agriculture, specifically, all households that grew horticulture crops. The random sample was derived by the Ministry of Agriculture using RANDBETWEEN in Microsoft Excel. The sample contained 240 farmers from the Central Division and 360 farmers from the Western Division on Vitu Levu.

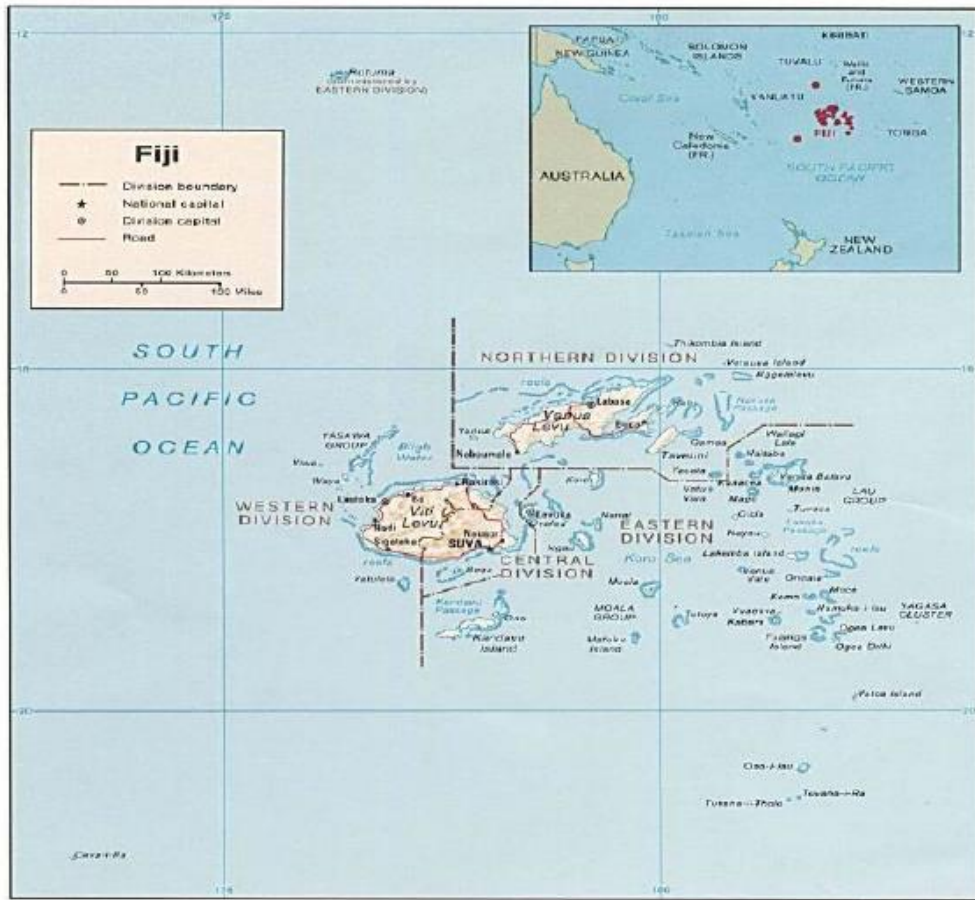


Figure 2.2. Map of Fiji Islands
 Source: Ministry of Agriculture Fiji, 2009, Page 3

2.2.2. The Fiji Rural Horticultural Producer Survey

Duncan and Sing (2009) attribute the failure of agricultural policies and schemes adopted by successive governments in Fiji as a result of their poor understanding of the economic, social and cultural characteristics of the people involved in farming – particularly those in the traditional village sector. Thus, as part of the FRTS, the Fiji Rural Horticultural Producer Survey (FRHPS) involved detailed household surveys of both male and female heads of households (if they both existed in a household). The survey instruments/questionnaires were designed to ascertain the patterns, determinants, and effects of both male and female farmer participation in evolving horticultural value chains in Fiji as well as a number of household socio-demographics and agricultural production

information. In the design of the survey instruments, we worked collaboratively with PARDI project partners to include questions relevant to our specific research objectives.

Both the male and female head of the household were interviewed separately using two different FRHPS instruments, a primary household survey instrument/questionnaire and a secondary instrument (both are provided in Appendix A and B). Interviews were conducted separately to ensure that both the male head of the household (if he existed) and the female head of the household (in most cases she was the spouse of the male head, if there was a male head), was able to answer questions honestly and without any interference from the male head of the household.

Therefore, the primary household agricultural production questionnaire was addressed to the person who was primarily responsible for agricultural production in the household. In the majority of cases, this was a man and we refer to him as the male head of the household.

This primary questionnaire contained questions about household characteristics and socio-demographics, household assets, and agricultural land. It also contained a series of in-depth questions about agricultural production, with a focus on the top five commercial crops grown by the household to gain an insight into what types of crops were most profitable, as well as the market channels selected by the household for sale of their produce. The primary questionnaire examined post-harvest handling by the household, as well as adoption of new crops, arrangements for purchasing of horticultural crops and relationship with crop buyers.

To explore the role of social capital, respondents were asked whether they were members of any farmer or village groups. The term social capital attempts to capture community and wider social claims on which individuals and households can draw by

virtue of their belonging to social groups of varying degrees of inclusiveness in society at large (Ellis, 2000). Respondents were also asked whether or not they had received any assistance from, or participated in any government or NGO programmes, and whether they had been affected natural disasters.

The respondent to the secondary FRHPS questionnaire was the female head of the household, in most cases she was the spouse of the male head of household (in the case that there was a male head of household). The female respondent was asked specific questions about her role in agricultural production, post-harvest handling and crop marketing. One of the main objectives of this secondary survey was to ascertain the level of women's empowerment in horticultural farming households in our sample.

Women's empowerment in agriculture is often used as a determinant of food and nutrition security, this rationale is rooted in a body of empirical evidence that demonstrates the ways in which women are essential to improvements in household agricultural productivity, food and nutrition security (Malapit, 2013). The secondary questionnaire contained a section on household decision-making, which examined the role of the female in making decisions regarding: which agricultural commodities to grow; how income generated by the household is spent; and child health and education.

The secondary questionnaire also asked questions about household purchases, consumption and expenditures on 79 different food categories including various retail formats (modern and traditional) where the products may have been purchased. The food consumption component also included foods grown by the household or exchanged with other households. If the female head of household was responsible for the household food shopping and preparation, then she was also asked about household shopping and consumption habits, otherwise the person primarily responsible for these tasks was interviewed.

For each household survey, enumerators took height and weight measurements for all members of the family present on the day of the survey, which enabled household BMI and health outcomes to be examined. A detailed explanation of these methods is provided in Chapter 4. There is a global trend towards an increase in obesity and a reduction in undernutrition, whereby obesity is superseding undernutrition in both urban and rural areas in developing countries (Monteiro et al, 2004; Ford et al., 2017). The increasing rate of obesity among the poor has important implications for the distribution of health inequalities (Popkin, 2012). Understanding the social disparities in health status is an important topic in the international health agenda and an essential element in establishing public health priorities (Monteiro et al, 2004). This is particularly pertinent in the Pacific setting and will be further explored in Chapter 4.

2.2.3. Development and data collection for the Fiji Rural Horticultural Producer Survey

In addition to sample selection, the two household survey instruments developed to collect the rural household data used in this PhD included several steps; and the author of this PhD thesis was involved in every step from design, enumerator training, pre-testing, data collection and analysis.

The first step was to design a survey instrument that could be used to elicit information required to address the thesis research questions, as well as provide research insights for the PARDI FRTS. The survey questions and early format were based on a similar work conducted in Indonesia (Minot, 2015; Tobia, 2015; Umberger, 2015 Wahida, 2015). However, this format was adapted for the Fijian context. The most recent Agricultural Census carried out by the Ministry of Agriculture in Fiji was reviewed to help design the survey and include terms that respondents would be most familiar with, as well as identify gaps in that research. The survey design process also involved

collaborating with our research partners to create a survey which covered horticultural production, post-harvest practices, crop marketing as well as household socio-demographic characteristics and food consumption habits.

Enumerator training was carried out by the PhD-student at the Ministry of Agriculture Office in Suva, Fiji. A group of enumerators from the Ministry of Agriculture were instructed on how to carry out the survey with a respondent, to ensure they understood the survey and how it was meant to be implemented. Enumerator manuals were created by the researcher to aid enumerators in the field whilst collecting data.

Pre-testing of the survey took place in March 2014 by the enumerators in the Central Division. The pre-testing of the survey provided enumerators with an opportunity to identify any problems or issues in relation to the practical application of the survey in the field. Once pre-testing was completed, the enumerators provided feedback to the researcher and subsequent amendments were made to the survey.

Collection of data by the trained enumerators for the producer survey was undertaken in April 2014. Respondents were either visited in person by the Ministry of Agriculture, or they were contacted by telephone to confirm they were able to participate. The surveys were undertaken on farm by the enumerators and took an average of 45 minutes to complete. Farmers were not paid an incentive to participate as per the Ministry of Agriculture normal policy.

2.2.4. Sample snapshot

The sample comprised of 26% Itauke (Indigenous Fijians) and 74% Indo-Fijians (Indian Fijians). Of the sample, 62% practise the Hindu religion. This is common religion amongst Indo-Fijians in Fiji. The average household size was 5 people. The mean age of the household head and spouse was 49 and 44 years of age respectively. The mean age of

children in the sample was 9 years of age. Table 2.1 contains the descriptive statistics for the rural households in the sample.

Table 2.1. Descriptive Statistics for the Fiji Rural Horticultural Producer Survey

Rural Agricultural Farm Households						
Variable	Definition	Mean	Std. Dev.	Min	Max	N
Household size	Household Size	4.77	1.98	1	16	507
Head age	Age of head of the household	49.28	12.06	24	95	500
Female age	Age of female of the household	43.97	12.00	18	82	450
Children under 5	Number of Children Under 5 years of age in household	0.17	0.43	0	2	507
Children aged 5 to 12	Number of Children aged between 5 and 12 years of age in the household	0.26	0.55	0	4	507
Children aged 12 to 18	Number of Children aged between 12 and 18 years of age in the household	0.21	0.49	0	2	507
Average children Age	Average age of children in the household with at least one child	8.73	4.39	0	17	351
Ethnicity	Ethnicity Dummy (1= Itauke, 0 = Other)	0.26	0.44	0	1	508
Religion	Religion Dummy (1 = if Hindu, 0= otherwise)	0.64	0.48	0	1	496
Central Division	Central Division Location Dummy (0 = no, 1 = yes)	0.35	0.48	0	1	500
Land size	Total Land Size (hectares)	3.89	4.56	0.16	42.49	448
Total household expenditure	Total household expenditure (FJD \$1000 per week) proxy for income	1.92	2.76	0.12	2.95	508

The mean land size of the sample was just under four hectares. While undertaking the pre-test of the survey, it was discovered that households were reluctant, and in some cases unable, to provide information on household income. This issue is a common concern when respondents are asked directly about their household income. To address this issue and minimize common measurement problems related to asking respondent about household income directly, in this study, total household expenditures were used as a proxy for household income as in previous research (e.g. Grosh and Glewwe 2000; McKay 2000). The mean total household expenditure for the sample was \$1920 FJD per week, and the median was \$1160 FJD per week. The author notes that the mean for total household expenditure could be relatively high as it has been skewed by some higher values in the sample (i.e. larger commercial farm households). The median total expenditure was FJD \$1160 per week, which is approximately AUD \$550. Figure 2.3 below shows the education levels attained by both female and male heads of the household.

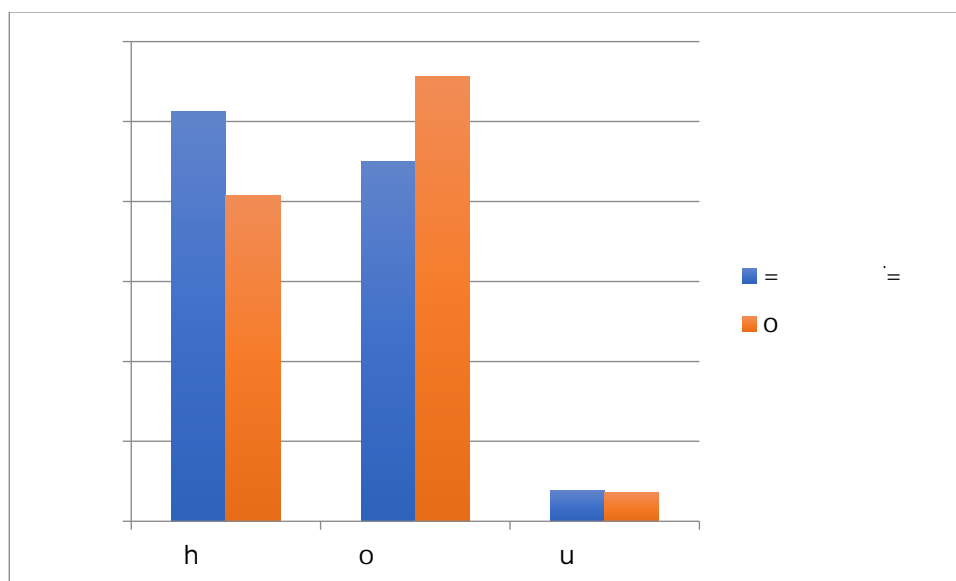


Figure 2.3. Education level for Household Head and Spouse

2.3. Descriptive Statistics: Fiji Rural Horticultural Producer Survey Households

2.3.1. Household assets

The survey contained questions relating to household assets, including mobile phones, credit cards, cars and trucks. Figure 2.4 below contains the total share of households who own various household assets.

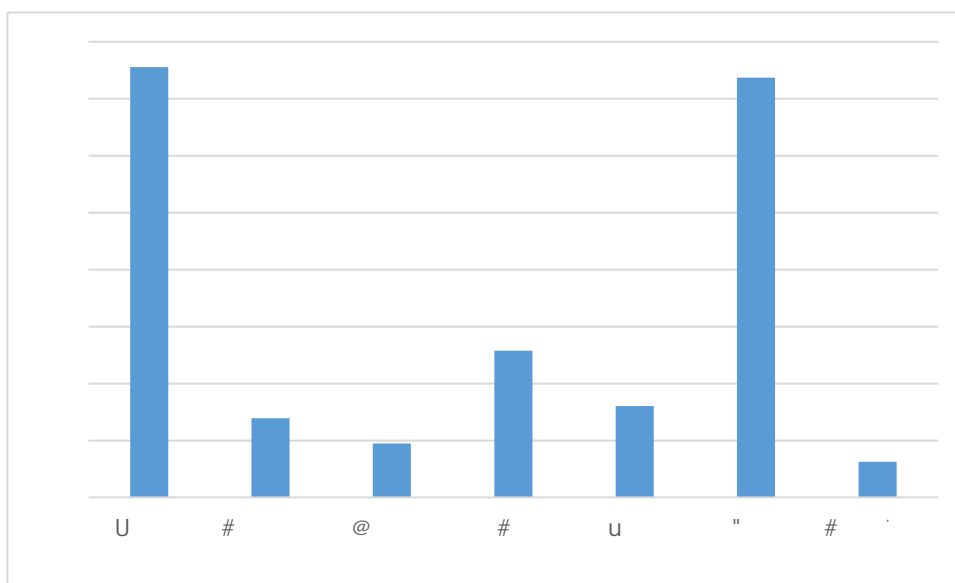


Figure 2.4. Ownership of household assets

A large portion of the sample owned a mobile phone and had a bank account. Just under 14% owned a computer and under 10% had access to the Internet. Only about 26% of households owned a car and 16% a truck.

2.3.2. Land tenure

Surprisingly, 28% of our sample owned their land freehold. The Department of Town and Country Planning Fiji (2017) report that 10% of total land in Fiji is freehold and registered under the Torrens system of land registration. In Fiji, 83% of land is Native

Land (Department of Town and Country Planning Fiji, 2017). All Native Land belongs to village groups or “land-owning units”. Typically, a portion of each land area is set aside for the site of the village, and the rest is Native reserve. Over 25% of our sample held a Native Land Trust Board Lease. Leases of Native Land are available through the Native Lease Trust Board, a statutory authority, which administers all such lands on behalf of Fijian owners. Of the sample, 22% had Mataqali land. Mataqali represents direct arrangements with the customary land-owning groups, where land is owned collectively within the clan, tribe or family due to kinship ties. Crown land represents about 7% of land tenure in Fiji, and just over 15% of the sample. Figure 5 below shows the land tenure arrangements by percentage for the sample.

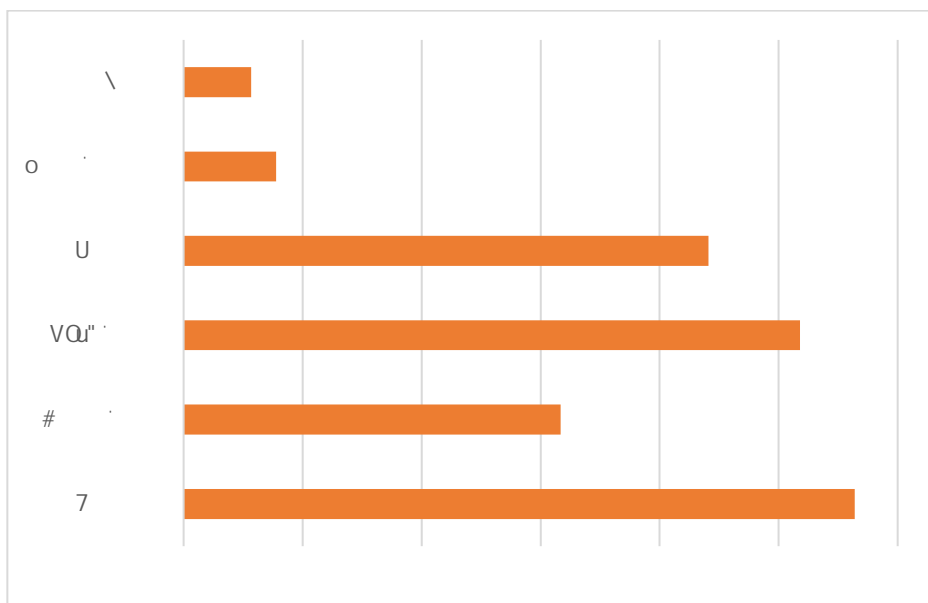


Figure 2.5. Land tenure arrangements

2.3.3. *Agricultural crops grown*

The most commonly grown crops (%) by households in the rural sample are contained in Figure 2.6 below. Eggplant was the most popular crop (10%), this is consistent with the national average according to the Ministry of Agriculture Fiji (2015).

Eggplant was closely followed in popularity by tomatoes (9%), okra (8%), long beans (7%) and Chinese cabbage (7%).

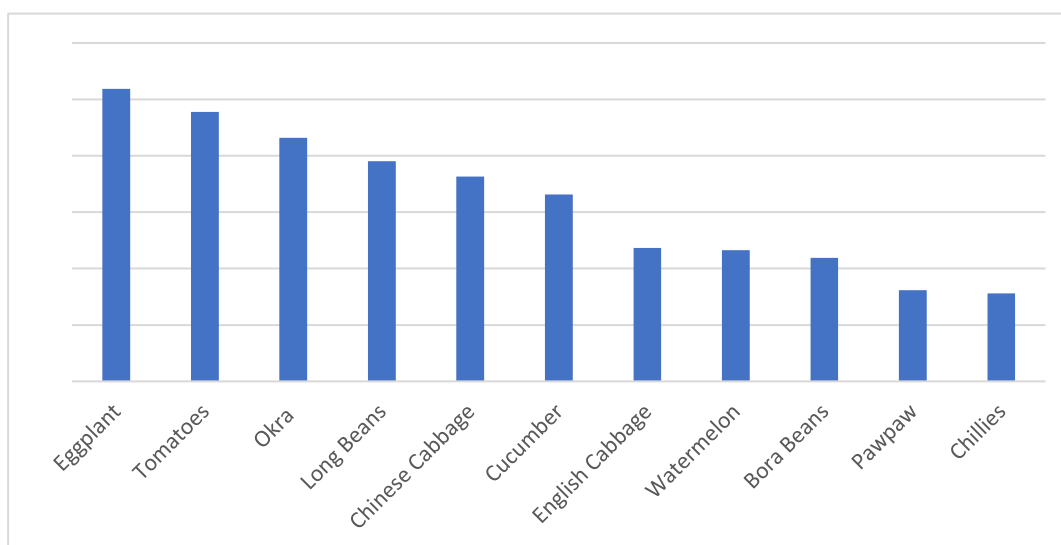


Figure 2.6. Most commonly grown crops

2.3.4. Market channels

Only a small percentage of the sample sold their produce through supermarkets (2%), food processors (3%), or hotels/resorts/restaurants (3%). Of the sample, 24%, sold their produce directly to exporters. Traditional market channels were the most popular amongst the sample, with 91% selling their produce at municipal markets and 14% at roadside stalls. While supermarkets are gaining market share amongst Fijian consumers, the municipal markets remain an important income source for rural agricultural households. The growing popularity of modern market channels in Fiji, presents an opportunity for Fijian producers, and could be a focus of the Fijian Government in relation to possible programs and interventions to improve the livelihoods of rural farm households. Figure 2.7 below shows the total share of market channels utilised by rural farm households to sell home-grown produce.

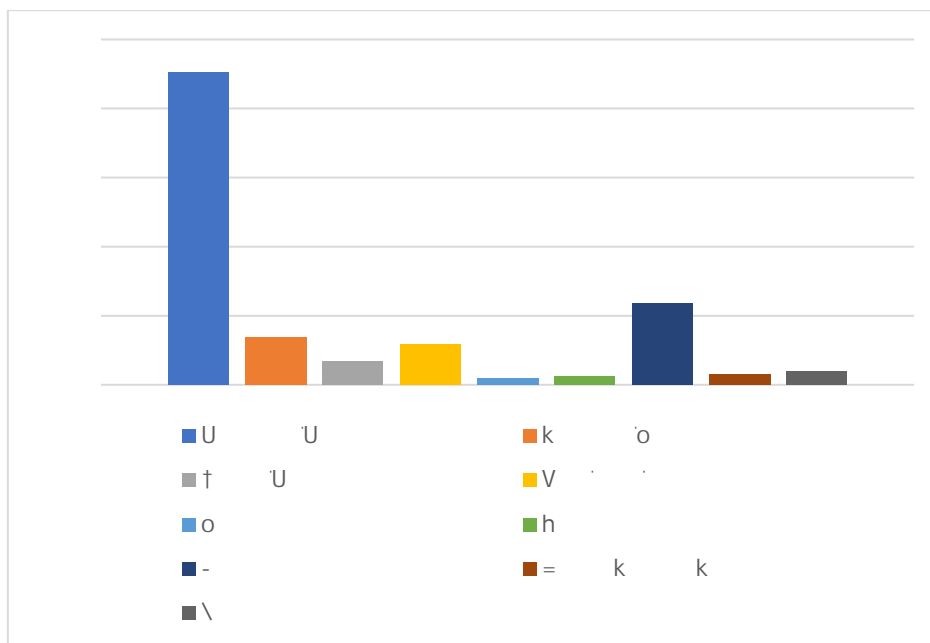


Figure 2.7. Market channels utilised by rural farm households

2.3.5. *Women’s empowerment in agriculture in Fiji*

As noted above, a body of empirical evidence exists, which demonstrates the ways in which women are essential to improvements in household agricultural productivity, food and nutrition security (Malapit et al., 2013). Rural women produce one-half of the world’s food, and in developing countries, between 60% and 80% of food crops. Women are more likely than men to spend their income on the well-being of their families, including more nutritious foods, school fees for children and health care (Mehra, 2008). A key failing of past efforts to reduce hunger and increase rural incomes has been the lack of attention paid to women as farmers, producers and farm workers.

Although empowerment is intrinsically experienced by individuals, existing indices of empowerment and gender are typically measured at the aggregate country level (Alkire et al., 2013). Current measures include the Organisation for Economic Cooperation and Development’s (OECD), Social Institutions and Gender Index (SIGI), which is a measure of gender equality based upon five legal and social institutions and is

used to rank countries. The Gender Gap Index (GGI) (Hausmann et al., 2012) and the Gender Inequality Index (GII) that were/are reported by the United Nations Development Programme (UNDP), cover gender inequalities in a broad set of domains. However, while these measures are useful for characterising progress toward gender equality, they do not provide direct measure of individual empowerment outcomes (Alkire et al., 2013). Furthermore, there are no existing indices that capture control over resources or agency within the agricultural sector, in which women account for 43% of the agricultural labour force in developing countries (FAO, 2011).

The Women's Empowerment in Agriculture Index (WEAI) (Alkire et al., 2013) is a survey-based index designed to measure the empowerment, agency, and inclusion of women in the agricultural sector. The WEAI was initially developed as a tool to monitor women's empowerment as part of the United States Government's Feed the Future Initiative. The WEAI builds up a multidimensional empowerment profile for each man and woman that reflects their overlapping achievements in different domains, and aggregates these. The WEAI can be adapted to measure empowerment of women in rural areas more generally, whether they are farmers, agricultural or non-agricultural wage workers, or engaged in non-farm businesses. The WEAI, or adaptations of it, can be used more generally to assess the state of empowerment and gender parity in agriculture. Alkire et al. (2013) note that although women's empowerment is multidimensional and draws from and affects many aspects of life, the focus of the WEAI is on those aspects of empowerment that relate directly to agriculture, an area they argue has been relatively neglected in studies of empowerment.

As this current study sought to explore the role that women in rural agricultural households are playing, particularly in household decision-making and agriculture we adapted the WEAI to examine how women's empowerment impacts household diet

quality and health outcomes in rural households in Fiji. This is critical in a nutrition context, as agriculture has direct links to nutrition, in that it provides a source of food and nutrients and a broad-based source of income for most rural households. As mentioned earlier, the secondary survey instrument was designed for the female head of the household, therefore it incorporated questions relevant to each of the five dimensions of empowerment included in the WEAI (decisions about agricultural production; access to and decision-making power over productive resources; control over use of income; leadership in the community; and time use). This is further detailed below.

Agricultural production

In the secondary survey, the female head of the household was asked a series of questions in relation to her role in agricultural decision-making. Specifically, she was asked whether she contributes to, or has any say, in decisions about what commodities to grow. She was considered to have input into agricultural decision-making, if she makes decisions about agricultural production exclusively, or with her spouse. She was also asked if she contributes to decisions regarding who agricultural produce is sold to, and whether or not she negotiates the price of produce with the buyer.

Of our sample, 74% of women were involved in decisions regarding what commodities to grow, and 72% were involved in decisions regarding whom to sell produce to. With respect to negotiating with buyers, 21% of women were involved in negotiating prices with buyers of the household's produce.

Resources

The female head of the household was asked if she owned or had access to the following assets: a mobile phone, a computer, the internet, a car, a truck, a bank account and a credit

card. The ownership of household assets by females compared to males is displayed in Figure 2.8 below.

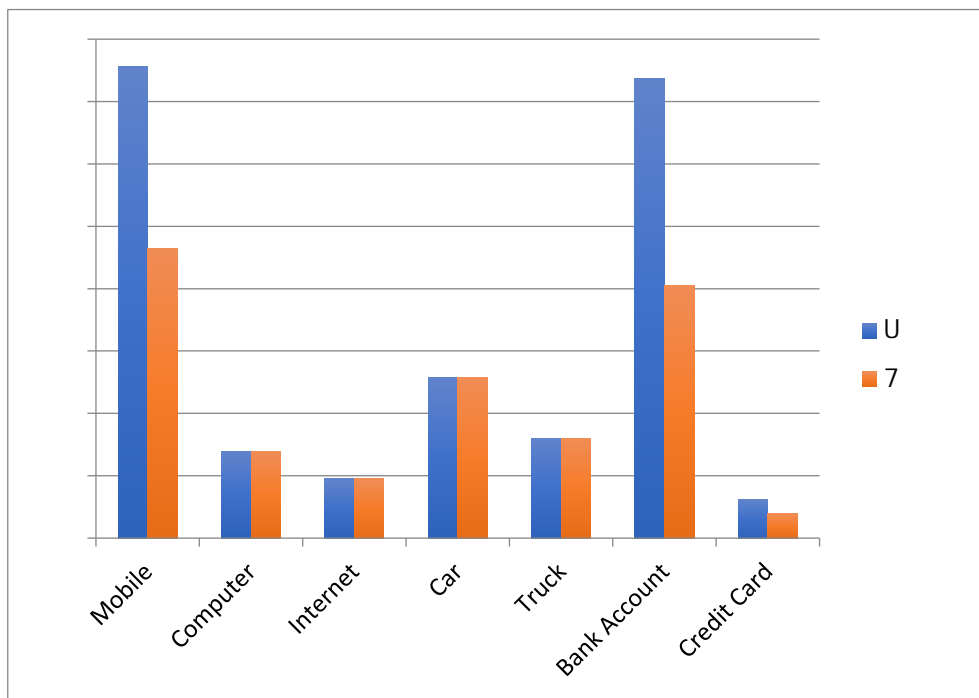


Figure 2.8. Ownership of household assets by females compared to males

Income

The female head of the household was asked if she contributes to or has decision-making power in how household income is spent. Females were considered to have input in decision-making about how to spend household income regardless of whether she makes decisions exclusively or shares the decision-making with her spouse. Of the sample, 83% of the females interviewed indicated that they were involved in decisions regarding how household income is spent.

Leadership

A measure of leadership in the WEAI is membership in social and economic groups. The respondent to the primary survey (in most cases this was a male and thus was the

male head of the household), was asked if any female members of the household belonged to a women's farmer group. It was reported that 15% of women in the sample, belonged to a women's farmer's group.

Time

The WEAI defines 'time' as the allocation of time to productive and domestic tasks. The Fiji Rural Horticultural Survey sought to capture women's activities both productive and domestic, across both survey instruments. The primary survey respondent was asked to indicate the main occupation of each member of the household, including the spouse and the hours per week they spend in that task (i.e. farming, employed outside the household, unpaid family worker).

The female head of the household was questioned about her involvement in agricultural activities and was asked to indicate the main crops she was responsible for and the types of activities she carried out on these crops from production to marketing.

Of our sample, 82% of women were involved in agricultural activities. A vast majority of women undertook both the planting (79%) and harvesting of crops (86%) on the household farm. Women were also actively involved in post-harvest activities such as cleaning (39%), sorting (36%) and grading (29%). Of our sample, almost 30% of women were involved in selling produce directly to consumers.

Additional information in relation to household decision-making

In addition to questions about their input into decisions about agricultural production and how income is spent, the female head of household was asked whether she contributes to decisions regarding child health and education. Of the sample, 77% were involved in such decisions. She was also asked if she is usually the person

responsible for the household food shopping. Of the sample, 73% of women were responsible for the household food shopping.

2.4. The Fiji Urban Consumer Survey

2.4.1. Sampling selection for the Fiji Urban Consumer Survey

The analysis for the empirical study presented in Chapter 5 uses data from the Fiji Urban Consumer Survey, which was a face-to-face survey of urban households conducted in Fiji in June and July of 2012 (Appendix C). The individuals responsible for food purchase and meal decisions from 1000 urban households on Fiji's most populated and largest island, Vitu Levu, were surveyed. The sample included 759 households from the capital city Suva, and 241 households from Nadi, a tourist hub on the western side of Vitu Levu where the international airport is located. The data collection was done in collaboration with the Fiji Bureau of Statistics (FBOS). Pre-existing enumeration area codes (EAs) developed for the national census was used to distinguish between seven different incomes classes (High, Middle, Low, Housing, Squatter, Urban Village and Misc/Mixed). The survey was consequently stratified by selecting a representative sample of 50 EAs codes followed by a random sample of 20 households from each EAs code to make up a total of 1,000 surveys.

2.4.2. The Fiji Urban Consumer Survey instrument

The survey instrument was adapted from that used by Umberger et al. (2015) and covered expenditure and consumption behaviour for a total of 79 different food categories and eight different modern and traditional retail formats including supermarkets, traditional main market, roadside stalls/hawker, corner shops/butcher/bakery, fish markets, restaurants, fast food and service stations. Data was collected in relation to household characteristics, food expenditures and decision-making, shopping behaviour and perceptions of, and preferences for, food retail outlets.

2.4.3. Data collection for the Fiji Urban Consumer Survey

The survey was conducted via face-to-face interviews at the households by a team of 27 trained enumerators. A detailed enumerator manual was developed to assist with training and to provide a reference manual during fieldwork. Face-to-face household interviews were conducted to avoid self-selection issues, ensure a more random representation across different income levels, and allow more time with the person responsible for food purchasing. Each survey took on average two hours to complete.

After each survey was conducted, it was checked by FBOS supervisors in the field to ensure any obvious errors or omissions could be rectified, while they still had access to the respondent. Once the surveys were fully completed the data was entered using a CSPro template to limit the number of entry errors before it was cleaned and analysed.

Table 2.2. Descriptive Statistics for Fiji Urban Consumer Survey Households

Variable	Definition	Mean	Std. Dev.	Min	Max	N
Household size	Household Size	4.83	2.43	1	14	997
Head age	Age of head of the household	43.35	12.60	18	86	966
Head education	Highest level of education of head of the household: 8 = primary, 13 = secondary, 16 = tertiary	9.79	3.99	3	19	912
Spouse age	Age of female of the household	43.34	12.60	18	86	723
Spouse education	Highest level of education of female of the household: 8 = primary, 13 = secondary, 16 = tertiary	10.86	4.12	0	20	918
Children under 5	Number of Children Under 5 years of age in household	1.55	0.82	0	5	997
Children aged 5 to 12	Number of Children aged between 5 and 12 years of age in the household	0.55	0.86	0	6	997
Children aged 12 to 18	Number of Children aged between 12 and 18 years of age in the household	0.55	0.86	0	5	997
Ethnicity	Ethnicity Dummy (1= Itauke, 0 = Indo Fijian)	0.26	0.43	0	1	996
Religion	Religion Dummy (1 = if Hindu, 0= otherwise)	0.54	0.49	0	1	996
Location	Location Dummy (0 = Nadi, 1 = Suva)	0.76	0.43	0	1	997
Household income	1 to 8 categories (FJD\$/month) (1= less than 100; 2= 101 - 500; 3 = 501-1000; 4=1001-1500; 5=1501-2000; 6=2001-3000; 7=3001-4000; 8 >4001 FJD\$/month)	3.48	1.44	1	8	987

2.4.4. Fiji Urban Consumer Survey sample overview

Of the urban sample, 54% were i-Taukei and 36% were Indo-Fijian. The two main religions practiced by the sample were Hinduism at 25% and Christianity at 66%. The average household earned between \$1000-\$1500 FJD (\$656-\$983 AUD) per month. The mean household size in the urban sample was 5 people. The mean age of the household head and spouse was 43 years of age. The mean education level for both the household head and spouse was secondary level, with women attaining a slightly higher level of secondary schooling than men. Of this sample, 38% had children aged under five years of age in the household. The urban sample comprised 76% of respondents from Suva and 23% from Nadi. In the urban sample 31% of women worked in a salaried position outside of the home.

2.4.5. Household assets

Of the urban respondents, 80% owned a refrigerator, 96% a mobile, 40% owned a computer/laptop and 89% had a bank account. Figure 9 shows the share of households who own various household assets.

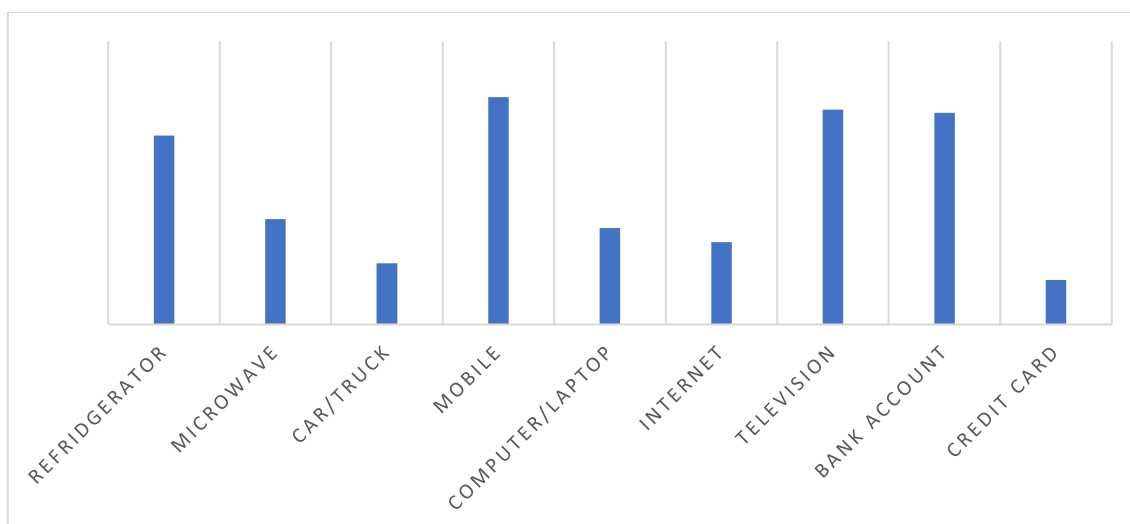


Figure 2.9. Percentage of household assets owned by each household

Chapter 3: Understanding the Determinants of Diet Quality among Rural Agricultural Households in Fiji

3.1. Introduction

Nutrition is closely linked to agriculture, not only because it is the sector responsible for food production, but also because many of the undernourished and food insecure people worldwide are smallholder farmers in developing countries (Pinstrup-Anderson, 2007; Chege et al., 2015, Frelat et al., 2016). These households largely depend on agriculture for their livelihoods, as such, there has been increasing interest among researchers and policymakers as to how to make smallholder agriculture more nutrition-sensitive (Remans et al., 2011; Keding et al., 2012; Pinstrup-Anderson, 2013).

As households are likely to consume a large share of the food products that they produce, greater diversity in agricultural production may increase the availability of different types of food for household consumption (Hawkes and Ruel, 2008; Malapit et al., 2013), therefore production diversity is seen as a promising strategy in improving the diet quality and health outcomes in smallholder farm households (Power et al., 2015; Franzo et al., 2013; Burlingame and Dernini, 2012).

Several recent studies have examined the relationship between farm production and dietary diversity, these studies have found that rural households with home production of fruits, vegetables and livestock products may have improved diet quality (Jones et al., 2014; Kumar et al., 2015; Malapit et al., 2015, Sibhatu et al., 2015; Koppmair et al., 2017; Koppmair and Qaim, 2017; Jones et al., 2017; Hirvonen and Hoddinott, 2017; Murrendo et al., 2018). However, a number of studies also suggest that access to markets may be more important for nutrition than increasing farm production diversity (Sibhatu et al., 2015; Ogutu et al., 2018; Maestre et al., 2017; Sibhatu and Qaim, 2018; Qaim and Sibhatu, 2018). In addition, women's empowerment in household decision-making can

also play an important role in shaping nutrition outcomes in smallholder farm householders (Jones et al., 2014; Malapit et al., 2015).

Despite the important link between agriculture and nutrition, there is little known about the relationship between production diversity and dietary diversity amongst PICTs. Agriculture remains the backbone of PICT economies: it is the main source of livelihood for the region as well as a major export earner (Malua and UNCTAD, 2003; FAO, 2018). However, there is little evidence available to understand how food systems, including agricultural production diversity, may impact upon diet diversity and health outcomes amongst PICTs. In addition to the issue of undernutrition, there are also emerging trends in overweight and obesity, even in rural areas of low-income countries where overnutrition was not previously a concern (Popkin et al., 2012 and 2017). This trend is widely observed amongst PICTs, who currently have the highest prevalence rates of adult obesity in the world (Abarca-Gómez et al., 2017), with NCDs reported as the leading cause of death in the region (Hou et al., 2016; WHO, 2018). Understanding the link between agriculture and diet quality could have widespread policy implications for PICTs in this regard.

In Fiji, agriculture generates income for approximately 65% of the total population (Hone et al., 2008; Ministry of Agriculture Fiji, 2009) and as one of the more developed economies of the PICTs, it provides a unique context to better understand the role of production diversity for farm household nutrition. While rural households in Fiji tend to be poorer than their urban counterparts (Fiji Bureau of Statistics, 2015), which reduces their capacity to purchase higher quality foods, they have greater opportunity to supplement their diet through the home production of nutrient dense foods. This study hypothesises that there is a positive correlation between rural household dietary diversity and household production diversity and the analysis in this chapter seeks to test this

hypothesis using a subset of data from the Fiji Rural Horticultural Producer Survey, which gathered data from 600 smallholder farming households that specialise in horticultural crops. This study explores the relationship between agricultural production diversity; access to food markets; and socio-economic factors such as gender empowerment, on diet quality in rural households in Fiji. This research has widespread policy implications for health and development outcomes in Fiji and across PICTs.

3.2. Literature Review

3.2.1 Production diversity and diet diversity

Agriculture may influence the quality of diets of smallholder farming households primarily through production of subsistence food crops or animals that households consume directly; or through the sale of agricultural goods that affect household incomes and therefore food purchases and consumption. Household production for home consumption is considered to be the most fundamental and direct pathway by which increased production translates into greater food availability and food security (Hawkes, 2008). Increased production of fruit, vegetables, and animal source foods (dairy, eggs, fish and meat) can greatly improve the quality and micronutrient content of diets (Hawkes, 2008). A number of studies have empirically analysed the link between farm production diversity and dietary diversity in a number of developing countries, while the results differ, a significant but relatively positive relationship was generally found (Herforth, 2010; Jones et al., 2014; Kumar et al., 2015; Malapit et al., 2015, Sibhatu et al., 2015; Koppmair et al., 2017; Koppmair and Qaim, 2017; Jones et al., 2017; Hirvonen and Hoddinott, 2017; Murrendo et al., 2018).

While there is certainly an intuitive connection between the diversity of agricultural production and diet diversity, according to Jones (2017) there has been no comprehensive synthesis of the empirical evidence for these associations. Indeed, the

relationship between agricultural production diversity and household diet diversity is not always straightforward and can be mitigated by other factors. For example, in a study by Hirvonen and Hoddinott (2017), it was found that increasing household production diversity leads to considerable improvements in children's diet diversity. However, this relationship was found to be particularly strong for households with limited access to food markets, but it did not hold for households without good access to markets for buying and selling food products. A number of recent studies have also pointed to the importance of market access for smallholder farm households, these studies are further explored below.

3.2.2 Market access and commercialisation

While home production of foods can directly impact diet diversity and quality, farm households can also buy different types of foods, including those they do not produce, when they generate sufficient income from production. A number of studies have found that market access and commercialisation may have a greater positive effect on household diet quality than increased production diversity. Sibhatu et al., (2015), from their examination data from Indonesia, Kenya, Ethiopia and Malawi, found that access to agricultural markets can have a greater positive effect on household diet quality than increased production diversity. Koppmair et al., (2017) found that while farm production diversity is positively associated with dietary diversity, the estimated effects were small, and access to markets for buying food and selling farm produce were more important for dietary diversity than diverse farm production. Studies by Ogutu et al., (2017); Maestre et al., (2017); Sibhatu and Qaim, (2018); and Qaim and Sibhatu, (2018) all suggest that from a nutrition perspective improving market access for smallholder farmers may be more important than farm diversification.

These studies show promising findings, however, the positive effects of market access and commercialisation of household production on diet quality can also be

mitigated by a number of factors. For example, commercialisation of agriculture may influence nutrition through various channels, including changes in income, the availability of own-produced foods, and gender roles within the household (von Bruan and Kennedy 1994; Carletto et al., 2015). Gains in household income from commercialisation may increase economic access to food, however, a substitution of purchased food for own-produced food may also impact diet quality by increasing the consumption of calories but not necessarily micronutrients (Ecker et al., 2012; Popkin et al., 2012 and Remans et al., 2015). Changes in gender roles may occur because men often take stronger control of farm production and income during the process of commercialisation (von Braun and Kennedy, 1994; Fischer and Qaim, 2012; Malapit et al., 2015; Chege et al., 2015). This can be problematic for household diet quality, as male-controlled income is often spent less on dietary quality and nutrition than female-controlled income (Fischer and Qaim, 2012; Malapit et al., 2013; 2015).

3.2.3 Women's empowerment

In addition to production diversity and market access, women's empowerment in farm household decision-making plays an important role in shaping nutrition outcomes. As noted above, commercialisation can lead to a change in gender roles with respect to farm production and control of income, which can have subsequent impacts on household diet quality. A number of studies have suggested that a women's control of resources is linked to larger allocations of resources to food for the household (Hoddinott and Haddad, 1995; Duflo and Udry, 2004; Doss, 2006; Sraboni et al., 2014).

Jones et al., (2014) found that diet diversity was significantly greater in households where women played a role in deciding how agricultural earnings were spent. Malapit et al., (2015) found that control over income by women is positively associated with child health outcomes and that women's empowerment mitigates the negative effect

of low production diversity on maternal and child dietary diversity in Nepal. More recently, Islam et al., (2017) found women's empowerment had positive and significant effects on household diet diversity in Bangladesh. These findings have important policy implications, for example, bundling women's empowerment interventions with agricultural interventions may make the later more effective in improving nutrition in households with low production diversity (Malapit et al., 2015).

Understanding the relationship between agriculture and diet quality is critically important in LMICs, given the concurrent challenges of persistent undernutrition and the rise in the prevalence of obesity and diet-related NCDs facing these countries (Popkin et al., 2012; Jones, 2017). Addressing the current research gap in relation to how specific components of food systems, including agricultural production diversity, may be contributing to diet diversity and health outcomes, will assist policy makers in designing policies towards diet and health-sensitive agriculture. This study aims to address the current gap in the literature with respect to PICTs.

3.3 Data and Case Study Description

The analysis in this article uses data from the Fiji Rural Horticultural Producer Survey, which includes a sample of 600 rural households who grow horticultural crops on the main island of Fiji, Vitu Levu. Rural households were randomly identified and extracted from an existing list of 885 horticulture farmers collated by Ministry of Agriculture offices on Vitu Levu. After pre-testing in March 2014, Fiji Rural Horticultural Producer Survey was undertaken in April 2014 by trained and experienced enumerators from the Fiji Ministry of Agriculture. As explained in Chapter 2, two survey instruments were used in this study. A primary survey instrument conducted via a face-to-face interview with the head of household, who was usually the male head of household; and a secondary survey instrument completed via an interview with the female

head of the household to understand the role that women play in the household as well as to ascertain information on women empowerment.

The survey instruments were designed to ascertain the patterns, determinants, and effects on household livelihoods of farmer participation in evolving horticultural value chains. The male and female head of the household were interviewed separately using two different survey instruments for households where both were present. The survey for the household head contained questions about household characteristics, assets, production, post-harvest and marketing characteristics and behaviour. The survey designed for the spouse (typically the female), contained specific questions about what agricultural and marketing tasks the spouse undertakes, as well as their role in household decision-making. This survey also contained questions about household shopping and consumption habits. The survey provided to the spouse covered 79 different food categories across a mix of 10 types of retail formats, modern and traditional. The food consumption component also included foods grown by the household or exchanged with other households.

Despite an original sample of 600 households interviewed by enumerators, there were only 589 households that were able to complete both the primary and secondary survey instruments. Further, some surveys were not fully completed. Therefore, there were 516 observations from the household head survey, and 509 from the survey designed for the spouse that were able to be utilised. The data from the primary and secondary surveys were merged to create a full data set on rural agricultural households in Fiji.

3.4 Methodology

Kokoski (1986) estimated that food consumption choices could be driven by, among other things, family composition and size; homemaker's occupation, age, employment, and education; ethnic background; technological changes; merchandising;

and psychological factors. Additionally, the studies discussed earlier have suggested that other variables such as farm production diversity (e.g. Herforth, 2010; Jones et al., 2014; Kumar et al., 2015; Sibhatu et al., 2015; Koppmair et al., 2017), access to modern markets (e.g. Ogutu et al., 2017; Maestre et al., 2017; Sibhatu and Qaim, 2018; and Qaim and Sibhatu, 2018), and gender roles in the household (e.g. Chege et al., 2015; Malapit et al., 2015; Islam et al., 2017) may also contribute to diet quality for rural households.

Therefore, this study's aim was to estimate the effect of diverse set of variables including farm production diversity; modern market access; and the gender in household decision-making, on household dietary quality by estimating the following regression model in Equation 3.1:

$$D_i = \beta_0 + \beta_{i1} \text{ProductionDiversity}_i + \beta_{i2} \text{ModernMarket Access}_i + \beta_3 \text{Female Empowerment}_i + \beta_4 X_i + \varepsilon_i. \quad (3.1)$$

D_i is a measure of dietary quality, explained further in the section below. X_i is a vector of other covariates that may influence dietary quality, all referring to farm household i . Variables included in vector X_i include a range of variables that were identified from the previous literature and were available in the survey, including farm characteristics such as land size, household size, children under the age of five, age of the household head, and education of the household head (Turrell and Kavanagh, 2006 and Backholer et al., 2015). β_0 , β_1 , β_2 , β_3 and β_4 are coefficients to be estimated, and ε_i is a random error term. Since small variations in price change information are usually not available in cross-sectional data, it was assumed that all households face the same relative prices for the same food items.

3.4.1 *Dependent variables*

Different specifications of this model were estimated, using various indicators of dietary quality, including a household dietary diversity score and a series of food group expenditure share variables representing share of healthy versus unhealthy food consumption for a specific household i . To achieve this, the methods of Volpe et al., (2013) were followed. First, each rural household's dietary diversity score (HDDS) was calculated. The HDDS is defined as the number of different foods or food groups consumed over a given reference period (Swindale and Bilinsky 2006; Gina et al., 2010). It is an index of the household's consumption of a set of nutritionally-diverse food items. In the survey (Appendix A), respondents were asked about their household's consumption and expenditures relative to 79 food items over a 12 month period. Following Swindale and Bilinsky (2006) and FAO guidelines (2011), these 79 items were classified into 12 groups: (i) cereals; (ii) tubers and roots; (iii) legumes, nuts and seeds; (iv) vegetables; (v) fruits; (vi) meat, poultry and offal; (vii) eggs; (viii) fish and seafood; (ix) milk and milk products; (x) oils and fats; (xi) sugar, salt and honey; and (xii) processed foods and beverages.

Research has shown that the last three food groups ((x)-(xii)) contribute little to the micronutrient density of the diet (Monteiro, 2009; Monteiro et al., 2013; Moubarac et al., 2017; Cornwell et al., 2018). There are also studies that have calculated dietary diversity scores only based on the previous nine food groups (e.g. (i)-(ix)) (Arimond et al., 2010; FAO, 2011). In the empirical analysis of HDDS using equation 3.1, sensitivity analysis was conducted using 12 food groups as well as only including the nine healthy food groups. Given that HDDS is a count variable that is not normally distributed, a common approach is to use Poisson regression, which is a generalized linear model form of regression analysis (e.g. Greene, 2012).

Second, using the household food expenditure information, another series of regressions were conducted on individual food groups to understand the relative consumption on both healthy and unhealthy food groups by the household. In order to standardise the measures of the different food groups to compare across households, we use share of food expenditures on each of the twelve food groups as a proxy for the relative consumption of nine ‘healthy’ and three ‘unhealthy’ food groups. In order to calculate expenditures for households that consumed at least some food produced at home or obtained via exchanges, the current local Fijian supermarket prices for these items were used to obtain a total expenditure value (FJD\$/day) for home grown foods and food exchanged. Food expenditure shares for each food group were calculated using Equation 3.2:

$$\frac{d_{if}}{\sum d_{i1}^{12}} \times 100 \quad (3.2)$$

where d_{if} is household i 's share of total food expenditures on food group f . Total food expenditures are the sum of expenditures on each of the 12 food groups ($f = 1 \dots 12$).

Simultaneous multivariate Tobit regressions were used to model the share of expenditures for each of the 12 different healthy and unhealthy food groups (e.g. Table 3.4). This model allowed us to estimate M-equation Tobit models simultaneously (Cappellari and Jenkins, 2006). The Tobit model (Tobin, 1958) is a standard method to cope with the problem of two censored points, at zero and one respectively, which has been widely used in the literature to study expenditure share (e.g. Atkinson et al., 1990; Tansel et al., 2006; Pawlowski et al., 2012). For a more convenient interpretation of the empirical results, instead of the coefficients, marginal effects for all variables are reported (which describe how household expenditure shares on the food group change when the explanatory variables increases by one unit).

3.4.2 Explanatory Variables

Two measures of farm production diversity are used. The first measure, ‘Crop, animal and fish count’, is the number of crop, livestock and fish species produced/reared on a farm within the last 12 months. This is a simple, unweighted count measure and has been used by several studies to measure production diversity (e.g. Herforth, 2010; Jones et al., 2014; Sibhatu et al., 2015; Koppmair et al., 2017). Secondly, we include an estimate of the consumption of own produce to examine the impact of the household’s production of agriculture on diet quality. ‘Own production consumed’ is a variable that measures the amount of food consumed from a household’s own agricultural production per day in kilograms. As discussed previously, it is hypothesised that there is a positive association between home production and household dietary quality, including expenditure shares on relevant food items that are produced at home and can be both consumed at home or sold for cash income.

To investigate the impact of modern food markets on diet quality, two variables are included. First, the dummy variable ‘Sale to modern market’, where a value of one was allocated to a household if it sold its produce to a modern food market (i.e. supermarket) and a value of zero otherwise. It was found at the time of analysis that there were only complete answers from 443 out of the 516 respondents in relation to this variable. As it was not possible to either predict the likely answer or re-ask this question to the respondents, these observations were not imputed. It is noted that the acceptable threshold of missing data to avoid bias in the result in 10-15%, in this case it was 14%. Furthermore, as this is a categorical variable it was not appropriate to impute it. Therefore, the final analysis, looked at the 443 observations where there was complete information on all the variables of interest.

The second market access variable included is 'Time to modern market' which is a measure of distance and time from the household to the nearest modern food retailer. Access to modern food markets can influence household nutrition in both positive and negative ways. Previous studies have shown that access to certain types of modern food environments (e.g. supermarkets and fast food outlets) leads to increased risk of diet-related health issues (Asfaw, 2008; Kelly et al., 2014; Kimenju et al., 2015). However, in the rural situation, access to a modern market could be positive where cash revenues are used to buy a diversity of healthy food groups, which households do not produce.

Three variables are included to measure the empowerment of the principal female (typically the spouse) in household decision-making. The first variable is a composite variable, 'Role of the female head of household in household decision-making', which is an index of: i) female contribution to agricultural decision-making; ii) female contribution to financial decision-making; and iii) female contribution to food shopping decision-making. The variable 'Female education' was also included, which represents the of the years of education attained by the female head of household. It was hypothesised that higher female education increases the awareness of the relationship between diet, nutrition and health, and therefore is a positive influence on diet quality (e.g. Turrell and Kavanagh, 2006). It was further hypothesised that women who work longer hours may have less time to spend on household food shopping, food purchase decisions and food preparation, which could therefore have a negative impact on household diet quality (e.g. Mancino and Kinsey, 2004). To capture the effect of the principal female working outside the household, the variable 'Female employment' is included to capture whether the principal female of the household is employed and works outside the home.

The variable 'Total household expenditure' was included as a proxy for income. The survey instrument did not include a question which asked for household income to

be quantified, hence total expenditure on food and non-food items was used as a proxy (O'Donnell et al., 2007). The age and education of the household head were included ('Head age' and 'Head education'), as studies such as Binkley and Golub (2011) found that both age and education have an important influence on the type of food purchased. Given that Hinduism is widely practiced by Indian Fijians (Indo-Fijians); which entails a number of restrictions on food consumption (e.g. a lactovegetarian diet, which prohibits meat, poultry, fish and eggs, although milk products are allowed and encouraged (Hammond, 2012), the variable 'Hindu' was included to indicate if a respondent practiced the Hindu religion. Other control variables included 'Household size', 'Children under five years of age', and 'Land size'.

Fiji is comprised of 300 islands, which are split into four Divisions with 15 Provinces. The survey was undertaken on the main island Vitu Levu, which is made up of two divisions the Central and Western. Fiji's capital city Suva is located in the Central division. The international airport is located in Nadi, the tourist hub of Fiji, which is situated in the Western Division. We anticipated some difference in expenditure on unhealthy foods between the two regions, due to greater availability of 'western' style food in the Western Division. To capture this, we created the 'Central Division' variable, a dummy variable that indicates whether the respondent lives in the Central Division.

Multicollinearity (using VIFs and correlation factors) among independent variables in the models were checked. No severe multicollinearity was detected. The presence of outliers was also checked. To analyse the association between diet diversity and healthy eating, the study used bootstrapped standard errors for all regression models. This allowed for a nonparametric approach for evaluating the distribution of a statistic based on random resampling, and also satisfy the condition of the assumption that error terms are independently and identically distributed (i.i.d).

3.5 Empirical Results and Discussion

3.5.1 Descriptive statistics

Descriptive statistics for all variables included in the analyses are shown in Tables 3.1 and 3.2. At the household level mean HDDS is 10.13, which shows that the average household consumed approximately 10 food groups during the past twelve months preceding the survey date. It was found that 26% of the households consumed fewer than 10 of the food groups and 27% have consumed all 12 food groups. In relation to expenditure shares on each of the 12 food groups, the highest expenditure share was on vegetables; fruits; and processed foods and beverages consecutively. The food group which was found to have the lowest expenditure share was cereals.

Table 3.2 contains the descriptive statistics for all the variables used as covariates in the different specifications of the regression models. On average, the rural households in the sample produce/cultivate approximately 12 different crops, including livestock and fish species. The most frequently produced crops produced/cultivated by the farm households in the sample are eggplant, beef and prawns respectively.

The total average value of home production, consumed per day, by these households, was FJ\$25/day. Almost 28% of the households sold one or more of their crops to modern markets (i.e. supermarkets, food processors, exporters, hotels/resorts/restaurants). The total average household expenditure, (our income proxy variable) was FJD\$1920/week. As noted in Chapter 2, the mean for total household expenditure may be relatively high as it has been skewed by some higher values in the sample. The median total household expenditure was FJD \$1160/week, which is approximately AUD \$550.

Of the sample, only a small fraction (9%) of females were employed outside of the home, while on average most females had attained a high school level education.

Approximately 70% of female heads were involved in decisions regarding agriculture, household income and household food consumption.

Table 3.1. Descriptive statistics for dependent variables

Variables	Definition	Mean	SD	Min	Max	N
HDDS	Household Diet Diversity Score – 12 groups	10.13	1.90	3	12	509
Cereals (i)	Share of total food expenditures on breads and cereals	1.06	0.07	0	8.53	509
Roots and Tubers (Share ii)	Share of total food expenditures on roots and tubers	5.49	6.93	0	60.12	509
Vegetables (Share iii)	Share of total food expenditures on vegetables	35.54	21.09	0	98.11	509
Fruits (Share iv)	Share of total food expenditures on fruits	16.69	1.32	0	46.01	509
Meat, Poultry and Offal (Share v)	Share of total food expenditures on meat, poultry etc.	7.29	4.12	0	71.93	509
Eggs (Share vi)	Share of total food expenditures on eggs	3.34	8.22	0	67.13	509
Fish and Seafood (Share vii)	Share of total food expenditures on fish and other seafood	4.96	6.16	0	51.83	509
Pulses, Legumes and Nuts (Share viii)	Share of total food expenditures on pulses and legumes	2.03	2.07	0	8.390	509
Milk and Milk Products (Share ix)	Share of total food expenditures on milk, cheese and other milk products	2.93	5.86	0	59.03	509
Oils and Fats (Share x)	Share of total food expenditures on oil and fats	5.77	4.33	0	19.12	509
Sugar, Salt, and Honey (Share xi)	Share of total food expenditures on sugar, salt and honey	4.15	1.84	0	15.12	509
Processed foods and beverages (Share xii)	Share of total food expenditures on all processed food	9.06	11.66	0	71.68	509

Table 3.2. Descriptive statistics for explanatory variables

Variable	Definition	Mean	Std. Dev.	Min	Max	N
Production Diversity variables						
Crop, animal and fish count	Number of crops, animals and fish per household own and/or produced	11.83	4.87	2	28	516
Own production consumed	Value of own production consumed per day (FD\$)	25.52	11.32	0	98.95	516
Market Access variables						
Sale to modern market	Household sells produce to modern market channel (dummy variable 0=no, 1=yes)	0.19	0.39	0	1	443
Time to modern market	Walking time to nearest modern market (Minutes)	12.23	29.36	1.50	260	496
Gender variables						
Role of the female in household decision-making	Aggregate score of three dummy variables as to whether female head of the household participates in: decision to grow, decision to spend, and decision to purchase food	2.16	1.04	0	3	516
Female education	Years of education completed by the female head of the household: 8=primary, 13=secondary, 16=tertiary	11.06	2.60	8	16	444
Female employment	Dummy variable if the female of the household works outside of the home (0=no, 1=yes)	0.90	0.29	0	1	508
Other household variables						
Total household expenditure	Total household expenditure (FJD\$1000 per week) proxy for income	1.92	2.75	0.12	29.5	508
Household size	Household size	4.77	1.96	1	16	508
Children under 5	Number of children under 5 years of age in household	0.43	0.68	0	3	508
Head age	Age of household head	43.97	12.00	18	82	446
Head education	Years of education completed by household head: 8=primary, 13=secondary, 16=tertiary	10.55	2.67	8	16	496
Hindu	Religion dummy (1=if Hindu, 0=otherwise)	0.26	0.44	0	1	508
Central Division	Central Division location dummy (0=no, 1=yes)	0.34	0.47	0	1	506
Land size	Total land size (ha)	3.89	4.56	0.16	42.49	448

3.5.2 Regression results

Table 3.3 shows the results of the Poisson model where HDDS was used as a dependent variable. The results suggest that an increase in consumption of home production is significantly negatively associated with dietary diversity. This may be attributable to most rural agricultural households in Fiji specialising in producing roots and tubers. According to the last Agricultural Census undertaken in Fiji in 2009, cassava and dalo, were the two most popular temporary crops (sown and harvested during the same agricultural year) grown in Fiji (Ministry of Agriculture Fiji, 2009). However, the marginal effects of these results are relatively small. Interestingly, there were no significant findings with respect to production diversity and diet diversity.

Table 3.3. Association between socio-economic characteristics and household dietary diversity score (HDDS) in rural Fiji: Poisson Model

Variables	Household Diet Diversity Score (HDDS)
Production diversity Variables	
Crop, animal, fish count	-0.002 (0.002)
Own production consumed	-0.001* (0.003)
Market Access Variables	
Time to modern market	-0.000 (0.000)
Sale to modern market	0.048** (0.020)
Gender variables	
Female education	0.001 (0.004)
Role of the female in household decision making	-0.008 (0.009)
Female employment	0.000 (0.004)
Control/household variables	
Total household expenditure	0.002 (0.004)
HH size	0.006 (0.004)
Children under 5	-0.002 (0.014)
Head education	-0.008* (0.004)
Head age	0.001 (0.001)
Hindu	-0.022 (0.017)
Central division	0.003 (0.005)
Land size	0.000 (0.001)
Land size squared	-0.000 (0.000)
Constant	2.458*** (0.122)
No. of observations	443
Pseudo R ²	0.10
Pearson goodness-of-fit	119.640
Prob>chi ² (352)	(0.000)

Note: Model was estimated with a Poisson estimator. Coefficient estimates are shown with boot-strap SEs in parentheses.

*, **, *** Statistically significant at the 10%, 5%, and 1% level, respectively.

Whilst it was found that the distance from a household to a modern market was not significant, the sale to modern market variable was both positive and significant in relation to the household's diet diversity. Additionally, the size of this coefficient is relatively large compared to the other variables. This positive marginal effect implies that an additional dollar (FJD) of earnings from selling at least part of its farm produce to a modern market/s, increases a rural household's diet diversity by 4.8%. These results confirm that market access matters for the dietary diversity of farm households in rural Fiji. These findings are also consistent with Sibhatu et al., (2015) in relation to households' who sell to modern food markets in Ethiopia and Malawi.

To test the robustness of the model, dietary diversity scores only including the nine healthy food groups were also modelled as a sensitivity analysis. The findings are largely in line with those already discussed.

One of the issues with using HDDS measures is that it cannot fully account for the quantity consumed of different food groups and it may be affected by many unobserved factors. Such factors could include food preferences, income and time constraints, which can influence not just where food is purchased from, but also the nutritional quality of the food consumed (Habte and Krawinkel, 2016). Therefore, in order to investigate the drivers of the consumption of healthy versus unhealthy foods, the share of expenditure on each of the 12 food groups were examined individually (results provided in Table 3.4).

Table 3.4. Determinants of Fijian rural households' food expenditure shares on healthy and unhealthy food groups: Multivariate Tobit Model marginal effects

Independent Variables	Healthy food groups									Unhealthy food groups		
	Cereals	Roots and Tubers	Vegetables	Fruits	Meat, Poultry and Offal	Eggs	Fish and Seafood	Pulses, Legumes, Nuts	Milk And Milk products	Oils and fats	Sugar, salt, honey	Processed foods and beverages
Production diversity variables												
Crop, animal, fish count	0.002 (0.001)	0.001 (0.001)	-0.006 (0.003)	-0.002 (0.002)	-0.002 (0.002)	0.000 (0.002)	-0.002** (0.000)	0.000 (0.000)	0.002* (0.001)	0.001** (0.000)	0.000 (0.001)	0.002 (0.001)
Own Production consumed	-0.000 (0.000)	0.000 (0.000)	0.001*** (0.001)	0.001*** (0.002)	-0.004* (0.003)	-0.001** (0.001)	-0.001** (0.000)	-0.001* (0.000)	-0.003** (0.000)	-0.001 (0.001)	0.001 (0.000)	0.006** (0.002)
Market access variables												
Time to closest modern market	-0.001 (0.000)	0.001*** (0.001)	-0.000 (0.000)	0.001*** (0.001)	-0.001 (0.001)	-0.001 (0.000)	-0.001 (0.001)	-0.003** (0.002)	0.000 (0.000)	0.000 (0.006)	0.000 (0.001)	0.000 (0.000)
Sale to modern market	0.007 (0.008)	-0.008 (0.008)	-0.055* (0.032)	0.028* (0.017)	0.019 (0.022)	0.019 (0.022)	0.004 (0.009)	0.001 (0.002)	0.012 (0.009)	0.005 (0.002)	0.003* (0.001)	0.002 (0.013)
Female empowerment variables												
Female education	0.001 (0.001)	0.003* (0.002)	-0.006 (0.005)	0.005 (0.002)	-0.001 (0.003)	0.001 (0.003)	-0.001 (0.002)	0.000 (0.000)	-0.001 (0.002)	-0.002 (0.008)	0.002 (0.007)	0.000 (0.001)
Role of female in household decision-making	-0.007** (0.003)	-0.004 (0.003)	0.002 (0.013)	0.006 (0.007)	-0.002 (0.008)	0.011 (0.009)	0.002 (0.004)	0.001 (0.001)	-0.007* (0.004)	-0.003*** (0.000)	-0.002** (0.003)	-0.012** (0.006)
Female employment	-0.002 (0.002)	-0.002 (0.002)	-0.002 (0.006)	-0.003 (0.003)	0.003 (0.004)	0.004 (0.004)	-0.001 (0.002)	0.001 (0.000)	0.002 (0.002)	-0.001 (0.001)	-0.000 (0.000)	0.003 (0.002)

Table 3.4 (continued). Determinants of Fijian rural households' food expenditure shares on healthy and unhealthy food groups: Multivariate Tobit Model marginal effects

Independent Variables	Healthy food groups									Unhealthy food groups		
	Cereals	Roots and Tubers	Vegetables	Fruits	Meat, Poultry and Offal	Eggs	Fish and Seafood	Pulses, Legumes, Nuts	Milk And Milk products	Oils and fats	Sugar, salt, honey	Processed foods and beverages
Control variables												
Total household expenditure	0.001 (0.002)	-0.000 (0.002)	-0.015** (0.006)	0.001 (0.003)	0.005 (0.003)	0.011** (0.004)	0.002 (0.002)	0.002* (0.001)	0.002 (0.001)	0.005 (0.006)	0.006* (0.000)	-0.024 (0.056)
Household Size	-0.001 (0.002)	0.005*** (0.002)	-0.004 (0.007)	-0.001 (0.004)	-0.011** (0.004)	-0.007 (0.005)	0.003 (0.002)	-0.000 (0.001)	-0.001 (0.000)	-0.000 (0.000)	0.006 (0.009)	0.210 (0.186)
Children under 5	0.005 (0.005)	-0.001 (0.005)	-0.003 (0.022)	0.010 (0.011)	-0.022* (0.013)	-0.006 (0.013)	-0.005 (0.006)	-0.000 (0.001)	0.003 (0.006)	-0.002 (0.001)	0.002** (0.001)	-0.003 (0.008)
Head education	-0.001 (0.001)	-0.001 (0.001)	0.004 (0.005)	-0.002 (0.002)	0.002 (0.003)	-0.002 (0.003)	-0.002 (0.002)	-0.000 (0.000)	-0.001 (0.002)	-0.001* (0.001)	-0.001 (0.006)	-0.002 (0.002)
Head age	0.001 (0.001)	0.003 (0.003)	-0.001 (0.001)	0.000 (0.000)	-0.000 (0.001)	0.000 (0.001)	-0.001 (0.000)	-0.001 (0.000)	0.004 (0.003)	-0.002 (0.006)	-0.000 (0.000)	-0.001 (0.001)
Hindu	0.000 (0.006)	0.010 (0.006)	-0.013 (0.028)	-0.011 (0.014)	-0.008 (0.018)	-0.021 (0.018)	-0.004 (0.007)	0.001 (0.002)	-0.000 (0.000)	-0.000 (0.001)	0.000 (0.000)	-0.004 (0.011)
Central division	0.016** (0.008)	0.023** (0.008)	-0.009 (0.032)	-0.059** (0.015)	-0.013 (0.019)	-0.022 (0.020)	0.017** (0.008)	0.002 (0.002)	-0.004 (0.008)	-0.003 (0.001)	-0.002 (0.001)	-0.037 (0.012)
Land Size	-0.001 (0.002)	-0.001 (0.002)	-0.012* (0.007)	0.003 (0.003)	0.003 (0.004)	0.014** (0.005)	0.002 (0.001)	0.001* (0.001)	0.001 (0.000)	-0.001 (0.001)	0.003 (0.001)	0.003 (0.003)
Constant	1.053** (0.033)	1.047* (0.034)	0.542*** (0.134)	0.075** (0.068)	0.033* (0.090)	0.113** (0.022)	0.094** (0.038)	0.092* (0.045)	0.099** (0.034)	0.029*** (0.006)	0.014** (0.006)	0.171*** (0.054)
# of observations	442	442	442	442	442	442	442	442	442	442	442	442
Log Likelihood	-12444.78											
chi2 (8)	114.92											
Prob > chi2	0.000											

Note: Model was estimated with a simultaneous Tobit estimator. Coefficient estimates are shown with robust SEs in parentheses.

*, **, *** Statistically significant at the 10%, 5%, and 1% level respectively

The results in Table 3.4 show that rural household share of expenditures on vegetables and fruits increased significantly when farm households consumed their own produce. A one FJD increase in the value of own farm production consumed is associated with a relatively small increase (0.1%) in expenditure shares on both vegetables and fruits. However, the relationship between own farm production consumed and expenditure shares on the following five food groups: meat, eggs, fish and seafood, pulses and milk were negative and significant. Specifically, a one FJD increase in the value of own farm production consumed decreases the expenditure shares on meat, poultry and offal by 0.4%; milk and milk products by 0.3%; and 0.1% for eggs, fish and seafood, and pulses, legumes and nuts. Conversely, for one unhealthy food group – processed foods and beverages, a one FJD increase in the value of own farm production consumed increases expenditure shares on processed foods and beverages by 0.6%. This relationship may be due to the fact that food items that the household does not produce (e.g. non-horticultural food products) are purchased from food markets and the price differentiation between healthy food items such as meat, poultry and seafood, compared to processed foods, may drive households to purchase processed foods (Grunert, 2005). It is important to note that in all cases, however, the magnitude of the coefficients suggest that the changes are relatively small, meaning a one FJD increase in the value of own farm production consumed was associated with a less than 1% change in the expenditure shares.

The two market access variables (time to modern market and sale to modern market) showed some interesting results. As the time (minutes) to the modern market increased, the likelihood of consumption of roots and tubers, and fruits increased by 0.1%; while the likelihood of consumption of pulses and legumes decreased by 0.3% among rural households. These results suggest that these are items are unlikely to be produced

on farm at home, and need to be purchased by households at a modern food markets. A key finding in relation to our sale to modern market variable, was that where households sell their produce to modern markets, there was a significant negative association with consumption of vegetables (5.5%), and a significant positive association (0.3%) with the consumption of sugar, salt and honey.

The findings in relation to the gender variables, specifically the role of female empowerment in decision-making, also showed some interesting results. In particular with respect to the household consumption of processed foods and beverages, where female empowerment in decision-making had a relatively large significant negative effect (-1.2%). There were also significant negative findings in relation to expenditure shares on the other two food groups, oils and fats (-0.3%) and sugar, salt and honey (-0.2%), respectively. We also found that the number of years of female education had a positive impact on the household's share of food expenditures of roots and tubers of 0.3%.

Household income (proxied by total household expenditures) had a significant negative impact on the consumption of vegetables by the household. Where household income increased by one FJD, the consumption of vegetables decreased by 1.5%. There were, however, significant positive findings with respect to eggs, with one FJD increase in income resulted in a 1.1% increase in the consumption of eggs by the household and 0.2% increase in pulses, legumes, nuts. These results suggest that an increase in household income may allow households to purchase items not produced on farm, such as eggs and pulses. Similarly, an increase of 0.6% was observed with respect to household income and sugar, salt and honey.

This study found a significant relationship between household size and the consumption of meat, poultry and offal. An increase in household size by one person was found to result in a 1.1% decrease in expenditure shares on meat, poultry and offal.

Similar results were observed where a household comprised of more children under the age of 5 years of age. Conversely, an increase in household size by one member, was found to increase household food expenditure share on roots and tubers by 0.5%.

The location dummy variable 'Central Division' also had significant results with respect to expenditure on healthy food groups. Rural households located in the Central Division, as opposed to the Western Division of Fiji were more likely to eat cereals (by 1.6%), roots and tubers (by 2.3%), and fish and seafood (by 1.7%). However, they were 5.9% less likely than their Western Division counterparts to eat vegetables.

This study also had significant findings with respect to land size. When the amount of cultivatable land size owned by the rural household increased by one hectare, the share of expenditures on vegetables decreased by 1.2%, whilst share of food expenditures on eggs increased by 1.4%.

3.6 Conclusions

This empirical investigation into the relationship between agricultural production diversity; access to food markets; and socio-economic factors such as gender empowerment, on diet quality in rural households in Fiji, has provided a number of significant insights. This study has important findings in relation to market access, namely that rural households who sell their produce to modern markets, have greater diet diversity than those who do not. This suggests that income derived from selling farm produce to modern markets allows for the purchase of non-farm food items. Furthermore, this study found that market access may be more important for farm household diet diversity than agricultural production diversity.

However, a negative externality as a result of the increased income from sale of agricultural produce to modern markets, is that these rural households also increased their

consumption of sugar, salt and honey. It was also found that households located closer to modern markets were less likely to eat traditional staple foods. Interestingly, consumption of traditional staple foods significantly decreased as the household's income increased. This may also be associated with income received from the sale of agricultural produce to modern markets.

The second key finding in this study was the strong identification of the gender empowerment variable in the modelling. The results showed that the greater a females' role in agricultural and food consumption decision-making, the less likely a household was to eat unhealthy foods. In addition, female education had a positive impact with respect to the household consumption of healthy traditional staple foods.

This research has addressed a gap in the literature in relation to how specific components of food systems, including agricultural production diversity and market access, may be contributing to diet diversity and health outcomes in PICTs. While access to modern markets may be more important for diet quality in farm households than production diversity, modern markets are also playing a role in the decline of healthy traditional staple foods. Therefore, policy makers face a challenge in promoting and expanding market access without further encouraging the decline of traditional foods.

The policy implications of this work, as well as the limitations of this study are further discussed in Chapter 6 of this thesis.

Chapter 4: Understanding the Determinants of Diet-related Health Outcomes in Adults and Children in Rural Agricultural Households in Fiji

4.1 Introduction

Chapter 1 of this thesis details the profound shifts in dietary patterns, encompassing a change mostly away from traditional diets composed of whole staple foods, such as pulses and grains to energy dense and nutrient poor diets, composed of refined carbohydrates, high fat intake and processed foods. This is widely referred to as the “nutrition transition” (Drenowski and Popkin, 1997; Popkin et al., 2012; Popkin, 2014; Popkin, 2017; Popkin and Reardon, 2018). In addition to increasing urbanisation and rising middle classes in developing countries, driving the nutrition transition is a change in global food systems, which is a result of technological change, trade liberalisation, and foreign direct investment. While the nutrition transition started much earlier and unfolded gradually over a period of several decades in the developed world, it is now being observed at a much more accelerated pace across developing countries (Qaim, 2017).

The nutrition transition in developing countries is thought to be a significant factor contributing to the widespread increase in diet-related NCDs such as cardiovascular disease and Type II Diabetes Mellitus (T2DM) (Mendez and Popkin, 2004; Popkin, 2006; Prentice, 2006; Matejowsky, 2009; Popkin and Reardon, 2018). A major modifiable risk factor for NCDs is overweight and obesity (Webber et al., 2012; Murray and Majeed, 2017; WHO, 2018). Obesity has long been considered a disease mainly prevalent in high-income countries, however as the economies of developing countries continue to improve with subsequent changes in diet and access to food, obesity is now a significant public health concern in developing countries.

The increasing rate of obesity and subsequent NCDs in developing countries has important implications for the distribution of health inequalities (Popkin, 2012), as the complications of these diseases are likely to overwhelm developing countries that are already straining under the burden of communicable diseases and undernutrition (Popkin 2012; Tremmel et al., 2017). The paradox of both under and over nutrition, known as the “double burden” in developing countries is a serious policy challenge. The double burden of child undernutrition and adult over nutrition exacerbates the risk of obesity and associated diseases and is incredibly taxing on underdeveloped health systems (Ford et al., 2017).

A region struggling under the burden of obesity and NCDs are PICTs. NCDs are already the leading cause of death in PICTs and existing risk factors suggest that NCDs will be a major health challenge for this region in the coming years (Anderson, 2013). NCDs place large health, financial and economic cost burdens on countries, in particular, for governments in PICTs, who are primarily responsible for financing the health care system and are already feeling the pain of public health care costs on their national budgets (Anderson, 2013). As one of the more developed countries in the region, Fiji provides a unique context for this study as it is on an upward trajectory to join other PICTs such as Nauru, American Samoa and Tonga, which currently have the highest rates of obesity in the world (WHO, 2014; Albarca-Gomez et al., 2017).

Using household level data as well as individual-level anthropometric data from adults and children living in the households interviewed as part of the Fiji Rural Horticultural Producer Survey, this research explores the effect of the home production of nutrient dense foods such as fruit and vegetables; access to markets; processed foods; and gender empowerment on diet-related health outcomes. To the author’s knowledge,

this is one of the first studies of its kind conducted in a PICT, and the results have important policy implications for the region, which is currently experiencing a NCD crisis.

4.2 Literature Review

4.2.1 *Overweight and obesity: a global health crisis*

The World Health Organisation (WHO) (2018) reported that in 2016, more than 1.9 billion adults aged 18 years and older were overweight; and of these, over 650 million adults were obese. Overall, about 13% of the world's adult population were obese and 39% of adults were overweight in 2016. The WHO (2018) notes that worldwide prevalence of obesity nearly tripled between 1975 and 2016. The prevalence of overweight and obesity has also increased among children and adolescents, rising from 4% in 1975 to 18% in 2016. This trend is concerning, as childhood obesity is associated with a higher chance of adult obesity, as well as premature death and disabilities (Prentice, 2006; WHO, 2018). These WHO findings are consistent with a number of other studies (Evans et al., 2001; Yoshiike et al., 2002; Ogden et al., 2004; Kim et al., 2005; Rennie et al., 2005; Monteiro et al., 2007; Nguyen et al., 2007; Wang et al., 2007; Helble and Francisco, 2017; Sartorius et al., 2017; Popkin and Reardon, 2018).

The Overseas Development Institute (ODI) in its *Future Diets* Report found that the prevalence of overweight and obesity now affects more adults in developing countries than those in high-income countries (ODI, 2014). Similarly, the prevalence of overweight and obesity in children in developing countries is also increasing significantly (Popkin, 2006; Popkin and Reardon, 2018, WHO, 2018). It has been found that the burden of obesity, particularly in developing countries, tends to shift towards groups of lower socio-economic status (SES) as that country's GNP increases (Monteiro et al., 2004; Jones-Smith et al., 2012). While a degree of economic prosperity is an enabler for obesity, the

level of prosperity does not have to be high for obesity to manifest (Swinburn et al., 2011), hence high levels of obesity prevalence are being observed in low-income countries such as PICTs.

4.2.2 The double burden on developing countries

Despite substantial economic growth, large inequalities remain in many LMICs, and it is common to see problems of underweight, stunting, and micronutrient deficiencies side-by-side with increasing rates of obesity (Popkin et al, 2012). While these countries continue to deal with the problems of infectious diseases and undernutrition, they are also experiencing a rapid upsurge in NCD risk factors such as obesity and overweight. This “dual burden” of undernutrition and obesity exists not only in countries and communities but in households and even in individuals, who may have excess adiposity along with micronutrient deficiencies, such as iron deficiency anaemia, or stunting and overweight (Doak et al., 2000; Popkin et al, 2012).

Of notable concern is the increasing prevalence of overweight and obesity in children in developing countries, as these children are more vulnerable to inadequate prenatal, infant, and young child nutrition. However, they are increasingly becoming more exposed to high-fat, high-sugar, high-salt, energy-dense, and micronutrient poor foods, which tend to be lower in cost but also lower in nutrient quality (WHO, 2018). Epidemiological research suggests that children born into food-insecure households, who then experience dramatic improvement in economic conditions during childhood, are more likely to have diet-related health issues such as T2DM or obesity as adults (Prentice, 2006). The double burden of disease is a serious challenge, because malnutrition and stunted growth are often seen to coexist in children, therefore, eliminating undernutrition without increasing obesity is required (Martorell et al., 2000).

4.2.3 *The Pacific health crisis*

PICTs remain the region most affected by obesity with the highest prevalence rates of adult obesity in the world. In at least 10 PICTs more than 50% of the population is overweight, with obesity prevalence ranging from 30% in Fiji, to 80% among women in American Samoa (Waqanivalu, 2010). Childhood obesity has also started to take on unseen dimensions (Helble and Francisco, 2017), with childhood obesity rates over 30% in Samoa and Wallis and Futuna, and overweight rates well above 50% for adolescents in the Cook Islands, Tonga, and Samoa (Wate, 2017). In addition, approximately 40% of PICTs population of 9.7 million has been diagnosed with a NCD, notably cardiovascular disease (CVD), diabetes and hypertension, these diseases account for three-quarters of all deaths in PICTs and 40-60% of total health-care expenditure (Waqanivalu, 2010). T2DM Diabetes prevalence among adults PICTs is also among the highest in the world.

As noted above, the obesity and NCD burden is set to continue to increase in Fiji, which is one of the more developed nations among PICTs. In Fiji, the National Nutrition Survey (NNS) data indicated the existence of both under and over nutrition (NFNC, 1995; 2005). A National Nutrition Survey was completed in Fiji in 2014, however the results of this survey are still not available. The NNS revealed the occurrence of infant malnutrition, underweight children, anaemia and overweight in many adults. The data indicated that overweight and obesity had increased from 33% in 1993 to 56% in 2004 (Fiji Ministry of Health, 2010). The prevalence of overweight in children had tripled between the 1993 and 2004 NNS. The existence of the double burden of undernutrition and obesity in Fiji was also confirmed in a study by Neil (2007), which found that among children under 10 years, 2-3% are stunted and 7-8% are wasted. The study also found that the prevalence of both underweight and overweight increases with age, with rural children having higher rates of underweight than urban children.

In 2014, T2DM was the number one cause of death in Fiji (Fiji Ministry of Health, 2015). In a study conducted by Lin et al., (2015) they found that T2DM and obesity trends have increased across genders and ethnicities, as well as across all age groups over the past 30 years, despite the development of policies and programs to address this disease. Increasing BMI and growth in the number of people who are obese will continue to drive-up rates of T2DM and other NCD contributing to the burden of premature morbidity and mortality, especially in women. In Fiji, CVD and T2DM are already exerting an effect on life expectancy because premature adult mortality has increased, and Fijian life expectancy has not improved since 1985 in both sexes and ethnicities (Lin et al., 2015).

In a study conducted by Brian et al., (2011), which aimed to determine the distribution and socio-demographic associations of BMI among Melanesian and Indian Fijians over 40, it was found that Melanesian Fijians were more likely to be overweight and obese than Indo-Fijians. Women of both ethnicities were more likely than men to be overweight or obese.

4.2.4 Health outcomes in rural areas

While urbanisation is considered the prime driver for nutrition transition and the emergence of obesity, recently, an increase in obesity has been observed in rural areas of some developing countries (Chow et al., 2008; Zhai et al., 2017; Jaacks et al., 2017; Sartorius et al., 2017). Brian et al., (2011) found in their study of adult Fijians over 40 years of age, that urban domicile was not a predictor for being overweight or obese, but rather the availability and pricing of processed foods. This study seeks to build upon the findings of Brian et al., (2011), examining the relationship between home production of nutrient dense foods such as fruit and vegetables; access to food markets; household expenditure on processed foods; and socio-economic factors such as gender

empowerment on health outcomes in rural households in Fiji. With the majority of people in PICTs residing in rural areas, this study has widespread implications.

4.3 Methodology

4.3.1 Data description

As mentioned earlier, the analyses in this chapter use data from the Fiji Rural Horticultural Producer Survey, which includes a sample of 589 rural households who grow horticultural crops on the main island of Fiji, Vitu Levu. The sample was extracted from an existing list of 885 horticulture farmers collated by Ministry of Agriculture offices on Vitu Levu. A random sample of 600 households was derived by the Ministry of Agriculture using RANDBETWEEN in Microsoft Excel. The producer survey was undertaken in April of 2014 by trained and experienced enumerators from the Fiji Ministry of Agriculture.

Two survey instruments were used to collect data via in-person interviews, with both the male and female heads in the households. The instruments were designed to ascertain the patterns, determinants, and effects on household livelihoods of farmer participation in evolving horticultural value chains. The male and female head of the household were interviewed separately using two different survey instruments, a primary and a secondary survey instrument. The primary instrument included questions about household characteristics, assets, and production, post-harvest and marketing characteristics and behaviour. As explained in Chapter 2, the interviews which utilised the secondary survey instrument were conducted with the spouse (typically the female head of household). The spouse was asked specific questions about what agricultural and marketing tasks they undertook as well as their role in household decision-making. Information on household food shopping and consumption habits was also obtained in the secondary survey, which covered 79 different food categories across a mix of 10 types

of retail formats, modern and traditional. The food consumption component also included foods grown by the household or exchanged with other households. Finally, the instrument also ascertained the height and weight of each individual living in the household so that body mass indices could be calculated for individuals. The respondents, as well as any children, or other household members present in the home, were weighed and had their height measured by enumerators to generate the BMI data for the household.

While the total number of respondents for both surveys was 589, some surveys were not fully completed. There were 516 observations from the household head survey (primary survey). Additionally, there were 509 observations from the secondary survey. The secondary survey which contained the BMI data) that were able to be utilised. The two data sets were merged to create a full data set on rural agricultural households in Fiji.

Based on the 509 fully completed surveys, there were 2446 individuals in our sample. Due to some issues with missing information, this study was able to utilise BMI data for 1410 adults and 576 children. Children under two years of age were not included in the model. The WHO does not recommend the use of the BMI for clinical use before the age of two years. It is noted that the BMI in infancy is based on recumbent length rather than stature and, to date, there has been little research on what BMI calculated from length means in infancy and on the consequences of high or low BMI in infancy (WHO, 2006; National Centre for Chronic Disease Prevention and Health Promotion, 2015).

Descriptive statistics of the main variables are presented in Table 4.1 with means and standard deviations.

4.3.2 Measuring overweight and obesity: Body Mass Index and BMI z-scores

Body mass index (BMI) is a simple index of weight-for-height that is commonly used to classify overweight and obesity in adults. It is defined as a person's weight in kilograms, divided by the square of the person's height in metres (kg/m^2). BMI does not measure body fat directly, but research has shown that BMI is moderately correlated with more direct measures of body fat obtained from skinfold thickness measurements, bioelectrical impedance, densitometry (underwater weighing), dual energy x-ray absorptiometry (DXA) and other methods (Garrow and Webster, 1985; Freedman et al., 2013; Wohlfahrt-Veje et al., 2014). BMI has been criticised for its use as an indicator of body fat as it does not take into account muscle mass, bone density, overall body composition, and racial and sex differences (Ahima and Lazar, 2013). While there are some criticisms of the use of BMI at the individual level, its shortcomings in this context are outweighed by the insights gained from its use in aggregate analyses of population health (Gutin, 2018).

A significant body of previous research has shown that BMI appears to be as strongly correlated with various metabolic and disease outcomes as more direct measures of body fatness (Steinberger et al., 2005; Willett et al., 2006; Flegal and Graubard, 2009; Freedman et al., 2009; Sun et al., 2010; Lawlor et al., 2010). For example, studies suggest that raised BMI is a major risk factor for NCDs such as cardiovascular diseases, T2DM, musculoskeletal disorders and some types of cancers (WHO, 2016; Lam et al., 2016; Ezzati, 2017; Nyberg et al., 2018).

The use of BMI for children is a relatively more recent development (Dietz et al., 1998; Neovius et al., 2004). In childhood, BMI changes substantially with age. Thus, for children, the BMI score is adjusted for age and gender in order to account for growth and body fat changes that occur as part of normal development. Because of this, for children,

BMI values are compared with reference values that are generally age, as well as gender specific. Therefore, children BMIs need to be further transformed in order to be put on a common footing (Flegal and Ogden, 2011). This is most often done by translating BMI-for-age into a z-score or a percentile relative to some specified distribution of BMI-for-age (Flegal and Ogden, 2011). This is further discussed below in the methods section of this chapter.

4.3.3 Measures of the dependent variables for diet-related health status

The main indicator of diet-related health status used in this study is the BMI of individuals, both adults and children, in the sample households. BMIs for adult household members are calculated using each individual's weight (kilograms) divided by height squared (metres) (WHO, 2018). This study also considers weight status, based on the WHO definitions. The WHO (2018) defines 'overweight' as a BMI >25, and 'obese' as BMI >30. Overweight and obesity are defined as abnormal or excessive fat accumulation that may impair health. This study examines the incidence of overweight and obese adults generally, as well as by gender.

In relation to children, this study calculates BMI z-scores and height-for-age z-scores for children (ages 2-18) by obtaining group means and standard deviations directly from growth charts produced by the US Centre for Disease Control (CDC) (Kuzcmarski et al., 2002). As suggested by the CDC and WHO, we exclude children under two years of age. The BMI z-score reflects an extensive series of transformations of the original weight and height data for a child. Weight and height are transformed into a BMI value and the BMI value is in turn is transformed into an age and sex specific z-score based on a normalising transformation or a smooth version of observed reference data (Flegal and Ogden, 2011). A BMI z-score or percentile represents a measure of weight, adjusted for

height, sex, and age, relative to a smoothed reference distribution, and not simply a measure of weight and height for a child (Flegal and Ogden, 2011).

Height-for-age z-scores for children (ages 2-18) are also calculated, as this is a measure of impaired growth, known as stunting. Stunting is identified by assessing a child's length or height (recumbent length for children less than two years old and standing height for children aged two years or older) and interpreting measurements by comparing them with an acceptable set of standard values. There is international agreement that children are stunted if their height-for-age is more than two standard deviations below the WHO Child Growth Standards median for the same age and sex (WHO, 2009; de Onis et al., 2013). Linear growth is considered a strong overall indicator of children's wellbeing and provides an accurate marker of inequalities in human development (de Onis et al., 2016).

4.3.4 Independent variables influencing diet-related health status

A number of independent variables were identified in the literature as being potentially important in influencing household health outcomes. Several recent studies suggest that rural households with home production of fruits, vegetables and livestock products may have improved diet quality (Herforth, 2010; Jones et al., 2014; Kumar et al., 2015; Malapit et al., 2015). The variable 'Own production consumed' was included to examine the relationship between home production of nutrient dense foods such as fruits and vegetables, and household health outcomes.

We captured the impact of access to food markets on health outcomes by asking respondents to indicate the time it usually takes to get from the household to the nearest traditional food market. Since the respondent provided information about the 'usual' time it takes to get to their nearest traditional food market, the variable 'Time to traditional market' is a subjective measure of physical access to traditional food markets. As

discussed in Chapter 3, access to food markets can influence household nutrition in both positive and negative ways. As just over 90% of the sample sold produce to traditional markets, it is anticipated that access to these markets will be positive where cash revenues are used to buy healthy food groups, which households do not produce.

In Fiji, the retail (supermarket) food sector has seen significant growth since the 1990s; there has also been an increased presence of global fast-food providers as well as small local fast-food services, restaurants and street vendors. These have contributed to changes in the Fijian diet by increasing the availability of imported processed foods, as well as higher-fat fast foods (Thow et al., 2010). Previous studies have shown that access to certain types of modern food environments (e.g. supermarkets and western-style fast food outlets) leads to increased risk of diet-related health issues (Asfaw, 2008; Tessier et al., 2008; Asfaw, 2011; Zhang et al., 2012; Banwell et al., 2013; Kelly et al., 2014; Umber et al., 2015; Tobia et al., 2015; Rischke et al., 2015; Demmler et al., 2017; Demmler et al., 2018). The variable ‘Share on processed foods’ was included to capture the total percentage of food expenditures spent on processed foods.

Female empowerment in household decision-making has been found to play an important role in household diet and health outcomes, especially in developing countries. We have included several variables to measure female empowerment. The first variable, ‘Female ag decisions’, indicates whether the female head of the household contributes to decisions about what agricultural commodities to grow. The ‘female financial decisions’ variable indicates whether the female head of the household contributes to decisions about how household income is spent. This has been included on the basis that previous literature has shown that there is a link between women’s control of resources and allocation of resources to food, with a positive association between greater control of resources by women and child health outcomes verified in both observational and

experimental studies (Malapit et al., 2013, 2015). In addition, the 'Female food shopping decisions' indicates whether the female head is responsible for the household food purchasing, either individually or together with the head of the household or other household members.

We have also included variables for female education for both secondary ('Female secondary education') and tertiary ('Female tertiary education') levels. Previous literature has shown that females that have completed higher levels of education have increased awareness of the relationship between diet, nutrition and health, and therefore, higher education has a positive influence on household diet quality (e.g. Turrel and Kavanagh, 2006).

We included the variable 'BMI maximum female' which is a measure of the maximum BMI of adult females in the household. Studies such as Gibson et al., (2007) have found that child BMI z-scores are significantly associated with higher maternal BMI and that having an overweight mother increases the likelihood of a child being overweight or obese. This variable intends to capture the impact of female BMI on child health outcomes in rural households.

The variable 'Female employment' was also included, which represents whether the female head of the household is employed and works outside the home. It was hypothesised that women who work longer hours may have less time to spend on household food shopping, food purchase decisions and food preparation which could therefore have a negative impact on household diet quality and health outcomes (e.g. Mancino and Kinsey, 2004).

Other independent variables included 'Total household expenditure', age ('Age male') and education ('Male secondary education' and 'Male tertiary education') of the

male head of the household. The dummy variable 'Central division' variable has also been included to indicate whether the household is located in the Western Division or Central Division of Fiji. Studies consistently show that factors such parental education, socio-economic status and place of residence can impact on child health outcomes (Ayaya et al., 2004; Murasko, 2017).

We used a proxy for household income, namely total expenditure on food and non-food items. As noted in Chapter 3, the survey instrument did not include a question which asked for household income to be quantified, hence total expenditure on food and non-food items was used as a proxy (O'Donnell et al., 2007). In addition to household income, ethnicity may also influence the BMI and health status of both adults and children. Fiji is a multi-ethnic society composed of two main ethnicities: i-Taukei (indigenous Fijians) and (Fijians of Indian decent). Studies such as Taylor et al., (2013) have identified increasing mortality trends in the i-Taukei population, especially among females. Ethnicity is an important cultural variable as there are distinct differences in food consumption patterns, particularly among Indo-Fijians who practice the Hindu religion, which entails a number of restrictions on food consumption. Many Hindus follow a lactovegetarian diet, which prohibits meat, poultry, fish and eggs, although milk products are allowed and encouraged (Hammond, 2013). Of our sample, 62% of households were Hindu. Ethnic differentials in NCD prevalence in Fiji have been documented in numerous studies since the 1960s (Ram et al, 1982; Ram, 1983; Ram and Olakowski, 1983; Ram et al, 1983; Patel et al, 1983; Tuomilehto et al, 1984, Zimmet et al, 1985; Cassidy, 1985; Brian et al., 2011) Taylor et al., 2013). As such, ethnicity was considered an important variable to include

Table 4.1: Descriptive statistics

Variable	Definition	Mean	Std. Dev.	Min	Max	N
Dependent Variables						
Adult BMI	Adult BMI (Male and Female)	25.59	5.66	11.42	65.74	1410
Male BMI	Adult male BMI	24.81	5.25	11.42	65.74	737
Female BMI	Adult female BMI	26.44	5.98	12.60	54.98	673
Child BMI z-score	Child BMI z-score	-0.09	4.04	-41.43	9.55	570
Child Stunting	Height-for-age z-score	-1.68	3.34	-28.23	6.46	573
Independent Variables						
Own production consumed	Quantity (kg) of food consumed each day that is produced at home ¹	7.81	10.25	0	103.05	1410
Time to traditional market	Time required to reach nearest traditional food market (minutes)	36.09	53.85	0.5	280	1410
Male food decisions	Dummy if male is only responsible for food purchasing (1=yes, 0=otherwise)	0.21	0.41	0	1	1410
Female food decisions	Dummy if wife is responsible for food purchasing with husband and/or children (1=yes, 0=otherwise)	0.56	0.49	0	1	1410
Female employment	Dummy if female of the household is employed in paid work outside the household (1=yes, 0=otherwise)	11.27	16.14	0	56	1410
Female ag decisions	Dummy if head female contributes to decisions about what commodities to grow (1=yes, 0=otherwise)	0.68	0.46	0	1	1410
Female financial decisions	Dummy if head female contributes to decisions about how household income is spent (1=yes, 0=otherwise)	0.77	0.41	0	1	1410
Female secondary education	Dummy variable (1 = secondary education is the highest level completed by the female head, 0 = otherwise)	0.53	0.49	0	1	1260
Female tertiary education	Dummy variable (1 = tertiary education is the highest level completed by the female head, 0 = otherwise)	0.02	0.16	0	1	1260
BMI maximum female	The maximum BMI of all adult females living in household	28.94	6.33	16.94	54.98	570
Share on processed food	Share of food expenditures on processed foods	4.77	4.83	0	32.95	1410

¹ The author notes the mean value for this variable could be relatively high, however the mean is likely to be skewed (i.e. by larger households) as the median value is 4.13kg per day.

Table 4.1(Continued). Descriptive statistics

Variable	Definition	Mean	Std. Dev.	Min	Max	N
Total household expenditure	Total expenditure by the household (\$1000FJD) proxy for income	1.84	2.41	0.12	20.23	1410
Age male	Age of the head of the household	41.09	15.81	18	97	1410
Indo-Fijian	Dummy for main ethnicity of household (1=Indo-Fijian, 0=Indigenous Fijian)	0.73	0.44	0	1	1410
Central Division	Dummy if the household is located in the Central Division (1=yes, 0=otherwise)	0.38	0.49	0	1	1410
Household head dummy	Dummy if the individual is the household head (1 = yes, 0 = otherwise)	0.26	0.44	0	1	1410
Male dummy	Dummy if the individual is male (1= yes, 0 = otherwise)	0.52	0.49	0	1	1410
Male secondary education	Dummy variable (1 = secondary education is the highest level completed by the male head, 0 = otherwise)	0.46	0.49	0	1	1260
Male tertiary education	Dummy variable (1 = tertiary education is the highest level completed by the male head, 0 = otherwise)	0.03	0.17	0	1	1260

4.3.5 Regression analysis

Ordinary Least Square (OLS) regressions, which is commonly used in the literature for continuous dependent variables (e.g. Komlos et al., 2009; Shankar et al., 2010; Mora et al., 2013) were undertaken to estimate the association between socio-economic characteristics and each of the health outcome variables for adults and children: 1) adult BMI, 2) child BMI z-scores and 3) height-for-age z-score. In this study we assume that outcome variables for each individual ($y_i, i=1 \dots$) depend on individuals' and households' socio-economic characteristics, which determine individuals' health outcomes. Assuming a linear relationship between the health outcomes and the set of exogenous variables, the model to estimate can be summarised as follows:

$$y_i = X_i\beta + Z_i\gamma + \varepsilon_i, \quad (4.1)$$

where y_i represents BMI for adults, and for children y_i represents BMI z-score and Height-for-age z-score (a measure of stunting). X_i captures socio-economic variables that might have an effect on y_i (as found in the literature), and Z_i represents women's role in the household decision-making. The term ε_i designates idiosyncratic error terms that capture the unobserved factors that explain y_i . We assume errors are independent and identically distributed with an asymptotic normal distribution. Thus, the model in equation (4.1) can be estimated using OLS, executed by statistical software Stata SE Version 14.

4.4 Adult Health Outcomes

4.4.1 General findings: prevalence of overweight and obesity

Of our sample, 50% of adults were considered overweight based on their BMI and 18% were considered to be obese. The findings with respect to obesity are slightly higher than the Fiji Ministry of Health (2010) figures noted above, potentially signalling an

increase since the last estimate. Compared to men, a higher share of women in the sample were overweight (56% compared to 45%, respectively) and there were more cases of obesity in women than were found in men (23% compared to 13%). These findings are consistent with studies such as Brian et al., (2011) and Taylor et al. (2013).

4.4.2 The impact of socio-economic factors on adult BMI

Table 4.2 shows the results of the estimates of the impact of the various socio-economic factors discussed above on adult BMI. Six models were estimated for the aggregate sample of all adults and separate models for male and female BMIs. For the three groups, we have i) a model which includes the education variables for the male and female heads of the household, and ii) a model which excludes the education variables. These models were included to ensure robustness, as there were a number of individuals with missing education information in the sample, due to non-responses in the data collection process. However, we observe similar results between both models.

Lower BMI is observed among the Indo-Fijian population of our sample, which is consistent with previous studies (Taylor et al., 2013). It was also found that those in the sample who reside in the Central Division, had higher BMI than those in the Western Division. The Central Division is home to Fiji's capital city Suva and is becoming increasingly urbanised. Therefore, residents in the Central Division may have greater access to processed, energy dense foods.

In households where the male was exclusively responsible for the household food purchasing decisions, higher BMI was observed for adults in the household. Where women were included in decision-making about food purchasing, higher BMI was observed in males. In households where females contributed to decision-making about agricultural production, a significant positive effect was observed on adult and female

BMI. If a female had attained at least a secondary education compared to primary education, this also had a positive effect on adult and male BMI.

Proximity to traditional food markets also had a significant effect on adult BMI, particularly in males (this may be attributable to gender dynamics within households). This could be due to households being able to purchase foods they are unable to produce on farm at home, as well as using the income derived from selling produce from local markets to do so. The consumption of home-grown produce also had a positive significant effect on adult BMI, but it was only weakly significant at the 0.10 significance level.

Our income proxy variable household expenditure had significant, but different results for male and female BMI. As household expenditure increases, female BMI is likely to increase, whereas male BMI is likely to decrease initially as household expenditure increases but increases again after household expenditure reaches 7,100 FJD a week.

We observed that the age of the adult individual had a significant impact on adult BMI across all models. As age of the adult individual increases, BMI increases; but after around 48 years old, BMI decreases as age increases.

Table 4.2. OLS regressions for adult BMI (aggregate and by gender)

<i>Variables</i>	<i>Adult BMI Model 1</i>	<i>Adult BMI Model 2</i>	<i>Male BMI Model 3</i>	<i>Male BMI Model 4</i>	<i>Female BMI Model 5</i>	<i>Female BMI Model 6</i>
Own production consumed	0.022	0.034*	0.034	0.053*	0.004	0.006
Time to traditional market	0.005*	0.006*	0.001	0.001	0.008**	0.009**
Male food shopping decisions	0.932**	1.117**	0.935	0.921	0.863	1.247**
Female food shopping decisions	0.679	0.847*	0.163	0.154	1.098**	1.396**
Female employment	-0.007	-0.009	-0.004	-0.007	-0.008	-0.009
Female agricultural decisions	0.830*	0.923**	1.067	1.261*	0.617	0.649
Female financial decisions	-0.039	-0.256	-0.139	-0.366	0.092	-0.064
Female secondary education level		0.578		0.261		0.931*
Female tertiary education						
		-0.219		0.381		-0.407
Household total expenditure (\$1000FJD)	0.058	0.078	-0.697***	-0.677***	0.151**	0.178*
Total household expenditure (\$1000FJD) squared			0.049***	0.049***		
Share on processed foods	-0.063	-0.070	-0.077	-0.077	-0.043	-0.055
Age	0.446***	0.462***	0.520***	0.600***	0.373***	0.342***
Age Squared	-0.004***	-0.004***	-0.005***	-0.006***	-0.003***	0.003***
Indo-Fijian	-2.302***	-2.190***	-2.322***	-2.169***	-2.380***	-2.289***
Central division location	0.919**	0.737*	1.155**	1.042*	0.629	0.376
Household head dummy	-0.975***	-0.957**	-1.951***	-1.897**	-0.862*	-0.828
Male dummy	-1.297***	-1.362***				
Male secondary education		-0.386		0.079		-0.775
Male tertiary education		1.914*		3.160*		0.372
Constant	16.631***	15.949***	16.517***	14.474***	16.395***	16.602***
R-squared	0.171	0.180	0.187	0.214	0.148	0.153
Observations	1,410	1,260	673	612	737	648
F-stat	13.58**	10.41**	7.67***	4.97***	8.74***	7.93***

*, **, ***Statistically significant at the 10%, 5%, and 1% level, respectively.

4.5 Probability of overweight and obesity among adults

Another way to present the results in Table 4.2 is to graph the probability of being overweight or obese against the independent variables. For statistically significant independent variables that are continuous, the graphs below depict their relationship with the probability of being overweight or obese.

4.5.1 Probability of being overweight ($BMI \geq 25$) and obese ($BMI \geq 30$) for adults, predictions from Model 2.

It is observed from Figure 4.1 below, that for every additional kilogram of food produced on farm and consumed by the household ('Own production consumed'), the probability of being overweight or obese increases and the increasing rate appears to be decreasing as more own produced food is consumed. In addition, the estimated probability of overweight or obese at any given level of own produced food consumed can be observed. For example, for an individual with average characteristics of the other independent variables, the probability of being overweight is around 0.66 while the probability of being obese is just slightly lower than 0.33, if the household consume 20 kilograms of own production each day. While this is a large and perhaps unrealistic amount of food produced on farm for a household to consume per day (the mean is 7.82 kg/day) it illustrates the general relationships between the variable and the probability of being overweight or obese.

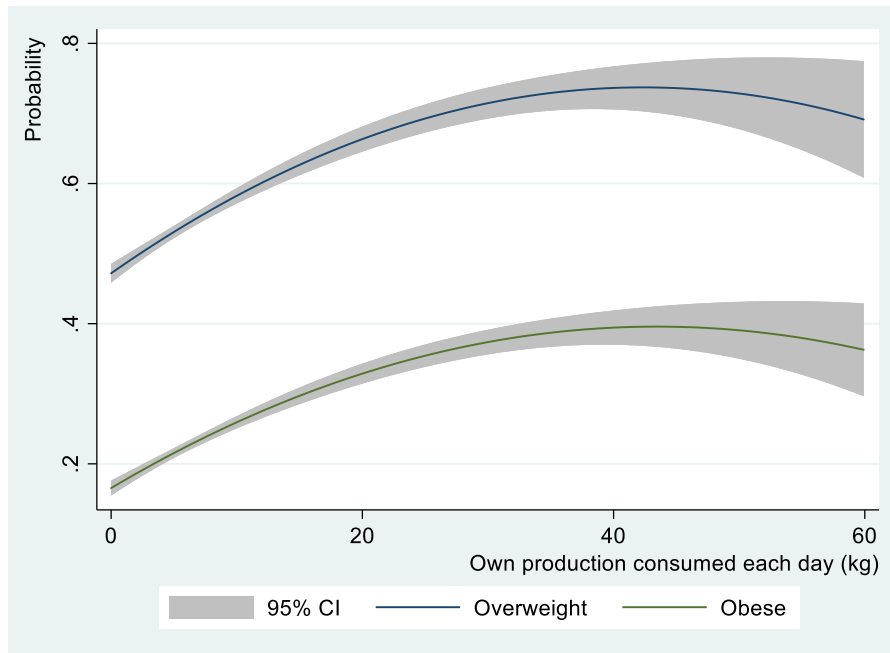


Figure 4.1 Relationship between own production consumed and probabilities of being overweight and obese, with 95% confidence intervals.

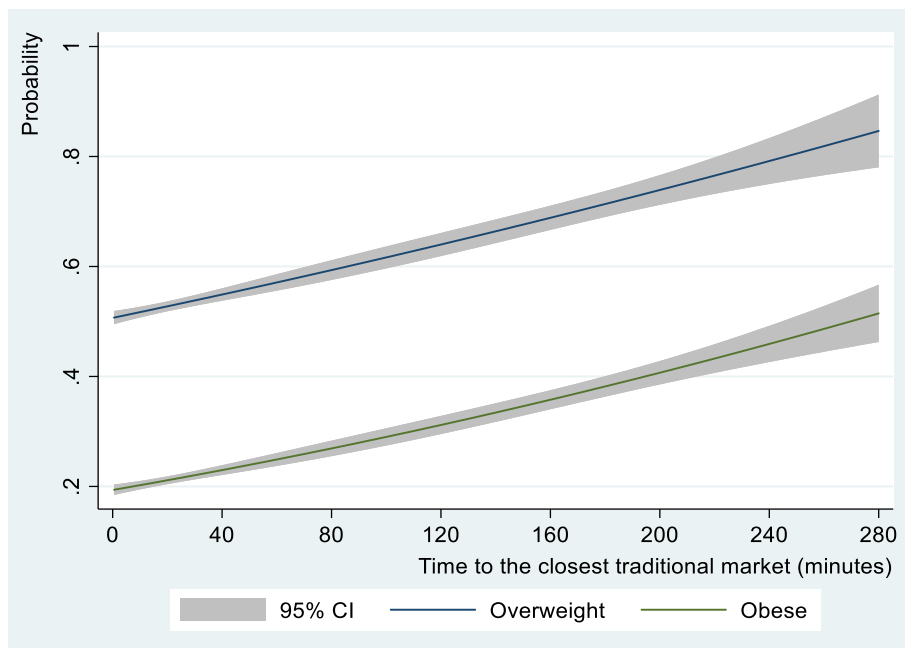


Figure 4.2 Relationship between time to the closest traditional market and probabilities of being overweight and obese, with 95% confidence intervals.

Figure 4.2 above presents the predicted probability of being overweight and obese respectively given the distance to the closest traditional market ('Time to traditional

market’). The more time it takes to reach a traditional market, the higher probability for an adult to be overweight/obese, given everything else being equal.

Figure 4.3 below depicts the relationship between age of the adult and the probability of being overweight or obese. It is observed that the peak of probability of overweight/obesity is at the age of 50.

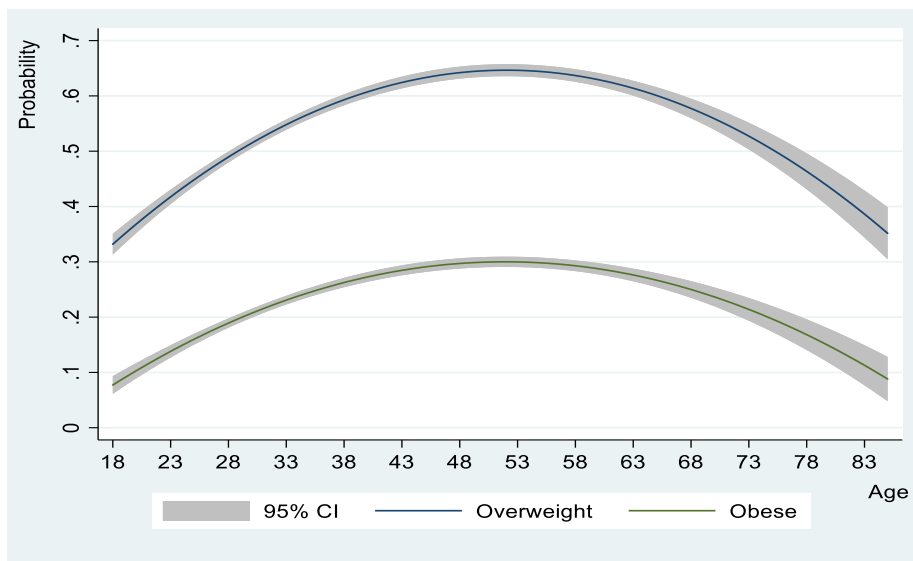


Figure 4.3 Relationship between age and probabilities of being overweight and obese, with 95% confidence intervals.

4.5.2 Probability of being overweight ($BMI \geq 25$) and obese ($BMI \geq 30$) for males, predictions from Model 4.

Figure 4.4 below displays male adults’ predicted probability of being overweight/obese, respectively, at different levels of household weekly expenditure. For example, for household weekly expenditure less than 7,100 FJD, the probability of being overweight (obese) for a male adult is around 0.5 (0.2), and when household weekly

expenditure increases from 7,100 FJD, a male adult's probability of being overweight/obese increases gradually.

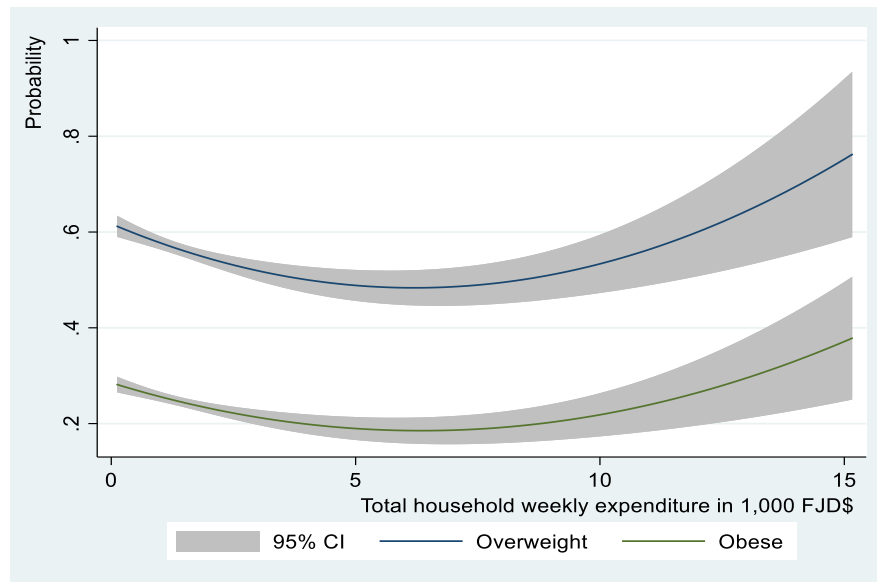


Figure 4.4 Relationship between expenditure and probabilities of being overweight and obese for male adults, with 95% confidence intervals.

4.5.3 Probability of being overweight ($BMI \geq 25$) and obese ($BMI \geq 30$) for females, predictions from Model 6.

Figure 4.5 below depicts the relationship between female adults' probability of being overweight/obese respectively and total household weekly expenditure. Unlike the quadratic relationship observed for male adults, the relationship for female adults is a linear one, with the probability of being overweight (obese) increasing as total household weekly expenditure increases.

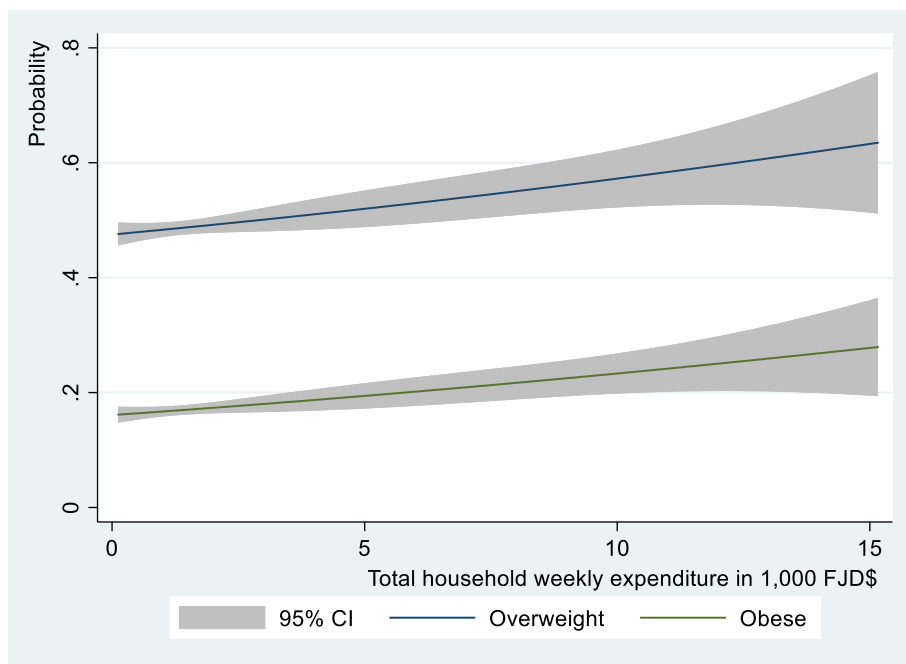


Figure 4.5 Relationship between expenditure and probabilities of being overweight and obese for female adults, with 95% confidence intervals.

For statistically significant categorical variables, a change in the probability of being overweight or obese is calculated for a change between the categories, which have been based on the predictions from Model 2 and are contained in Table 4.3 Below.

Table 4.3: Change in probability of being overweight or obese for adults

Variables	Change	Probability of a change in Overweight	Probability of a change in Obese
Purchaser	Wife only to Husband only	0.07	0.06
Female Decision to grow	No to Yes	0.06	0.05
Head	Household member to household head	-0.06	-0.05
Gender	Female to male	-0.09	-0.07
Head education	Primary to tertiary education	0.13	0.11
Spouse education	Primary to secondary education	0.04	0.03

4.6 Child Health Outcomes

4.6.1 General findings

There was a high incidence (36%) of stunting found amongst children in our sample. Stunting occurs where a child's height-for-age z-score is below -2, which is due to low height-for-age (Onis et al., 2007). In the period between 1993-2004, the incidence of stunting more than doubled in Fiji (Fiji Ministry of Health, 2013). However, there were no significant cases of wasting (low weight-for-height) found in the sample.

There were also a significant number of overweight and obese children in the sample, 25% and 10%, respectively. The findings are summarised in Figure 4.6 below.

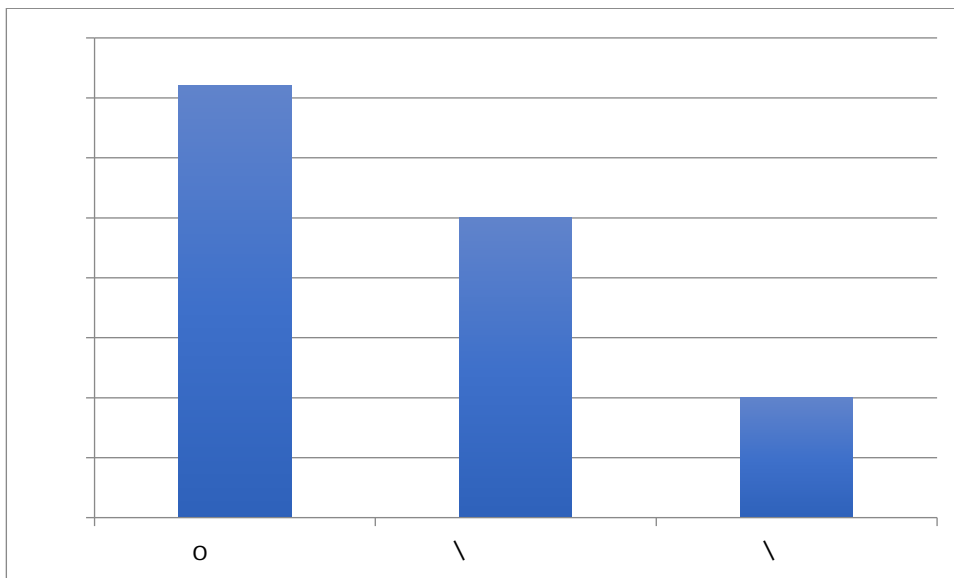


Figure 4.6: Incidence of child stunting, overweight and obesity

4.6.2 The impact of socio-economic factors on child BMI z-scores and stunting

Table 4.4 contains the results of the impact of socio-economic factors on child BMI z-scores (models 1 and 2) and child height-for-age z-scores (models 3 and 4). Similar to the adult analyses, to ensure robustness, we have included a model which

contains the education variables for the principal adult male and female of each household, and a model which excludes these variables.

The variable ‘Own production consumed,’ which accounts for the quantity of food consumed each day that is food grown by the household, was weakly significant ($\alpha = 0.10$) and negative. This suggests that households which consume more food produced at home may have lower rates of obesity (i.e. a lower BMI z-score). Additionally, considering the sign on the variable that is a proxy for income and squared (‘Total household expenditure squared’) as well as its significance ($\alpha = 0.05$), it appears that as households’ income increases there is an increase in BMI and perhaps a related increase in overweight and obesity of children, however this would suggest that BMI only increases to a point and actually begins to decline with higher levels of expenditures.

Further, we found that the ethnicity dummy variable, ‘Indo-Fijian’, which indicates if the child was from an Indo-Fijian family had a significant ($\alpha = 0.01$ and $\alpha = 0.05$, for Model 1 and Model 2, respectively) and negative impact on BMI z-score. This is consistent with the results for adult BMI models discussed earlier. Additionally, the variable ‘Age male’ which represents the years of age of the head of household had a significant ($\alpha = 0.01$) and negative association with child BMI. We found that for households with adult females who have higher BMI, children in those households are more likely to have higher BMI z-scores. These results suggest that households that are Indo-Fijian, have an older head of household, and consume greater amounts of food produced at home, are associated with decreases in BMI and thus are more likely to be in a healthy weight range.

With respect to the model estimating child height-for-age z-score, we found that a significant ($\alpha = 0.01$) and negative relationship with the variable ‘Time to traditional

market'. Therefore, this result would suggest that as the travel time (a proxy for distance) to traditional food market increases, a household's risk for child stunting increases.

A significant ($\alpha = 0.05$) and positive relationship was found between child stunting and the dummy variable 'Central Division'. Children who were located in the Central Division were less likely to experience stunting than those who resided in the Western Division. As noted above, the Central Division contains the capital city Suva and is becoming increasingly urbanised. Additionally, there may be greater access to healthcare in the Central Division which may explain the negative association with the likelihood of child stunting. Furthermore, the age of the child was found to have a significant ($\alpha = 0.01$) and negative relationship with child BMI z-scores, and a weakly significant ($\alpha = 0.10$) and positive relationship with child stunting. This finding is consistent with previous studies such as Neil (2007).

The household income proxy variable 'Household total expenditure' and 'Household total expenditure squared' had significant results with respect to height-for-age z-scores. It was found that as income increases there is a higher chance of stunting initially, however the impact becomes positive (lower chance of stunting) after a certain point. This finding is further discussed below.

A weakly significant ($\alpha = 0.10$) and negative relationship was found between the 'Education of household head's spouse' variable and height-for-age z-scores in Model 4. This finding suggests that a child in a household where the spouse has reached a primary school level education is less likely to be stunted than a child in a household where the spouse has reached a secondary education level. Interestingly, this result is inconsistent with the findings of the wider study in relation to the relationship between female education and household dietary quality.

Table 4.4. OLS regressions for Child BMI z-score and stunting

Variables	Child BMI for age Model 1	Child BMI for age Model 2	Child height- for-age Model 3	Child height-for- age Model 4
Own production consumed	-0.054*	-0.054*	0.028	0.018
Time to traditional market	0.004	0.004	-0.013***	-0.012***
Male shopping decisions	0.580	0.809	0.271	0.382
Female shopping decisions	0.505	0.588	0.602	0.815
Female employment	-0.005	-0.004	-0.021*	-0.025*
Female growing decisions	-0.011	0.164	0.494	0.128
Female financial decisions	0.921	1.249	-0.401	-0.212
Female secondary education		-0.117		-1.149***
Female tertiary education		0.454		-0.353
BMI maximum female	0.092**	0.076**	-0.034	-0.042
Household total expenditure (\$1000FJD)	0.363*	0.353	-0.492*	-0.524*
Household total expenditure (\$1000FJD) squared	-0.025**	-0.026**	0.023**	0.023**
Share of processed foods	0.014	0.014	-0.024	-0.045
Age male	-0.120***	-0.130***	0.083*	0.089**
Indo-Fijian	-1.499***	-1.485**	-0.438	-0.506
Central division	-0.334	-0.297	1.103*	1.198**
Male secondary education		0.074		-0.421
Male tertiary education	-0.434			0.001
Constant	-1.871	-2.644*	-1.173	0.018
R-squared	0.101	0.107	0.135	0.169
Observations	570	535	537	538
Adjusted R-squared	0.0092	0.1	0.103	0.137

*, **, ***Statistically significant at the 10%, 5%, and 1% level, respectively.

(a) Reference group is wife only. (b) Reference group is primary education for household head. (c) Reference group is primary education for household head's spouse.

4.7 Probability of Overweight and Obesity among Children

Figure 4.7 below depicts the relationship between the probabilities for overweight (BMI z-score >2) and obese (BMI z-score >3) against total household spending, as predicted on the basis of the OLS regressions above. The predicted probabilities peaked at household expenditure level about 7,400 FJD/week and start to decline quite quickly as expenditure increases.

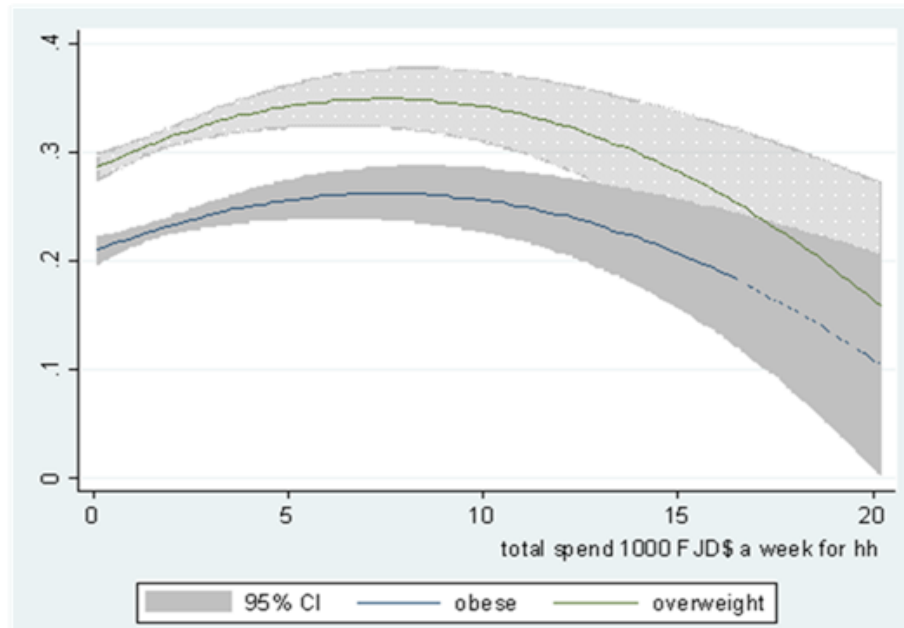


Figure 4.7: Relationship between expenditure and probabilities of being overweight and obese for children, with 95% confidence intervals.

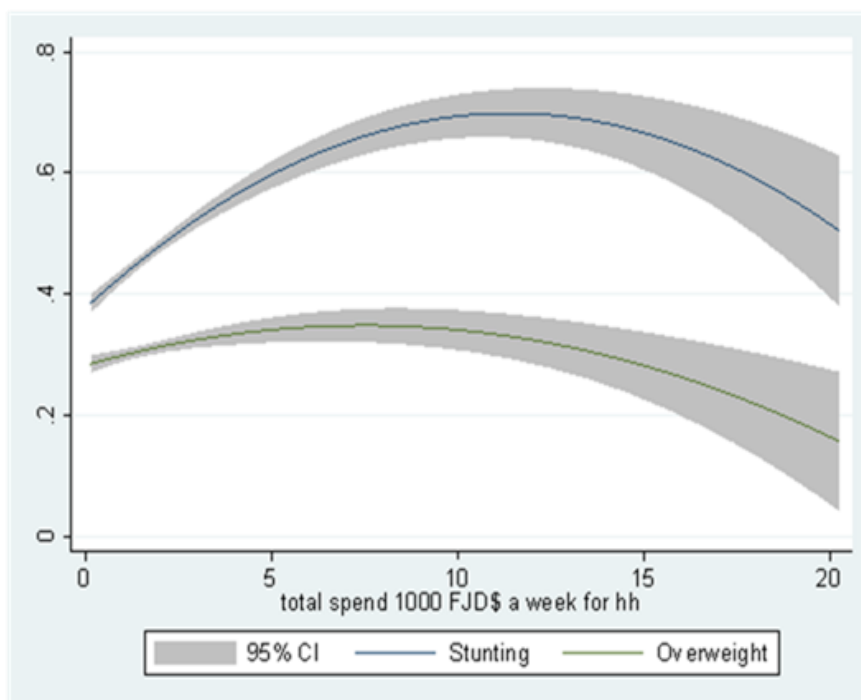


Figure 4.8: Relationship between expenditure and probabilities of stunting for children, with 95% confidence intervals.

Figure 4.8 above depicts the relationship between the probabilities for stunting (BMI z-score < -2) against total household spending, as predicted from the OLS regressions. The probability of stunting increases with total household spending initially, but start to decrease after household expenditure reaches about 10,555 FJD/week.

4.8 Conclusions

This study contributes to the literature as one of the first empirical investigations of the link between access to food markets; household expenditure on processed foods; home production of nutrient dense foods; and socio-economic factors, including gender roles, on health outcomes in rural households in Fiji.

This research confirms the existence of the double burden of under nutrition and obesity in Fiji, with 25% of the children overweight based on their BMI z-score and 10% obese, while 36% were stunted. The high incidence of stunting is concerning as under

nutrition at important stages of foetal development can also induce permanent physiological changes that result in obesity.

This study found that proximity to traditional food markets had a significant effect on adult BMI, particularly in males. Traditional food markets in Fiji contain locally grown and some imported fruit and vegetables. The significance of the proximity to traditional markets on BMI could be explained by the fact that households are able to purchase foods they are unable to produce on their own farms (Jones et al., 2014). With respect to child health outcomes, it was found that proximity to traditional markets had important implications in relation to child stunting. Households further away from traditional markets were more likely to experience stunting than those in closer proximity. The most direct cause of stunting is inadequate nutrition, or eating foods that lack growth-promoting nutrients (Bhutta et al., 2008). As noted above, traditional markets are the source of healthy unprocessed traditional foods, particularly fruits and vegetables.

This research found that the higher BMI of the adult females in the household, the more likely the children were to have a higher BMI z-score. Our finding is consistent with Gibson et al., (2007) who found that child BMI z-scores are significantly associated with higher maternal BMI and that having an overweight mother increases the likelihood of a child being overweight or obese. This finding highlights the need to find ways of targeting prevention and intervention efforts for childhood obesity at families with overweight parents.

This study found that in households where females contributed to decision-making in relation to agricultural production, a significant positive effect was observed on adult and female BMI. In addition, it was found that consumption of homegrown produce had a significant positive effect on male BMI but had a significant effect in reducing child BMI z-score.

The policy implications of this work, as well as the limitations of this study are further discussed in chapter 6 of this thesis.

Chapter 5: Understanding the Determinants of Diet Diversity and Healthy Eating Among Urban Households in Fiji

5.1 Introduction

Chapter 1 of this thesis details the transformation of global agrifood systems, whereby technological developments, trade liberalisation, foreign direct investment, urbanisation and the rising middle classes in developing countries are contributing to a profound shift in the way food is produced, processed, distributed and consumed (Qaim, 2017). A key component of this transformation is the food retail sector, in particular, the rapid spread of supermarkets, also known as the “supermarket revolution”.

A change in diets has also occurred in parallel to, and in two-way causality with, changes in the broader food system (Drewowski and Popkin, 1997; Bray and Popkin, 1998; Riveria et al., 2004; Pingali, 2007; Popkin et al, 2012; Popkin, 2017; Popkin and Reardon, 2018). This dietary shift, referred to as the “nutrition transition” occurred somewhat gradually in developed countries some time ago and is now being observed unfolding across developing countries at much more rapid rate (Popkin et al., 2012; Qaim, 2017).

There are growing concerns that changing retail environments may possibly speed up the nutrition transition, particularly in developing countries where consumers are increasingly purchasing their foods from supermarkets instead of wet markets and other traditional outlets (Timmer, 2009; Reardon et al., 2012; Reardon, Timmer and Minten, 2012; Chege et al., 2015). Compared with traditional retail food markets, supermarkets tend to have a wider variety of processed and highly processed foods and drinks, often in larger package sizes and combined with special promotion campaigns (Hawkes, 2008; Timmer, 2009; Swinburn et al., 2011; Qaim, 2017). As such, the spread of supermarkets

and other modern food outlets in developing countries may contribute to an “obesogenic” diet transition. A number of studies have examined the association between supermarkets and dietary shifts in developing countries, finding evidence that suggests that changes in food systems (i.e. the supermarket revolution) have to some extent played a role in the diet and nutrition transition and the increased consumption of energy-dense, processed foods (Asfaw, 2008; Tessier et al., 2008; Asfaw, 2011; Zhang et al., 2012; Banwell et al., 2013; Kelly et al., 2014; Umber et al., 2015; Tobia et al., 2015; Rischke et al., 2015; Demmler et al., 2017; Demmler et al., 2018).

While a number of studies (including those noted above) have focused on the relationship between modern food retail penetration and dietary transition in developing countries, the results have been varied. This study addresses a number of gaps in the literature, first by examining the link between food market environments and dietary quality amongst PICTs, where little is known about the impact of modern food retail penetration. Using a unique set of household level data from a survey conducted in the two major urban centres of Fiji, this research explores how food market environments and socio-economic factors affect the diet quality of urban households in Fiji.

Fiji provides a unique context for this study, as it is one of the most developed economies amongst PICTs, and as mentioned in previous chapters it has undergone a significant nutrition transition. It is hypothesised, based on current trends occurring in other developing countries, that modern food markets are likely to have a negative impact on diet quality, in particular by providing urban Fijian households with greater access to unhealthy foods, including calorie dense imported and processed foods. This research has important policy implications for PICTs who are currently experiencing an obesity and NCD crisis.

5.2 Literature Review

5.2.1 Urbanisation

A major factor impacting on both food consumption and retail food market shopping is the proportion of the Fijian population living in urban areas. This has increased from 38% in 1986 to 56% in 2017 (Fiji Bureau of Statistics, 2017). Epidemiological studies conducted in Fiji since the 1960s have identified that urbanisation is associated with considerable prevalence of NCDs due to their associated risk factors such as high salt intake, physical inactivity, atherogenic dyslipidemia, obesity, hypertension and diabetes (Kesteloot et al., 1980; Dwyer and Briggs, 1983; Ram et al., 1983; Zimmet et al., 1985; Collins et al., 1996; Taylor et al., 2013). Urban food environments – with supermarkets, food vendors and restaurants – facilitate access to unhealthy diets, although they can also improve access to safe and nutritious foods for people who can afford them, however, for the urban poor, the most easily available and affordable diets are often unhealthy (Hawkes et al., 2017).

Other socio-demographic changes, such as increasing disposable incomes and more women entering the workforce, have also played a role in shifting food demand with subsequent effects on diet quality and diet-related health (Popkin, 1999; 2006; Mendez and Popkin, 2004; D’Hease and Van Huylenbroeck, 2005; Pingali, 2007; Asfaw, 2008).

5.2.2 Global food trade and PICTs

PICTs have undergone a dramatic nutrition transition since World War II. The main catalyst driving dietary change is trade in food (Evans et al., 2001; Hughes and Lawrence, 2005; Thow and Snodown, 2012). Traditional diets in PICTs were relatively healthy and based on large quantities of staple foods (roots, tubers, fruits, fresh fish and

leafy greens) has been replaced by a diet high in meat, processed foods, sugar, and refined staples such as rice (Thaman and Clarke, 1983; Coyne, 2000; WHO, 2003; Thow et al., 2010; 2011; Snowden et al., 2013; Estieme et al., 2014; Wate, 2017). Chapter 1 of this thesis provides further background with respect to the nutrition transition that has taken place in PICTs.

PICTs are particularly vulnerable to the effect of international trade and changes in the global economy (Thow et al., 2011), and are increasingly dependent on imported foods. For example, in Fiji the most recent Food Balance Sheet in 2009 revealed that 68% of total calories consumed by Fijians came from imported food (Vatucawaqa, 2012). Imported foods such as processed fatty meats, have been identified as a key contributor to diet-related disease in the Pacific (Foliaki and Pearce, 2003; Schultz, 2004; Hughes and Lawrence, 2005). Snowden et al., (2010) attribute the move away from traditional diets and a growing reliance on imported foods such as rice, meat products, and sugary snacks as a major contributor to the serious problem of NCDs in PICTs.

Although a number of studies have looked at trade and food policy issues in the Pacific (Hone, 2003; Schultz, 2004; Hughes and Lawrence, 2005; Thow and Snowdon, 2010; Snowdon et al., 2011), this study examines, for the first time, the link between a range of socio-economic influences, location and food market choices on diet quality and food expenditure choices in Fiji. Noting the nutrition transition that has occurred in Fiji, as noted above and in Chapters 1, 3 and 4, this study seeks to examine how modern food markets and socio-economic factors impact upon the diet quality of urban households in Fiji.

5.3 Data and Case Study Description

The analysis in this chapter uses data from a face-to-face survey of urban households, the Fiji Urban Consumer Survey, which was conducted in Fiji in June and July of 2012. The individuals responsible for food purchase and meal decisions from 1000 urban households on Fiji's most populated and largest island, Vitu Levu, were interviewed during the study. Our sample included 759 households from the capital city Suva and 241 households from Nadi, a tourist hub on the western side of Vitu Levu where the international airport is located.

The data collection was done in collaboration with the Fiji Bureau of Statistics (FBOS). Pre-existing enumeration area codes (EAs) developed for the national census was used to distinguish between seven different incomes classes (High, Middle, Low, Housing, Squatter, Urban Village and Misc/Mixed). The survey was consequently stratified by selecting a representative sample of 50 EA codes followed by a random sample of 20 households from each EAs code to make up a total of 1000 surveys.

The survey instrument was adapted from that used by Umberger et al. (2015) and covered expenditures and consumption behaviour for a total of 79 different food categories and eight different modern and traditional retail formats including supermarkets, traditional main market, roadside stalls/hawker, corner shops/butcher/bakery, fish markets, restaurants, fast food and service stations. Data was collected in relation to household characteristics, food expenditures and decision-making, shopping behaviour and perceptions of, and preferences for, food retail outlets.

The survey interviews were conducted face-to-face at the households by a team of 27 trained enumerators. A detailed enumerator manual was developed to assist with training and to provide a reference manual during fieldwork. Face-to-face household interviews were conducted to avoid self-selection issues, ensure a more random

representation across different income levels, and to allow more time with the person responsible for food purchasing (Winship and Mare, 1992). Each survey took on average two hours to complete.

After each survey was conducted, it was checked by FBOS supervisors in the field to ensure any obvious errors or omissions could be rectified by enumerators while they still had access to the respondent. Once the surveys were fully completed the data was entered using a CSPro template to limit the number of entry errors before it was cleaned and analysed.

5.4 Methodology

To analyse determinants of dietary diversity and healthy eating behaviour among urban Fijian households the basic concept of utility maximisation problem is applied (Cragg, 1971). It is assumed that the household acts to solve the constrained utility maximisation problem for food consumption, for example:

$$y_i = g(x_i, b) \tag{5.1}$$

Where y_i is the dependent variable representing the household diet quality measure, for a specific household i , x_i is a vector of independent variables representing food market environment and household socio-economic characteristics and b is a vector of parameter estimates. Since small variations in price change information are usually not available in cross-sectional data, it was assumed that all households face the same relative prices for the same food items.

5.4.1 Dependent variable measurement

The dependent variable (y_i) is measured in three ways: 1) household diet diversity score (HDDS); 2) share (%) of total food expenditures on each of twelve different food groups; 3) share (%) of total food expenditure on healthy food ('Healthy share'). Table

5.1 provides the descriptive statistics and variable measurement for each dependent variable.

Household diet diversity score (HDDS) is defined as the number of different foods or food groups consumed by a household over a 12 month period (Hoddinott and Yohannes, 2002; Swindale and Bilinsky, 2006; Gina et al., 2010). Following Swindale and Bilinsky (2006) and FAO Guidelines (2011), all foods were classified into 12 groups. The following 12 food groups are included to calculate household dietary diversity scores: (i) cereals; (ii) roots and tubers; (iii) legumes, nuts and seeds; (iv) vegetables; (v) fruits; (vi) meat, poultry and offal; (vii) eggs; (viii) fish and seafood; (ix) milk and milk products; (x) oils and fats; (xi) sugar, salt and honey; and (xii) processed foods and beverages.

There are studies that have calculated dietary diversity scores only based on food groups one to nine that are listed above (Arimond et al. 2010; FAO, 2011). However, taking into account the nutrition transition that has occurred in PICTs it was important to include food groups 10, 11 and 12 as listed above, as they are likely to be the food groups that are most likely to contribute to poor diet quality. The 12 food groups were categorised as either healthy or unhealthy based on Volpe et al. (2013) and USDA (2010), along with further adjustments made based on the Fiji Guide to Healthy Eating (Fiji Ministry of Health, 2015).

The food items classified as “healthy” food groups were: (i) cereals; (ii) roots and tubers; (iii) vegetables; (iv) fruits; (v) meat, poultry and offal; (vi) eggs; (vii) fish and seafood; (viii) pulses, legumes and nuts; and (ix) milk and milk products. The three “unhealthy” food groups created from our food list were: (x) fats and oils; (xi) sugar, salt and honey; and (xii) processed foods and beverages. Sensitivity analysis on the dietary diversity models was undertaken by only including the nine healthy food groups. Given that HDDS is a count variable that is not normally distributed, a common approach is to

use Poisson regression, which is a generalised linear model form of regression analysis (e.g. Greene, 2012; Cameron and Trivedi, 2013; Shibhatu et al., 2015; Koppmair et al., 2017).

Expenditure shares for each of the 12 food groups for each household, i were calculated by first summing up expenditures on all 79 food groups at all types of food retail outlets (modern and traditional) to get total food expenditures per household. We then aggregated expenditures for the 12 food groups used to calculate the HDDS for each household i to get a measure of total expenditure for each of those food groups. The total expenditure for each food group for the household was then divided by the total food expenditures for the household to get the expenditure share for each of the 12 food groups. The mean share of food expenditures that households in the sample spent on each of the 12 food groups on average is provided in Table 5.1.

The third dependent variable ‘Healthy share’ is a continuous variable representing a household’s total share of expenditure on healthy food. Healthy share was created by summing for each household, i , the expenditures on the nine healthy food groups noted above, and dividing the sum by the total food expenditures for household i . We used the current local Fijian supermarket prices for these items to get a total expenditure value (FJD\$/day) for both the expenditure share and healthy share variables.

Multiple regression analysis with Ordinary Least Square (OLS) was used to estimate the model the share of expenditure on healthy food, while simultaneous multivariate Tobit regressions were used to estimate share of expenditure of different healthy and unhealthy food groups. This allowed us to estimate M-equation Tobit models simultaneously (Cappellari and Jenkins, 2006). For a more convenient interpretation, we report marginal effects for all explanatory variables for Poisson- and OLS models. In these two models, marginal effects describe how the number of food groups consumed

changes when the explanatory variables change by one unit. Estimated coefficients are depicted in the simultaneous multivariate Tobit regressions.

5.4.2 *Independent variable measurement and justification*

A number of independent variables were identified in the literature as being potentially important in influencing the diet quality and food expenditure of a household. One of the key variables of interest in this study was ‘Modern food market share’, which was a continuous variable with a range between 1-100 representing the household share (%) of food expenditures made in modern food markets (e.g. supermarkets, fast food outlets and service stations). This variable was created by summing up expenditures made in modern food markets on any of the 79 food categories at household *i*, and then dividing by total household food expenditures for household *i*. Food expenditures made at traditional retail outlets, including municipal markets and roadside stalls have been excluded. Consumers who purchase a larger share of their food at modern food markets may purchase less healthy foods for their household. In addition, a continuous variable of time to modern markets was created which included the time taken to go to nearest supermarket, main market in town/city, restaurant, fast food outlet, service station and convenience store.

Previous studies have shown higher income is associated with greater consumption of vegetables and fruits (Irala-Estevez et al., 2000; Groth et al., 2001; Giskes et al., 2002; Perez, 2002; Smith, Bogin et al., 2005; French et al., 2010; Miller et al., 2016). However, a few studies have found that an increase in income has decreased the consumption of certain food groups (e.g., grains and milk products) (Smith and Baghurst, 1992; Nayga et al., 1999; Kearney, 2010; Popkin, 2012). In our model, ‘Income’ was a categorical variable representing the approximate monthly income of each household.

Other household-level variables were included in the analyses with the aim of reflecting socio-cultural influences on dietary diversity. These socio-demographic variables included: Household size, household composition (e.g. number of children under the age of 5, education and age of the respondent, and main religion of household), and location of the household (Suva or Nadi).

The variable 'Household size' was included because households with more family members to support may have income constraints which limit their economic access to some types of more healthy food groups (Schroeter et al., 2013). The variable 'Children under 5' represents the number of children in the household who are five years old or younger. This variable was included because households with young children may make different food purchasing decisions due to the specific dietary needs of young children (Umberger et al., 2015).

The variable 'Education' was included because literature suggests that higher education is associated with an increased likelihood of purchasing healthier foods (i.e., vegetables and fruit, unprocessed meats, low-fat milk, and high-fibre foods) (Kirkpatrick and Tarasuk, 2003; Turrell and Kavanagh. 2006, Bere et al., 2008; Appelhans et al., 2012). The partial effect of the respondent's age ('Age') on the share of healthy food expenditures is expected to be positive. Previous studies have shown that individuals become more concerned about their diet as they age (Frazao and Allshouse, 2003).

A variable, 'Hindu', is included to indicate that the main religion of the household is Hind. Hinduism is widely practiced by Indo-Fijians and entails a number of restrictions on food consumption. Many Hindus follow a lactovegetarian diet, which prohibits meat, poultry, fish and eggs, although milk products are allowed and encouraged (Hammond, 2013). The variable 'Hindu' captures the effects of Hinduism on food consumption and is equal to one if the main religion of the household is Hinduism. As data was collected

from both the capital city Suva and tourist hub Nadi, the location variable 'Suva' was tested, a dummy variable that indicates whether the respondent lives in Suva.

To estimate the impact of eating at home versus elsewhere, food purchased outside the home ('Food-away-from-home') variable was created as a measure. This categorical variable was created based on the respondent's answers to the question about how frequently the household would purchase a main or evening meal (the meal could be eaten at home or outside of the home, but the meal was purchased 'already prepared' by someone other than a member of the household).

To examine the influence of nutritional information, the dummy variable use of nutritional information was created. This variable identifies whether the respondent had indicated that nutritional information was an important factor in influencing their decision to purchase food products, which was expected to positively influence diet quality (e.g. Huston and Finke, 2003).

Female empowerment in household decision-making has been found to play an important role in household diet and health outcomes, especially in developing countries. For example, in a study conducted in Ghana by Malapit and Quisumbi (2015), it was found that mothers and children in dual-decision maker households have more diverse diets. We chose three main variables to explore the influence of the female head of the household on diet quality in urban households in Fiji. The variable 'Female education' represents the years of education completed by the female head of the household. This variable was included as it was hypothesised that higher female education is likely to lead to increased awareness of the relationship between diet, nutrition and health and therefore is a positive influence on household diet quality (e.g. Turrel and Kavanagh, 2006). A decision-making variable in relation to food consumption ('Female food choice') is an aggregate score or index with values ranging from 1-3 and accounts for three variables (i.

if a female adult family member was responsible for deciding which foods to purchase; ii. if a female adult family member was responsible for the majority of the food shopping; and iii. if a female adult family member was responsible for decision-making in relation to the household's food consumption or meals). The variable 'Female employment' represents whether the principal female of the household was employed/worked outside of the home. It was hypothesised that females who work longer hours may have less time to spend on household food shopping and food purchase decisions, which could therefore have a negative impact on household diet quality (e.g. Mancino and Kinsey, 2004).

We also checked for multicollinearity (using VIFs and correlation factors) among independent variables in the model. No severe multicollinearity was detected. Furthermore, the presence of outliers was checked with a few values needing to be removed from our estimation. The study used bootstrapped standard errors for all regression models, which allows us to have a nonparametric approach for evaluating the distribution of a statistic based on random resampling and satisfy the condition of the assumption that error terms are independently and identically distributed (i.i.d.).

5.5 Results

5.5.2 Descriptive statistics

Descriptive statistics for the variables used in the present study are shown in Tables 5.1 and 5.2. At the household level, the mean HDDS is 10.06; which implies that the average household has consumed at least 10 food groups on average over the past twelve months. Around 20% of the households consumed fewer than 10 food groups and only 8.70% consumed all 12 food groups. The highest share of expenditures on a food group was for processed foods, the second highest was fish and seafood, and the third highest was cereals. The lowest share of expenditure was found to be on the food group pulses, legumes and nuts. The mean for 'Healthy share' was 72.85, which implies that on average

72% of household food expenditure was spent on healthy foods, based on the 9 healthy food groups defined above.

Table 5.2 shows that the total share of food purchased from modern food markets (Modern food market share) was approximately 59%. The average income of urban Fijian households was approximately 1500 FJD\$/month. Of the sample, approximately 26% are Hindu and 66% are Christian, with small percentage of Muslim and others. The average time taken to get to the nearest modern market is approximately a 15-minute walk. Cumulatively, around 53% of the time, a female family member was responsible for deciding what food items to purchase, undertaking the food shopping and deciding what food/meals would be consumed by the household. Finally, it was found that approximately 27% of the female heads of household in our sample worked outside of the home.

Table 5.1. Descriptive Statistics: Dependent variables

<i>Variables</i>	<i>Definition</i>	<i>Mean</i>	<i>SD</i>	<i>Min</i>	<i>Max</i>	<i>N</i>
HDDS	Household Diet Diversity Score	10.06	1.08	5	12	996
Cereals (Share 1)	Share of food expenditures on breads and cereals	10.17	6.90	0	87.87	996
Roots and Tubers (Share 2)	Share of food expenditures on roots and tubers	6.39	4.06	0	32.27	996
Vegetables (Share 3)	Share of food expenditures on vegetables	14.73	7.67	0	79.30	996
Fruits (Share 4)	Share of food expenditures on fruits	8.49	6.42	0	41.08	996
Meat, Poultry and Offal (Share 5)	Share of food expenditures on meat, poultry etc.	6.93	6.11	0	60.11	996
Eggs (Share 6)	Share of food expenditures on eggs	2.25	1.77	0	24.94	996
Fish and Seafood (Share 7)	Share of food expenditures on fish and other seafood	11.65	6.21	0	44.10	996
Pulses, Legumes and Nuts (Share 8)	Share of food expenditures on pulses and legumes	1.13	0.41	0	3.36	996
Milk and Milk Products (Share 9)	Share of food expenditures on milk products	3.12	3.10	0	40.45	996
Oils and Fats (Share 10)	Share of food expenditures on oil and fats	2.14	1.54	0	13.19	996
Sugar, Salt, and Honey (Share 11)	Share of food expenditures on sugar, salt and honey	2.23	0.68	0	11.27	996
Processed foods and beverages (Share 12)	Share of food expenditures on processed food	19.52	9.95	0	84.62	996
Healthy share	Share of food expenditures on healthy foods (food groups 1-9)	72.85	13.05	6.98	99.11	996

Table 5.2. Descriptive Statistics: Explanatory variables

<i>Variables</i>	<i>Definition</i>	<i>Mean</i>	<i>SD</i>	<i>Min</i>	<i>Max</i>	<i>N</i>
Modern food market share	Total share of expenditures on food purchased from modern market, (%)	59.85	13.05	6.986	79.112	996
Income	Categorical (FJD\$/month): 1 = ≤ 100; 2 = 101 - 500; 3 = 501-1000; 4 = 1001-1500; 5 = 1501-2000; 6 = 2001-3000; 7 = 3001-4000; 8 = >4001 FJD\$/month)	3.47	1.44	1	8	987
Household size	Number of people living in the household	4.82	2.43	1	14	997
Children under 5	Number of children who are aged ≤ 5 years of age	1.55	0.82	0	5	997
Education	Respondent's years of education completed	9.79	3.99	3	19	912
Age	Age (years) of the respondent	43.34	12.60	18	86	966
Hindu	Religion dummy (1 = Main religion of the household is Hindu; 0 = otherwise)	0.54	0.49	0	1	996
Suva	Household located in Suva = 1; Nadi = 0	0.76	0.42	0	1	997
Food-away-from-home	Frequency of purchasing food prepared outside of the home: Never = 0, Few times a year = 1, Once a month = 2, 2-3 times per month = 3, once a week=4, 2-6 times per week=5 and everyday = 6	2.49	1.58	0	6	995
Time to modern market	Time to closest modern market (Minutes)	14.80	9.72	0	45.50	995
Use nutritional information	1 = the respondent utilises nutritional information when making food purchase decisions; 0 = otherwise	0.74	0.43	0	1	993
Female Education	Number of years of education completed by the female head of household	10.86	4.12	0	20	918
Female food choice	Aggregate score/index indicating female household members' responsibilities related to: what food to purchase; majority of the food shopping; and household's meals/food consumption	2.28	1.05	0	3	988
Female employment	1 = the female head of household worked outside of the home; 0 = did not work outside of the home	0.36	0.48	0	1	920

5.5.3 *Regression results*

Table 5.3 shows the results of Poisson regression model where HDDS was used as a dependent variable. These results suggest that household income; increased frequency of eating out; and use of nutritional information had significant and positive effects on household diet diversity score (HDDS), although the effect is relatively small. In the sample, an increase in monthly income, increased frequency of eating out and use of nutritional information leads to 0.6%, 0.1% and 0.4% increase in the number of food groups consumed by the household respectively. This finding is consistent with several other studies, which have found that higher-quality diets tend to be consumed by better-educated and more affluent people (Thiele et al., 2004; Daramon and Drewnouski, 2008).

As noted above, our results indicated that when households purchase food outside the household more often, their diet diversity also increased. This is an interesting finding and should be considered carefully in light of studies such as Todd et al., (2010) which found that in USA for the average adult, food consumed away from home increased daily caloric intake and reduced diet quality. Furthermore, studies have linked frequent eating out to higher caloric intake, weight gain and obesity (Pereira, 2004; Wansink, 2004). It should be noted that the HDDS measure does not account for quantity consumed of different food groups and portion size, and other unobserved factors, such as food preferences, income and time constraints. These factors influence not just the choice of where to eat, but also the nutritional quality of what is eaten.

The positive and significant finding in relation to use of nutritional information is consistent with other studies which have found that the use of nutritional information, while shopping for food products or eating out, has a positive effect on diet quality (e.g. Barreiro-Hurlé et al., 2010). However, as hypothesised, if a household practices

Hinduism, there was a significant negative impact on dietary diversity, which translated to a 2.1% decrease in the number of food groups consumed.

To check the robustness of our model, as a sensitivity analysis, we used a variant of the 12-point HDDS and conducted one analysis where the HDDS dependent variable only included the nine more “healthy” food groups. The findings are largely in line with those discussed above. Breusch-Pagan / Cook-Weisberg tests were used to check for the presence of heteroscedasticity, which indicated there was not a serious heteroscedasticity issue (Green, 2012).

Table 5.3. Determinants of household diet diversity score (HDDS) in urban Fiji: Poisson model

<i>Variables</i>	<i>HDDS</i>
Modern food market share	-0.001 (0.000)
Income	0.006** (0.003)
Household size	0.000 (0.002)
Children under 5	-0.003 (0.006)
Education	0.002 (0.002)
Age	0.003 (0.004)
Hindu	-0.021** (0.010)
Suva	0.000 (0.010)
Food-away-from-home	0.001* (0.010)
Time to modern market	0.004 (0.000)
Use nutritional information	0.004* (0.009)
Female empowerment variables	
Female education	-0.007 (0.002)
Female food choice	0.002 (0.005)
Female employment	0.009 (0.009)
Constant	2.267*** (0.039)
No. of observations	905
Pseudo R ²	0.007
Pearson goodness-of-fit	81.236
Prob > chi2(671)	(1.000)

Note: Model was estimated with a Poisson estimator. Coefficient estimates are shown with bootstrap SEs in parentheses. *, **, *** Statistically significant at the 10%, 5%, and 1% level, respectively.

Tables 5.4 and 5.5 show the results of the models exploring the variables impacting expenditure share on healthy foods and expenditure shares on each of the 12 distinct food groups discussed above. The results in Table 5.3 indicate that a household's expenditure share on healthy foods significantly decreased if the household purchased a greater share of foods from modern food markets. Similar to our findings in Table 5.2, a significant positive effect was evident for the income variable. However, a household's total expenditure on healthy foods increased significantly with the age of the respondent and the education level of the female head of the household. The results also show that households who practice Hinduism spend more on healthy food compared to households that practice other religions.

The results in Table 5.4 indicate that the likelihood of expenditure share on healthy foods (such as roots and tubers, vegetables and fruits) significantly decreases when the household purchased a greater share of their food from modern food markets (although the coefficients of these variables are statistically significant only for the fruit food group). This is consistent with a number of studies which have found that supermarket purchases increase the share of highly processed foods at the expense of staple foods (Asfaw, 2008; Kelly et al., 2014; Rischke et al., 2015; Umberger et al., 2015). Additionally, consumption of roots and tubers (which are traditional foods for indigenous Fijians) and eggs significantly increased if the household lived further away from modern supermarkets.

Table 5.4. Determinants of households' share of healthy food expenditure (Healthy share) in urban Fiji: OLS model

<i>Variables</i>	<i>share of healthy food expenditure</i>
Modern food market share	-0.163* (0.053)
Income	1.595** (0.372)
Household size	-0.434 (0.273)
Children under 5	0.262 (0.557)
Education	0.197 (0.183)
Age	0.126** (0.043)
Hindu	1.683* (0.891)
Suva	-0.058 (0.940)
Food-away-from-home	0.333 (0.265)
Time to modern market	0.009 (0.049)
Use of nutritional information	-0.892 (0.968)
<hr/>	
Female empowerment	
Female education	0.353* (0.199)
Female food choice	0.221 (0.507)
Female employment	0.207 (0.001)
<hr/>	
Constant	85.903*** (4.070)
<hr/>	
No. of observations	905
R ²	0.092
F(14, 671)	13.971
Prob > F	0.000

Note: Model was estimated with a OLS estimator. Coefficient estimates are shown with bootstrap SEs in parentheses. *, **, *** Statistically significant at the 10%, 5%, and 1% level, respectively.

Table 5.5. Determinants of households' share of healthy and unhealthy food expenditure in urban Fiji: Multivariate Simultaneous Tobit model

<i>Independent Variables</i>	Healthy food groups									Unhealthy food groups		
	Cereals	Roots and Tubers	Vegetables	Fruits	Meat, Poultry and Offal	Eggs	Fish and Seafood	Pulses, Legumes, Nuts	Milk And Milk products	Oils and fats	Sugar, salt, honey	Processed foods and beverages
Modern food market share	0.039 (0.024)	-0.002 (0.014)	-0.006 (0.027)	-0.036* (0.023)	-0.014 (0.024)	0.014* (0.007)	0.006 (0.022)	-0.011 (0.008)	0.016 (0.012)	0.008 (0.006)	-0.005 (0.007)	0.071** (0.034)
Income	0.289* (0.197)	0.018 (0.115)	-0.160 (0.219)	0.148 (0.192)	0.445** (0.192)	0.057 (0.056)	0.261 (0.174)	-0.034 (0.066)	0.112 (0.101)	0.060 (0.045)	0.003 (0.062)	0.678** (0.280)
Household size	0.118 (0.131)	0.067 (0.076)	-0.107 (0.144)	-0.038 (0.127)	-0.126 (0.128)	-0.007 (0.038)	0.016 (0.119)	-0.045 (0.044)	0.048 (0.067)	-0.046 (0.031)	0.061 (0.040)	0.210 (0.186)
Children under 5	-0.561* (0.359)	-0.499** (0.207)	-0.253 (0.392)	-0.070 (0.349)	-0.021 (0.350)	-0.084 (0.103)	-0.227 (0.323)	-0.137 (0.128)	-0.168 (0.186)	0.028 (0.081)	-0.178 (0.115)	-0.738 (0.498)
Education	-0.038 (0.103)	-0.048 (0.060)	-0.039 (0.025)	-0.056 (0.101)	0.147 (0.101)	0.030 (0.031)	-0.077 (0.093)	0.017** (0.035)	0.061 (0.053)	-0.011 (0.024)	0.001 (0.033)	0.075 (0.146)
Age	-0.015 (0.023)	-0.012 (0.013)	0.031 (0.025)	0.028 (0.022)	-0.021 (0.023)	-0.002 (0.006)	-0.013 (0.021)	0.002 (0.007)	-0.008 (0.012)	-0.002 (0.006)	0.001 (0.007)	-0.019 (0.032)
Hindu	-0.143 (0.598)	2.261** (0.349)	1.973** (0.668)	0.101 (0.581)	-1.125** (0.584)	0.058 (0.173)	-0.009 (0.541)	0.978** (0.190)	1.531 (0.307)	0.861** (0.136)	0.814 (0.181)	0.437 (0.836)
Suva	-0.271 (0.630)	0.013 (0.362)	-0.517 (0.687)	-0.557 (0.606)	-0.148 (0.613)	-0.091 (0.179)	0.427 (0.558)	-0.161 (0.204)	0.026 (0.323)	-0.015 (0.141)	0.017 (0.197)	0.705 (0.868)

Table 5.5. (continued) Determinants of households' share of healthy and unhealthy food expenditure in urban Fiji: Multivariate Simultaneous Tobit model

<i>Independent Variables</i>	Healthy food groups									Unhealthy food groups		
	Cereals	Roots and Tubers	Vegetables	Fruits	Meat, Poultry and Offal	Eggs	Fish and Seafood	Pulses, Legumes, Nuts	Milk And Milk products	Oils and fats	Sugar, salt, honey	Processed foods and beverages
Food-away-from-home	0.095 (0.163)	0.120 (0.096)	-0.009 (0.184)	0.164 (0.161)	0.249* (0.159)	0.013 (0.046)	-0.032 (0.146)	0.028 (0.052)	0.089 (0.083)	-0.067 (0.037)	-0.025 (0.052)	-0.202 (0.231)
Time to nearest modern market	-0.019 (0.028)	0.027* (0.016)	-0.010 (0.031)	-0.007 (0.027)	-0.009 (0.027)	0.013* (0.008)	0.025 (0.026)	0.012 (0.008)	0.006 (0.014)	-0.001 (0.006)	0.068 (0.021)	-0.036 (0.041)
Use of nutritional information	-0.510 (0.595)	0.298 (0.345)	-0.088 (0.653)	-0.666 (0.576)	-1.383** (0.579)	0.192 (0.171)	0.176 (0.531)	-0.028 (0.196)	-0.026 (0.308)	-0.023 (0.135)	-0.066 (0.184)	1.149 (0.824)
Female empowerment												
Female education	-0.053 (0.112)	-0.014 (0.162)	-0.046 (0.124)	0.174* (0.108)	-0.135 (0.110)	-0.024 (0.032)	0.060 (0.101)	0.075* (0.038)	-0.044 (0.058)	-0.048* (0.008)	0.018 (0.037)	0.012 (0.160)
Female food choice	0.079 (0.279)	-0.015 (0.162)	0.126 (0.309)	0.076 (0.269)	0.065 (0.272)	-0.031 (0.080)	0.085 (0.251)	-0.012 (0.092)	-0.005 (0.144)	0.066 (0.063)	-0.075 (0.086)	0.214 (0.389)
Female employment	0.485 (0.571)	-0.555 (0.330)	-0.338 (0.624)	-0.883 (0.549)	-0.361 (0.556)	-0.064 (0.164)	0.324 (0.513)	-0.038 (0.191)	0.303 (0.294)	-0.156 (0.129)	0.149** (0.177)	0.028* (0.093)
Constant	7.499** (2.572)	6.684*** (1.496)	14.066*** (2.833)	8.592*** (2.486)	7.661** (2.516)	4.013** (1.022)	10.180*** (2.311)	12.392** (1.045)	13.383** (1.334)	1.964** (0.585)	6.734** (1.049)	9.745** (3.583)
# of observations	905	905	905	905	905	905	905	905	905	905	905	905
Likelihood ratio test of rho 1-12	0											
chi2 (8)	46.623											
Prob > chi2	= 0.000											

Note: Model was estimated with a simultaneous tobit estimator. Coefficient estimates are shown with robust SEs in parentheses.

*, **, *** Statistically significant at the 10%, 5%, and 1% level, respectively.

Like the HDDS results in Table 5.2, and the results capturing the share of expenditure on healthy foods ('Healthy share') in Table 5.3, household income was positively associated with higher expenditure shares for a number of healthy food groups, namely: cereals; poultry and meat. Expenditure shares on cereals and roots and tubers decreased significantly when the number of children under five in the household increased.

As expected, religion (Hindu) had a large impact on the share of expenditures on different food groups. This is mainly due to the consumption restrictions on different food groups by followers of the Hindu religion. Results show that households who practice Hinduism significantly increased their consumption of roots, tubers, vegetables, pulses and legumes; while they significantly decreased their consumption of meat and poultry, compared to households who practice other religions.

A significant positive impact was found in relation to households who ate out more often (Food-away-from-home) with an increase in the consumption of meat and poultry. However, the consumption of meat and poultry was found to decrease significantly if the household used nutritional labels and information when purchasing food.

Key findings of this study include that that households significantly increased their share of expenditure on processed food and beverages when: the share of expenditure at modern food markets increased; household income increased; and with the participation of female household members in the workforce. There was also significant and negative relationship between the share of expenditure on oils and fat with years of education of the female head of the household. This may imply that as the female head of the household becomes more educated, the consumption of oils and fats by the household decreases significantly, as has been found in other studies (e.g. Kirkpatrick

and Tarasuk, 2003; Turrell and Kavanagh. 2006; Bere et al., 2008; Appelhans et al., 2012).

5.6 Conclusions

This study provides further evidence that the nutrition transition is in full effect in Fiji, with consumption trends mirroring other developing regions such as Asia. The structure of the Fijian diet is changing; a shift away from nutritious local foods to highly processed foods is evident. This research shows that retail food environments are influential, as supermarkets continue to gain market share of food expenditure in Fiji. The results indicate that supermarket purchases tend to increase the share of highly processed foods at the expense of staple foods, this is consistent with the findings of previous studies such as Asfaw, 2008; Tessier et al., 2008; Asfaw, 2011; Zhang et al., 2012; Banwell et al., 2013; Kelly et al., 2014; Umber et al., 2015; Tobia et al., 2015; Rischke et al., 2015; Demmler et al., 2017; Demmler et al., 2018.

This research addresses the current gap in the literature with respect to the impact of modern food market environments on diet quality in PICTs. It has also provided interesting insights with respect to the use of nutritional information and the impact of female education on household diet quality. To the author's knowledge, this study was one of the first amongst PICTs to explore the link between diet quality and food environments and socio-economic factors, and has significant policy implications for policy makers in PICTs. These implications are further explored in chapter 6 of this thesis.

Chapter 6: Conclusion and Policy Implications

This thesis has examined the determinants of diet quality in rural and urban households in Fiji and has implications for other PICTs. This chapter provides a summary of the thesis and its key findings, the contribution of this thesis to the current literature, and presents policy implications that can be utilised by policy makers to address the current health crisis in Fiji and amongst other PICTs. Finally, the limitations of this thesis as well as opportunities for future work in this area are identified and discussed.

6.1 Overview of the Thesis and Key Findings

Chapter 1 outlined the key issues and relevant literature that motivated both the rural and urban studies presented in this thesis. Global agrifood systems are undergoing a rapid transformation, which has contributed to a significant shift in the way food is produced, processed, purchased and consumed. Modernisation of the food retail sector has been attributed to a change in diet in both developed and developing countries. There has also been a substantial increase in the incidence of obesity and diet-related NCDs.

PICTs are in the midst of an obesity NCD crisis, these small island countries now rely heavily on imported foods and face considerable challenges due to power dynamics in policy and international trade. Fiji provides a unique context as one of the more developed and highest populated economies of the region, to explore the impact of evolving value chains and the determinants of diet quality and health outcomes.

Chapter 2 provided details on the Fiji Retail Transformation Study (FRTS), which aimed to examine opportunities for improving fresh produce market chains in Fiji, focusing on fruits and vegetables. The FRTS was undertaken as part of the Pacific Agribusiness Research for Development Initiative (PARDI), which was funded by the Australian Centre for International Agricultural Research (ACIAR) in 2010. Both the

Fiji Urban Consumer Survey and the Fiji Rural Horticultural Producer Survey, which provided the data for this thesis, formed part of the FRTS.

In Chapter 2 it was explained that the Fiji Rural Horticultural Producer Survey (data utilised in Chapters 3 and 4) was undertaken by the Ministry of Agriculture Fiji in 2014, and involved face-to-face surveys in 600 rural households across the Western and Central Divisions of Vitu Levu. Both the male and female heads of each household (where available) were interviewed using separate survey instruments, where the secondary survey instrument was always completed by the female head of household as it asked questions related to the female's role in various household decisions.

Chapter 2 also provided an overview of the Fiji Urban Consumer Survey (Chapter 5) that was conducted by the Fiji Bureau of Statistics in June and July of 2012. This involved face-to-face surveys conducted in 1000 urban households in Fiji's two major cities - Suva and Nadi. Chapter 2 contains the descriptive statistics of both the rural and urban household surveys, with particular focus upon the rural data. This chapter also examines the extent of women's empowerment in agriculture. It was found that rural women were actively involved in agricultural decision-making and activities, including the planting and harvesting of crops.

Chapter 3 examined in detail the determinants of diet quality among rural agricultural households in Fiji. Diet quality was measured through the Household's Diet Diversity Score (HDDS), which accounts for the number of unique foods consumed by household members over a given period) and share of expenditure on different food groups. This study found that households who sell their produce to modern markets have greater diet diversity, however, households who lived closer to modern food markets were less likely to eat traditional healthy staple foods. It was also found that where the principal

female (female head of the household) contributed more to household decision-making, the household was less likely to consume unhealthy foods.

Chapter 4 explored the determinants of diet-related health outcomes in adults and children in rural agricultural households in Fiji. This study explored the link between market access; household expenditure on processed foods; the household production of nutrient dense foods such as fruit and vegetables; and socio-economic factors such as gender empowerment on health outcomes in rural households in Fiji. It was found that the consumption of homegrown produce had a significant effect in reducing child BMI z-scores. This study confirmed the existence of the double burden of under nutrition and obesity in Fiji, with a) 25% of the children overweight based on their BMI z-score and 10% obese, and b) there was also a high incidence (36%) of stunting amongst children. It was found that higher the BMI of female members of the household, the more likely the children were to have a higher BMI z-score. This study found 50% of adults in rural agricultural households were considered overweight based on their BMI and 18% obese, with a higher incidence of obesity observed in women than men. Distance to the closest traditional market also had an impact on household BMI. Adults in households located further away from traditional food markets were more likely to be overweight or obese. Additionally, children in households that were located further away from traditional food markets were more likely to experience child stunting.

Chapter 5 examined the determinants of diet quality among urban households in Fiji. Diet quality is measured through the Household's Diet Diversity Score and share of expenditure on different food groups. It was found that diet diversity is positively and significantly impacted by increased income, frequency of eating out, and use of nutritional information in urban Fijian households. Those households who purchased a greater share of their food from modern markets spent relatively less on healthy foods. A

positive relationship was found between education of the female head of household and consumption of healthy foods by the household.

6.2 Contributions to the Literature

As one of the more developed and highest populated economies in the region, Fiji provides a unique context to examine the determinants of diet quality and health outcomes with wider implications for other PICTs. Despite the current health crisis plaguing PICTs, little has been done to explore the determinants of diet quality and health. This region is largely overlooked due to its smaller population and low-economic status. This thesis addresses the current research gap by examining the determinants of diet quality and diet-related health outcomes in Fiji, with wider policy implications for PICTs. Further, this study is one of the only studies to the author's knowledge, which examines diet quality and diet-related health outcomes in *both* rural and urban Fijian households. The unique rural and urban data sets provide insights on household and individual diet quality and diet-related health characteristics, and the impact of various socio-economic factors on diet quality and health outcomes.

With respect to *rural* households, we contribute to the literature as one of the first empirical investigations examining the link between home production of nutrient dense foods in *rural* households; and socio-economic factors, including gender empowerment, on diet quality and health outcomes in Fiji. This study is one of the first to the author's knowledge that has examined the role of women's empowerment in relation to diet quality and health outcomes in Fiji. The study not only examined empowerment factors such as control over household income, which has been examined in a number of studies (e.g. Jones et al., 2014; Malapit et al., 2015), but looks more widely at women's empowerment in household decision making, including in agricultural decision making, and the impact this has on household on diet quality and health outcomes.

With respect to the *urban* study presented in Chapter 5, we address a research gap with respect to the relationship between food markets, both modern and traditional, on diet quality and diet-related health outcomes. While a number of studies have examined the association between supermarkets and dietary shifts in developing countries such as Latin America, China, Thailand, Indonesia, and Africa, little is known about this association amongst PICTs.

This study found that expenditure shares on healthy foods in urban households significantly decreases when the household purchased a greater share of their food from modern food markets (i.e. supermarkets). This finding supports studies such as Asfaw, 2008; Tessier et al., 2008; Asfaw, 2011; Zhang et al., 2012; Banwell et al., 2013; Kelly et al., 2014; Umber et al., 2015; Tobia et al., 2015; Rischke et al., 2015; Demmler et al., 2017; Demmler et al., 2018, which found that supermarket purchases increase the share of highly processed foods at the expense of staple foods. Thus, the urban study contributes to the literature by providing an understanding of how modern food markets are impacting diet and health in Fiji, with wider implications for other PICTs.

This thesis also provides interesting insights into the impact of modern food markets on *rural* agricultural households. As both producers and consumers of food, food markets can influence diet quality and health outcomes of rural households with respect to household income and the availability of own-produced foods. While gains in household income from commercialisation may increase economic access to food, a substitution of purchased food for own-produced food may also impact diet quality. This study adds to the existing body of literature (Ecker et al., 2012; Popkin et al., 2012 and Remans et al., 2015) by providing an understanding of the effects of market access on diet quality in rural Fijian agricultural households. This study found that households who sold produce to modern markets had greater diet diversity, which implies that a rural

household's earnings from selling at least part of its farm produce to a modern market/s, increases its ability to buy diverse range of foods. However, we also found that the consumption of roots and tubers (traditional Fijian foods), significantly decreased as the household's income increased. Further, rural households who lived closer to modern food markets were less likely to eat the traditional healthy staple foods, Therefore, positive gains from commercialisation of agriculture is offset somewhat by the reduction in some healthier foods.

Further, in rural households, those who were located further away from traditional municipal markets were more likely to have children who were experiencing child stunting. The findings in this thesis add weight to existing research with respect to market access and diet quality (Sibhatu et al., 2015; Ogutu et al., 2017; Maestre et al., 2017; Sibhatu and Qaim, 2018; Qaim and Sibhatu 2018). These studies found from a nutrition perspective improving market access for smallholder farmers may be more important than farm diversification. This thesis confirms that market access plays an important role in the diet quality of farm households in rural Fiji.

Overall this thesis fills a research gap in relation to the determinants of diet quality and health outcomes in Fiji and has wider implications for PICTs. The findings lay the foundations for future research in this area and make a number of policy contributions which are further outlined below.

6.3 The Policy Landscape in Fiji

In order to make viable policy recommendations, it is critical to understand the policy landscape in Fiji. In particular, any barriers and facilitators which may undermine or advance the enforcement and effectiveness of any policies designed to address diet quality and health outcomes in Fiji.

There are several key players central to successful health and obesity policy in Fiji. The most integral are Government institutions covering a range of sectors (e.g. agricultural, health and even education), the private sector and international actors such as the World Trade Organisation (WTO). Gortmaker et al., (2011) note that governments are the most important actors in reversing the obesity epidemic, because protection and promotion of public goods, including public health, is a core responsibility. However, while the consequences of obesity mainly burden the health system, other ministries such as finance, education, agriculture, transportation and urban planning also play an important role in creating environments conducive to obesity prevention. Studies undertaken by Hendricks et al., (2015) and Waqa et al., (2017), explored the perceived barriers and facilitators in the Fijian policy landscape. Both studies found that barriers related to collaboration between health and non-health sectors within government and society are often seen as the underlying problem. These findings are supported by earlier studies conducted by Thow et al., (2011) and Snowdon et al., (2011). Hendricks et al., (2015) note that many countries, especially other small island nations, also experience similar barriers.

In addition to the Government, policy decisions made in the health and agricultural sectors in many countries are driven by different stakeholders, including the private sector, the media, funding agencies, and special interest groups (Lobstein et al., 2003; Resnick et al., 2016; Waqa et al., 2017). The private sector includes the food and beverage industries, the media, and industries responsible for the built environment. They shape food and the environments we live in and, through communications and marketing, also shape people's perceptions, desires and accepted norms. Therefore, the support and involvement of these players is critical in any efforts to reduce obesogenic environments. However, the private sector are powerful lobbyists and where a policy is not in their

economic interests, they have the capacity to seriously undermine it, which has been the case with respect to regulations on marketing to children, traffic light labelling, and taxes on unhealthy foods (Gortmaker et al., 2011).

Many international agencies affect food and public health, and national governments are usually the major stakeholders and funders of these bodies. For PICTs, the World Trade Organisation (WTO) plays an important role in trade and diet quality. According to Snowdon et al., (2013), exposure to international trade is a critical factor influencing the quality of foods sold in the region. Connell and Soutar (2007) found that free trade movement poses acute problems for PICTs. Furthermore, in a study by Ravuvu et al., (2017), it was found that entry into WTO trade agreements have contributed to the nutrition transition in Fiji through the increased availability of imported foods with varying nutritional quality. Hendricks et al., (2015) found that the power inequalities that exist between the Fijian Government and international actors such as the WTO are a major impediment to obesity policy. The WTO, for which Fiji is a member state, has a clear liberalisation agenda which has been formalised in trade agreements that prohibit imposing barriers to trade. As such, the Fijian Government is hampered by its membership to the WTO when looking to develop policies that limit the importation of unhealthy food.

Hendricks et al. (2015) argues, and this author agrees, that Fiji's policy landscape can become more conducive to obesity policies if power inequalities are reduced, including those discussed above (i.e. Government, private sector, WTO). In Fiji and other PICTs, this may be achievable through increased food self-sufficiency, strengthened intersectoral collaboration, and the establishment of an explicit functional focal unit within government to monitor and forecast the health impact of policy changes in non-health sectors.

In addition, sociocultural factors which influence eating, activity and body size, including the “big is beautiful” paradigm that exists in Fiji needs to be taken into account in policy development. Traditionally, in the Pacific Islands, larger stature has been associated with greater beauty, social standing, health and wealth (Ringrose and Zimmet, 1979; Brewis and McGarvey, 2000). While contemporary research suggests a general downward shift in body size ideals, there remains a disconnect between the recognition that body size is too large, something that is common among contemporary Pacific Islanders, and positive behaviour change (Brewis and McGarvey, 1998; Becker et al., 2005; Williams et al., 2006; Ricciardelli et al., 2007; Swami et al., 2007; Yates et al., 2004; Brewis et al., 2011; Teevale , 2011). Similarly, food is of particular cultural importance in PICTs and therefore a challenge for intervention (Hawley and McGarvey, 2015). Foods that by “Western” standards would be considered too fatty for consumption are enjoyed as delicacies, and consuming large portions of food is considered polite, especially in the context of a feast, which is a common occurrence (Harden, 2009; Gewertz et al., 2010).

Health and well-being are complex concepts among many PICT communities with health in the biomedical sense often superseded by familial and social obligations which are strongly related to a sense of social well-being (Wong et al., 2004; Capstick et al., 2009). According to Hawley and McGarvey (2015), aside from the lack of health prioritisation, economic poverty is a major contributor to both an obesogenic lifestyle and inadequate healthcare access and management of chronic disease. Due in part to economic barriers, health care is often sought late in the progression of a disease once a patient is highly symptomatic resulting in more challenging cases for physicians, poorer outcomes, and more costly treatment. PICTs are a chronically medically underserved region, which is further exacerbated by high levels of outward migration among doctors

and other skilled workers. While recent decades have seen improvements in health status in PICTs, concerns remain about differences in health status between the most affluent and least affluent PICTs, as well as between different population groups within countries (WHO, 2013). Health inequities, defined as unfair and avoidable differences in health status, are strongly related to the social determinants of health. Addressing the social determinants of health in PICTs will be essential to achieve better and more equitable health outcomes across countries, areas and population groups within PICTs.

It is against this background that the policy implications of the results from Chapters 3, 4 and 5 of this thesis will be considered.

6.4 Evaluating Food Trade Policy from a Health Perspective

As a large proportion of Fiji's food is imported, evaluating food trade policy from a health perspective should be considered. For many of the small, dispersed countries of the Pacific, there is concern about international food trade, especially the effects that consumption of imported foods has on health in terms of food quality and safety; and the increasing level of dependence on food imports has on food security.

Food dependence is now a way of life for PICTs. Hughes et al., (2005) claim that food imports have limited the possibility for growth of indigenous food production for cash sale, as the population of urban centres are growing at the expense of rural expertise in food production. Imported rice, bread and noodles are now the leading Pacific staples, not local taro and yam. Fatty imported meats are the leading sources of protein, not seafood. Concerningly, allegations of food "dumping" have been made against food exporting countries such as Australia, New Zealand and the USA with respect to fatty meat products. Sugar and confectionaries have replaced island fruits and starches. PICTs are now consuming from a very limited 'universal menu' of reduced diversity and choice.

Food regulation is a particularly strong policy instrument that can be used to influence the composition, availability and accessibility of food and help protect food security. A number of regulatory approaches that could be utilised to address obesity in PICTs are discussed below.

6.4.1 Restrictions on the supply of certain foods

PICTs face common challenges in terms of barriers to trade and regulatory capacity, including their remoteness, geography and limited national resources. Therefore, their competitive advantage is limited. Furthermore, the underlying premise of most trade agreements is to remove barriers to trade and as such, efforts to restrict the supply of certain food into PICTs can be problematic. A further power inequality exists with respect to foreign aid. PICTs receive substantial aid from a number of key countries, including Australia, New Zealand, the United States and France, and increasingly China, Korea and Japan, which makes restricting supply of foods from these countries difficult.

For example, in 2000, Fiji banned the supply of mutton flaps under the Trading Standards Act, which resulted in a dramatic reduction in the importation of muttons flaps (Kumar, 2000). As a result, Fiji faced a threat from New Zealand that it would pursue sanctions at the WTO when Fiji implemented the ban. The conflict between aid (including for health programmes) and trade is particularly evident in the case of mutton flap exports, where New Zealand has provided aid for efforts to control NCDs, including the provision of renal dialysis, while at the same time exporting high-fat mutton offcuts (mutton flaps) to the region (Wyber et al., 2009). There has been no assessment of the impact of the ban in Fiji from a diet quality and health outcome perspective. Snowdon and Thow (2013) consider that weakness of enforcement may also be an issue, and relabelling of flaps as other cuts of meat may occur.

However, there is also evidence that trading relationships and bilateral agreements can have a positive impact on the food supply, including, for example, the bilateral trade agreement between Tuvalu and Fiji. Tuvalu is an atoll country, and as such, crop production is challenging there. In 2011, the two governments signed a bilateral trade agreement allowing crops from Rotuma to be supplied directly to Tuvalu (Government of Fiji, 2011). Fiji is also taking relevant biosecurity measures in Rotuma so that crops do not need to be routed via its central ports. Plans are underway for similar agreements between Fiji and its neighbour Kiribati, another atoll country.

While Hughes et al., (2005) advocate for the enforcement of strict trade measures and restriction on the supply of certain foods, it is clear that such an approach might be problematic. Snowdon and Thow (2013) consider that trade agreements add further complexity to attempts to improve the food environment, limiting policy space and encouraging food imports. To address this issue it has been suggested that when countries consider trade agreements, it is essential that health professionals are involved in the negotiations (Smith et al., 2009). Countries must also consider whether the benefits of trade agreements outweigh the risks (Snowdon and Thow, 2013). Such measures should be adopted by the Fijian Government going forward.

However, the benefits of bilateral trade agreements between PICTs should not be overlooked. There is an opportunity for Fiji not just to improve diet quality within Fiji but across PICTs, particularly those that are less self-sufficient. Overall, while trade restrictions may be justified in some cases (e.g. mutton flaps), they are difficult to enforce particularly by smaller countries such as Fiji. It has been argued that countries with better economies can help Fiji in this regard by voluntarily limiting their export of health damaging products and assisting Fiji in strengthening local enterprises and farms, human resources, and technological development (Hendricks et al., 2015). Therefore, on this

basis, a collaborative approach may be more effective, albeit the likelihood of this happening is probably very small.

6.4.2 Pricing controls on certain foods

Tariffs and domestic subsidies are trade-related agricultural instruments that fall under the Agreement on Agriculture (AoA), which is an international treaty of the WTO. There are two main tools that can be used in this context, first subsidies that encourage the consumption of nutritious foods, and second taxes aimed unhealthy foods such as soft drinks (Ford et al., 2017). These tools have been utilised in a number of countries. For example, in the United States, programmes to reduce the price of healthy foods led to a 78% increase in their consumption (Suhrcke et al., 2005). In 2011, Denmark introduced a tax on foods containing more than 2.3% saturated fat (Mytton et al., 2012), and in France, legislation was passed in 2012 for a tax on drinks containing sugar, with the resulting proceeds earmarked for programmes to help combat obesity (Duckett et al., 2016).

However, where such measures have been implemented in Fiji, they seem to have had mixed success, in particular due to private sector pressure. Waqa et al., (2017) note that taxes on sugar-sweetened beverages have been adopted and then removed multiple times in Fiji over recent decades as a consequence of major objections and debates, despite the implementation of taxes being quite straightforward (Thow et al., 2010; Thow et al., 2011; Thow, Quested et al., 2011). The Fijian Government had some success in implementing import tariffs on palm oil and monosodium glutamate in 2012 and 2013. Import tariffs applied to fruits and vegetables not grown locally were substantially reduced in the 2012 and 2013 budgets to support efforts to increase their intake (Snowdon and Thow, 2013).

In implementing food-related taxes, care needs to be taken that price changes do not increase socio-economic inequalities (Branca et al., 2007) and this is particularly important in PICTs. The WHO (2016) warn that the majority of evidence of effectiveness of policy-based initiatives are from high-income countries. As such, caution needs to be taken in adapting these initiatives to other contexts, such as in low- and middle-income countries. Taxes are likely to cause a financial burden on low- income consumers because they spend a larger share of their income on food than high-income consumers (Miao et al., 2011). To counter such a burden, consideration should be given to coupling taxes with subsidies for healthy foods such as fruit and vegetables, to make sure these foods are accessible to low income households. For example, the Fijian Government could consider excise taxes to both imports and domestic production of soft drinks, which could be imposed with corresponding subsidies that encourage both the production and consumption of local fruits and vegetables.

6.4.3 Labelling requirements

Nutrition labelling has been shown to encourage more healthy diets among people who read the labels (WHO, 2004; Hawkes et al., 2015) and adequate nutritional information through product labelling is seen as a necessary component of helping consumers make healthier food choices (WHO, 2011). Interpretive nutrition labels provide simplified nutrient-specific text, colours and/or symbols on the front of pre-packaged foods, to encourage and enable consumers to make healthier choices. This type of labelling has been proposed as part of a comprehensive policy response to the global epidemic of non-communicable diseases. However, regulation of nutrition labelling falls under the remit of not just the health sector, but also trade. Consequently, nutrition labelling requirements may create ‘technical barriers’ to the free movement of packaged foods across borders (Thow et al., 2017). As such, they fall under the remit of WTO

agreements, the most relevant being the WTO Agreement on Technical Barriers to Trade (the "TBT Agreement").

There are a number of approaches that can be taken. Front-of-pack nutrition signposting systems include "traffic-light" systems where the nutrient contents such as fat, sugar and salt are colour-coded into high, moderate or low levels. There are also endorsement schemes involve the use of a symbol that appears on a food label to indicate that the product has met particular standards set by that programme, for example, the Australian Heart Foundation "Pick the Tick" programme (National Heart Foundation of Australia, 2008). Both types of labelling schemes seek to assist consumers in making healthier choices and provide incentives for food manufacturers to formulate healthier products.

In 2012, Fiji introduced a requirement that nutrient information panels include sodium and trans-fatty acid values in addition to the previously required nutrients (Food and Safety (Amendment) Regulations). Both Fiji and the Solomon Islands have implemented labelling regulations (although not yet enforced), that canned meat products with fat content over 20% must have warning labels on the shelves that the "product is high in fat – for a healthy diet eat less". These regulations are targeted at high fat products such as corned beef and mutton (Snowdon and Thow, 2013).

It was found in Chapter 5 of this thesis that there was a positive and significant association between use of nutritional information and diet diversity in urban households. Therefore, implementation of a front-of-pack nutrition labelling scheme may be effective in improving diet quality in Fiji. It is important that education around healthy food choices and portion size is used to complement the labelling system. It should be noted that Fiji is currently implementing the healthy star rating, which is a front-of-pack nutritional labelling scheme used in Australia and New Zealand (WHO, 2015). Nutrition information

at point of choice, front-of-pack labelling and wider educational campaigns could be an important policy tool to help change consumption behaviour in Fiji.

There is also reports that Fiji's Ministry of Agriculture, Ministry of Health and the Ministry of Trade and Commerce are currently working together to progress a Food Security Bill, which incorporates Codex Food Standards (Australian Trade and Investment Commission, 2018). The Bill looks at regulations in place for labelling and packaging of food products. Presently, there is little information available in relation to the contents of the Bill, however, it provides an opportunity for the Government of Fiji to shape the legislation from a health perspective.

6.5 Agricultural Interventions

Agricultural interventions are an important policy tool for Fiji, as not only can they serve to improve diet quality and health outcomes, but also to improve the general livelihoods for the 65% of Fijians who rely on agriculture for income. While trade and fiscal policies to support NCD remediation outcomes such as the measures discussed above, are often promoted, there has been inconclusive evidence of their relative effectiveness (Thow et al., 2010). Furthermore, there is the possibility that such trade reforms (enforced without any corresponding local agricultural interventions) may place increased competitive price pressures on locally sourced product, with potentially adverse impacts. A more effective and long-term solution to NCD's in Fiji and PICTS, must also include investment and expansion of the local fruit and vegetable production systems (Underhill et al., 2017).

Fruits and vegetables are an essential part of the human diet. Promoting dietary habits based on increased consumption of fresh fruits and vegetables is widely considered to be a critical first step in tackling NCDs (Verlangieri et al., 1985; van't Veer et al., 2000; Dauchet et al., 2005; Carter et al., 2010). It is suggested that increasing fruit and vegetable

consumption may also assist dietary weight management strategies to prevent obesity (Pollard et al., 2008). Eating greater amounts of fruits and vegetables may also increase the feeling of satiety and result in the displacement of more energy-dense foods (Tohill, 2005). Therefore, incorporating more fruit and vegetables can reduce the overall energy density of the diet, promote satiety and decrease the total energy intake and increase diet quality (Rolls et al., 2005; Ledikwe et al., 2006).

In order to increase food self-sufficiency, the subsistence agriculture culture that exists in Fiji must be addressed. For decades most Fijians lived by growing food only for their own needs, there was no need to develop a more commercially oriented agriculture sector. As a result, farmers have a poor attitude towards commercial farming. Furthermore, additional constraints such as poor infrastructure in many farming areas leads to high transportation costs, making it difficult to transport products from villages to farms, from farms to markets, and from the outer islands to the main islands (Hendricks et al., 2015).

Policies aimed at the production and consumption of healthier traditional foods and investment in rural and agricultural development are critical in the Pacific (Thow et al., 2011). Chapter 4 of this thesis found that the consumption of homegrown produce had a significant effect in reducing child BMI z-scores. Several recent studies suggest that rural households with home production of fruits, vegetables and livestock products may have improved diet quality (Herforth, 2010; Jones et al., 2014; Kumar et al., 2015; Malapit et al., 2015).

According to Morgan et al., (2015) a drive to boost agricultural and fishing industries by promoting local produce will help to counteract the commercialisation of highly refined imported food but this will need collaborative commitment. Policies that focus on local food production, improved agricultural production through promoting new

technologies, crop diversification, capacity building activities, dissemination of information, and monitoring (Hendricks et al., 2015) should all be considered by the Fijian Government. Furthermore, investment in the processing of healthy traditional foods will also help to improve their convenience and accessibility (Thow et al., 2011) and could provide further opportunities for local employment. Of course, existing constraints such as a lack of rural infrastructure, the impact of natural disasters and access to markets should also be addressed by the Fijian Government to ensure that such policies will be successful.

6.6 Market Access

While crop diversification has shown associations with household dietary diversification, it should not be considered a main goal in itself in all contexts (Sibhatu et al., 2015). Ruel et al., (2018) note that the consistent and large modifying effect of market access on agriculture's impact on nutrition outcomes, especially access to, and consumption of, diverse diets. Chapter 3 of this thesis found that rural households who sell their produce to modern markets, have greater diet diversity than those who do not. This suggests that income derived from selling farm produce to modern markets allows the purchase of non-farm food items. This finding has clear implications for continued work on market development in Fiji. Emerging high-value chains in developing countries can contribute to income growth in the farm sector and improved access to food for rural and urban populations (Qaim, 2017). Chege et al., (2015) found that smallholder farmers benefit from marketing contracts with supermarkets in terms of productivity and higher incomes. From a policy perspective, it is important that collaboration with the private sector and modern food markets occurs to create more opportunity and reduce barriers to entry for smallholders to participate in modern retail supply chains.

Municipal markets should not be overlooked and still play an important role in Fiji and other PICTs. Of the rural sample, over 90% sold to municipal markets. Therefore, continued investment in municipal markets is crucial and policies that aim to improve rural infrastructure and access to municipal markets should be considered.

Any market interventions should also take into account the role of women in agricultural households. The findings in Chapter 3 of this thesis support this approach, particularly the positive impact that women's involvement in agricultural and food consumption decision making has on household diet quality. A number of studies have found that male household members take greater control of agricultural income when the farm enterprise is shifting from subsistence orientation to higher degrees of commercialisation (Hoddinott and Haddad, 1995; von Braun and Kennedy, 2004; Fischer and Qaim, 2012; Malapit et al., 2015; Chege et al., 2015). This type of shift in gender roles within the farm household is undesirable from a nutrition, health and broader development perspective. Therefore, gender-sensitive approaches in programmes that try to link smallholders to markets and high-value chains are an important step in this direction.

6.7 Food Market Environments

Modern food markets are important environments where interventions may increase the availability and access to healthier food choices. The presence of food stores and the availability of healthy products in those stores, are important contributors to healthy eating patterns. Interventions to increase availability, variety and convenience, pricing and promotional strategies have been found feasible and modest evidence has demonstrated their efficacy in influencing healthy eating behaviour (Glanz and Yaroch, 2004).

Ruel et al., (2018) recommend that food markets could be leveraged to become more nutrition sensitive and provide a source of information about nutrient- rich foods, healthy diets, and meal planning, further impacting diets and nutrition. Demmler et al., (2017) suggest that requiring supermarkets to also offer fresh fruits and vegetables, and to position such a fresh produce section in a key place within the store, could be one possible option for nutrition-sensitive policy making.

In Fiji, Johns et al., (2018) found that while traditional markets remain important for purchasing in urban areas of Fiji, over the years, supermarkets have taken over a significant percentage of the market, with a mix of local, imported, processed and fresh food products. It was also found that supermarkets have captured 50% of the market share in urban areas, while traditional markets still retain 28% of the share of urban household food expenditure.

Chapters 3-5 of this thesis show that retail food environments are influential on diet quality and related health outcomes, which is important to understand as supermarkets continue to gain market share of food expenditure in Fiji. The results of this research indicate that supermarket purchases tend to increase the share of highly processed foods at the expense of staple foods. These findings are consistent with previous studies such as Asfaw (2008); Kelly et al., (2014); Rischke et al., (2015); Umberger et al., (2015); Worku et al., (2017); Hassen et al., (2016); Demmler et al., (2017); and Demmler et al., (2018). From a policy perspective, it will be important to leverage modern markets as a gateway for positive change, to educate consumers and promote healthier food choices. Therefore, policy interventions should include ways to encourage healthy eating within the modern food environment. For example, incentivising supermarket stores to also offer local fruit and vegetables products at reasonable prices could be a possible policy intervention. This should also be

complemented by building consumer awareness around the importance of fruit and vegetables in healthy diets, which could also be implemented in stores. These measures will require cooperation and collaboration with the private sector.

Chapter 4 of this study found that a household's proximity to traditional markets had important implications in relation to child stunting. Children in households located further away from traditional markets were more likely to experience stunting than those in closer proximity. The most direct cause of stunting is inadequate nutrition, or eating foods that lack growth-promoting nutrients (Bhutta et al., 2008;). Traditional markets in Fiji and PICTs are the source of healthy unprocessed traditional foods, particularly fruits and vegetables. Policies such as those noted above could be utilised to further develop municipal markets, as well as promote the production and consumption of healthy local foods through these markets.

While agricultural interventions and food environments are important factors, a consumer driven approach to policy interventions must also be considered. Nestle et al. (1998) challenge the traditional public health approach to dietary change, which has been based on the premise that consumers will abandon unhealthy diets in order to prevent future illness. Instead, they suggest that obstacles to dietary change, such as limited economics, accessibility, knowledge, skills and the awareness of opposing peer-pressure, advertising and cultural determinants need to be considered when promoting dietary change. Underhill et al., (2017) in their recent study in Tonga found that consumer purchasing in Tonga is based on complex and transient social, gender, cultural and economic considerations and is trending away from fruit and vegetable consumption. They promote a more consumer-centric approach to industry development, with an emphasis on production systems that are compatible with existing social structures, customary land ownership constraints, and local nutritional needs. This regional study

has important implications for reform in Fiji, and this whole of value chain approach should underpin policy development particularly in encouraging the consumption of local foods.

6.8 The Marketing of Unhealthy Foods and Beverages to Children

The prevalence of overweight and obesity in children is also related to growing up in an obesogenic environment. Diet-related behaviours such as food preference are established early in life (Iannotti et al., 2012), which supports obesity prevention programming that targets children. Modifiable risk factors for childhood obesity include high consumption of dietary fat, carbohydrates and sweetened drinks (Black et al., 2013). Policies aimed at reducing the consumption of these types of foods should be considered. The findings in Chapter 4 of this thesis with respect to child health outcomes and the prevalence of the double burden of under and over nutrition in rural households, indicate that policy measures need to be implemented in relation to child health outcomes. In particular, a policy to address childhood overweight and obesity could be the restriction and regulation of marketing of unhealthy foods and beverages.

The marketing of food and non-alcoholic beverages to children is very potent and highly influential (Cairns et al., 2009). Particularly strong evidence exists that links television advertising to children's food knowledge, preferences, purchase requests and consumption patterns. Furthermore, television advertising is associated with increased consumption of snacks and drinks high in sugar, as well as excess calorie intake (WHO, 2011). Regulatory and fiscal interventions (e.g. regulation of food advertising to children) were found to be the least expensive measures among those examined by the Organisation for Economic Co-operation and Development (OECD). It has been argued that fiscal measures were the only interventions likely to pay for themselves, i.e. they were likely to

generate larger savings in health expenditure than costs of delivery (Gortmaker et al., 2011).

A 2013 study in Fiji found that school children were able to identify multiple food products they had seen advertised (Hope et al., 2013). The study found that 94% of respondents reported that seeing adverts makes them want to try products 71% had asked others to buy advertised products for them. There was evidence that food advertising contributed to incorrect nutrition beliefs. The study found that levels of street and television advertising for 'junk foods' were high and that 14 events sponsored by 'junk food' products were found to have taken place within one year of the study. It was recommended that there was a need for a regulatory approach to limit junk food advertising in Fiji. A further study conducted by Raj et al., (2013) found that junk food marketing occurred during hours when children are likely to be watching and in areas around schools. The study recommended strong efforts from government and the industry to protect children and adolescents from 'junk food' advertising.

These measures are supported by public health organisations who have urged governments to introduce stronger restrictions on unhealthy food marketing to children. In 2010, the WHO released a Set of Recommendations on the Marketing of Foods and Non-alcoholic Beverages to Children, which called on states to introduce policy measures to reduce children's exposure to, and the persuasive power of, marketing for unhealthy food products. Handsley and Reeve (2018) argue that children's exposure to unhealthy food marketing should be considered a 'salient' human rights issue. In particular, they consider that under the United Nations Convention on the Rights of the Child, which requires that the best interests of the child be a primary consideration in all actions concerning children, including in legislative and regulatory action by states. As such, they suggest that the best interests of the child should be weighed against the economic

interests of food, advertising and broadcasting industries. They argue that that food companies have an obligation to take measures to address children's exposure to unhealthy food marketing.

Fiji is currently considering regulations regarding the marketing of food and non-alcoholic beverages. A health impact assessment of draft regulations found that if the regulations were adopted and enforced as worded, they would have a positive impact on the reduction of childhood disease and the improvement of population health in Fiji (Harris et al., 2016). Junk food advertising to children is prevalent and of concern to health officials in Fiji. While power inequalities between the Fijian Government and the private sector adds complexity to dealing with junk food advertising aimed at children, as for example, the big food producers sponsor most programs, and without such sponsorship it is difficult to produce television shows (Hendricks et al., 2015). However, despite this challenge in terms of a policy intervention, it may be worth pursuing, as it is low cost and could be effective in dealing with childhood obesity.

6.9 The double burden

It was noted in Chapter 4 that 36% of the children in the rural sample were considered stunted. This finding is concerning, as undernutrition at important stages of foetal development can also induce permanent physiological changes that result in obesity. Almost all stunting takes place in the 1000 days after conception. The large socio-economic inequalities in stunting prevalence in almost all low-income and middle-income countries, show the importance of determinants such as maternal education, which is associated with improved child-care practices related to health and nutrition and reduced odds of stunting, and better ability to access and benefit from interventions (Black et al., 2013). Programmes that are aimed at maternal education should be considered as part of the approach to reduce stunting and childhood obesity in Fiji.

Chapter 4 also found that higher the BMI of adult females in the household, the more likely the children were to have a higher BMI z-score. Studies such as Gibson et al. (2007) have found that child BMI z-scores are significantly associated with higher maternal BMI, and that having an overweight mother increases the likelihood of a child being overweight or obese. This finding highlights the need to find ways of targeting prevention and intervention efforts for childhood obesity at families with overweight parents in Fiji.

These research findings have wider implications for PICTs and other regions in South East Asia where similar patterns of stunting and obesity can be observed. According to Dietz (2017) the heterogeneity of obesity trends across regions indicate that research could shed light on the drivers of the decline in undernutrition, the disassociation of the increases in child and adult obesity, and stunting and obesity in the same children. While the double burden of nutritional disease adds an additional layer of complexity, it also raises the possibility that double-duty actions could simultaneously reduce obesity and undernutrition (Hawkes et al., 2017; Deitz, 2017). For example, increased use of breastmilk substitutes in the same children and processed foods as complementary foods and snacks for infants could provide calories without nutrients (Zehner, 2016) and thereby increase the likelihood of obesity, undernutrition, and stunting and obesity in the same children. Confirmation that consumption of these foods is associated with both stunting and obesity in the same children would increase the likelihood that this relationship is casual and suggest potential interventions (Deitz, 2017). This PhD research can inform future research such as the example noted above, in relation to the double burden in PICTs and beyond, particularly in relation to maternal education and health.

6.10 Limitations and Future Work

As described within this thesis and further below, the methodologies employed suffer from some limitations. This section highlights some of the challenges and issues faced, how they were dealt with and the potential impact on the results. Opportunities for future work are also explored.

6.10.1 Food recall methods

This thesis utilises food recall data, which required respondents to recall their ‘normal’ food consumption over a 12-month period and food purchasing over a one-month period. Previous research has normally conducted food recall research over a 24-hour or 7-day period. However, extending the recall period allowed the author to capture a household’s consumption pattern over a greater period of time and account for seasonal fluctuations. The survey also allowed the author to ascertain whether food was purchased, where it was purchased from, whether food was grown by the household or swapped between neighbouring households and farms.

While the length of time used to capture household consumption provided the author with a greater scope of information, the extended recall period is a limitation. In particular, this may call into question some concerns with respect to the accuracy of the information recalled by respondents.

In relation to food recall methods, studies such as Procter-Gray et al., (2017) found that compared to a 24-hour recall method, food frequency questionnaires tended to underestimate the proportions that respondents classified as eating unhealthy. However, in a study conducted by Appelhans et al., (2017), it was found that objectively documented household food purchases yield an unbiased and reasonably accurate estimate of overall diet quality as measured through 24-hour diet recalls but are generally less useful for characterising dietary intake of specific nutrients. Therefore, some degree

of caution is warranted when interpreting food purchase data as a reflection of diet in epidemiological and clinical research.

Food purchasing is considered a key mediator between the food environment and eating behaviour, and food purchasing patterns are increasingly measured in epidemiologic and intervention studies. However, the extent to which food purchases actually reflect individuals' dietary intake has not been rigorously tested and could be the subject of future work in this area.

Furthermore, dietary methods are susceptible to sources of error with respect to data collection. The validity of a diet method depends on the use of a standardised methodology, the interviewer's skill, and the subject's ability to report intake accurately (Procter-Gray et al., 2017). The use of face-to-face surveys helped to overcome issues with recall and self-selection that may occur with mailout/written surveys.

This study required an estimate of monthly purchasing and annual consumption of foods. Efforts were taken during the training of enumerators to ensure respondents could be assisted to answer questions as accurately as possible. It is noted that while measures such as the weighing of food may assist in ensuring reported consumption amounts are more accurate, such measures require additional time and effort by the subject and are likely to be most effective in short study durations (e.g. 24 hours). This study did not require respondents to report/recall portion sizes although future epidemiological work may seek to do so.

6.10.2 Dietary Diversity as a measure

Dietary diversity has long been recognised by nutritionists as a key element of high-quality diets (Ruel, 2003). Additionally, with the current recognition that dietary factors are associated with increased risks of chronic diseases, dietary recommendations

promote increased dietary diversity along with reducing intake of selected nutrients such as fat, refined sugars, and salt. This is now particularly relevant in developing countries who are experiencing rapid nutrition transitions. This thesis explores diet diversity using a number of different measures, including a household diet diversity score, and expenditure on healthy versus unhealthy food groups.

Diversity, however, is but one component of overall dietary quality and may not, in itself, ensure achievement of all dietary goals. As identified in this thesis, diversity might add processed foods at the expense of healthy traditional foods. A number of measurement issues still need to be addressed to improve assessment of dietary diversity. These include the selection of foods and food groupings, the consideration of portion size and frequency of intake, and the selection of scoring systems, cut off points, and reference periods that will ensure the validity and reliability of the indicator for the purpose for which it is used (Ruel, 2003). Further validation research is needed to settle the issue of whether food or food group diversity best predicts nutrient adequacy in different contexts. This research lays the foundation for more detailed food recall studies. The study provides a broad picture of consumption patterns across rural and urban Fiji. This study is the first of its type to the author's knowledge and will help to inform future research in this area. In particular, 24-hour or 7-day recalls could now be utilised for a deeper analysis of dietary diversity and dietary quality in Fiji. More detailed research could include portion sizes and the weighing of food to ensure accuracy in reporting. Portion sizes will also provide important insights with respect to diet diversity, as it enables an examination of how much healthy and unhealthy foods are actually being consumed. While a household may appear to eat a diverse diet, this may not result in positive health outcomes if households are consuming large quantities of unhealthy foods and only small quantities of healthy foods. It is important that in addition to concentrated short-term studies (i.e.

24-hour/7-day recalls), that seasonality is also accounted for in future work. Future studies may also seek to utilise different and/or additional metrics with respect to diet quality, for example the Household Food Insecurity Access Scale (HFIAS) or the Coping Strategies Index (CSI). The HFIAS consists of 9 items specific to an experience of food insecurity occurring within the previous four weeks. The HFIAS is used to estimate the prevalence of food insecurity and has been found to be useful particularly in assessing the impact of food aid programs (Coates et al., 2007). The CSI has been used for early warning and food security monitoring and assessment across Africa, the Middle East and Asia (Maxwell et al., 2003). It has been found to be a useful tool for assessing food aid needs and whether food aid has been targeted to the most food insecure households (Maxwell et al., 2003).

6.10.3 Data collection challenges

Unfortunately, as noted in Chapters 3 and 4, there were a number of surveys of rural households that were incomplete and therefore could not be utilised. A limitation of the rural survey was the long survey completion time, which may have led to respondent fatigue, and both participants and enumerators taking less care when completing questions in the later sections of the survey. Despite this, there was still a relatively large amount of completed surveys overall. While the study was long in length, it did enable the collection of a broad data set, which provides many insights into the determinants of diet quality in both rural and urban households in Fiji and can inform future work into a number of aspects of diet quality and health outcomes.

6.10.4 Issues to be addressed in future work

As noted in Chapter 2 of this thesis, Vitu Levu was selected as the location for this study as it is the largest island in Fiji and home to 70% of its population. Future

research may also seek to include smaller islands in Fiji and across PICTs, to gain insights into the challenges and opportunities facing households on smaller islands.

Furthermore, future studies should examine BMI in urban areas of Fiji and other PICTs. As noted in Chapters 1 and 5 of this thesis, urbanisation is considered as an important contributor to the nutrition transition and its subsequent impact on health outcomes. As PICTs are continuing to become more urbanised, this research will have important policy implications.

Future research may also seek to examine cultural and gender issues relevant to diet quality and health outcomes amongst PICTs. While this thesis examined women's empowerment in relation to diet quality and health outcomes, it also had interesting findings with respect to male and female BMI, which may warrant additional future research as to cultural and household dynamics in this context. Finally, given the unique ethnic composition in Fiji, future research may seek to specifically address ethnic differentials. This study observed lower BMI amongst Indo-Fijians, but had negative findings with respect to diet diversity. While this can be explained by the fact that most Indo-Fijians practice Hinduism, which imposes a number of restrictions on their diet (as discussed in chapters 3-5), these findings have implications for policy makers. In particular, programs to address diet quality should take these findings into account and make sure programs/policies/interventions are culturally/ethnically appropriate.

6.11 Conclusion

The insights gained from Chapters 3-5 of this thesis have a number of important policy implications. The findings highlight the important role of food markets, the role of women in household decision-making and the consumption of homegrown produce in improving diet quality and health outcomes in Fiji and the wider PICTs.

Modern markets continue to gain market share in Fiji, as such, it is important that these markets are leveraged as much as possible to promote healthy eating, in particular the consumption of local healthy staple foods. Measures to encourage healthy consumption would complement agricultural interventions that seek to encourage the production of local foods. Furthermore, policy interventions that assist local producers in accessing modern markets will also be important for improving diet quality in rural agricultural households.

Continued investment in municipal markets is required as these markets play an important role in relation to diet quality and health outcomes and should not be overlooked with respect to policies that increase access to these markets, both for consumers and producers. This thesis found that consumption of homegrown produce had a significant effect in reducing child BMI z-scores and that where women contribute to household decision-making with respect to agricultural production, the household is less likely to consume unhealthy foods. Therefore, agricultural interventions designed to increase household production should also seek to empower women in household and agricultural decision-making.

The difficulties in enforcement of policy actions such as regulations to restrict food and beverage marketing to children, and front-of-pack traffic light labelling, are well known and further exacerbated by the power inequalities that exist in Fiji and other PICTs. However, these actions are well supported by cost-effectiveness evidence and are important tools in dealing with the negative effects of modern food markets. A multisectoral approach is required to overcome the present challenges that exist in the Fijian policy environment and to ensure policy in this area is effective and enforceable.

This thesis provides a number of important insights for policy makers and can be utilised to shape and inform policy and interventions, which aim to improve the diet

quality and health outcomes in Fiji and among other PICTs. This study provides a broad picture of consumption habits amongst rural and urban households and will serve to inform more directed future research in this area.

SURVEY OF HORTICULTURAL PRODUCERS FIJI

THE UNIVERSITY OF ADELAIDE IN COLLABORATION WITH THE UNIVERSITY OF THE SOUTH PACIFIC AND THE MINISTRY OF AGRICULTURE FIJI

CONFIDENTIAL

Objective: The purpose of this survey is to improve our understanding of the patterns, determinants, and effects of participation of farmers in evolving horticultural value chains.

Use of data: The data collected as part of this survey are for research purposes **ONLY**.
Household-level data will not be shared with non-research organizations. .
Only summary results will be included in published report.

Name of head family/ Name of Company	
Name of respondent	
Address/location	
Phone number	

Division	
Province	
District	

Enumerator Code	
-----------------	--

	Date			Name	Sign
	Day	Month	Year		
Interview			2014		
Field check			2014		
Office Check			2014		
Data Entry - Start			2014		
Data Entry - Finish			2014		

Research funded by a grant from the Australian Centre for International Agricultural Research (ACIAR)

Version March 2014



Australian Government
Australian Centre for International Agricultural Research

A. CHARACTERISTICS OF MEMBERS OF THE HOUSEHOLD (Not applicable for corporate farms)

	Please list the names of members of this household [list in order of age, from oldest to youngest]	Is [name] a male or female? 1.Male 2.Female	What Ethnicity is [name]? 1. itaukei 2. Indo-Fijian 3. Chinese 4. Expat (non pacific islander) 5. Other (including other pacific island countries)	What religion is [name]? 1. Muslim 2. Christian 3. Hindu 4. Other	What is the relationship between [name] and the head of the household? 1. Head 2. Spouse 3. Son/daughter 4. Stepchild/Adopted Child 5. Son-in-law/Daughter-in-law 6. Mother/Father of the respondent 7. Mother-in-law/Father-in-law 8. Brother/Sister 9. Grandchild 10. Grandparent 11. Other related 12. Other unrelated	How old is [name]? [age at last birthday, use 0 if less than 1 year old]	Ask this question for members 6 years or older	Ask these questions for members 17 years or older.		On average how many hours a week does he/she work in this activity)
							What level of education has [name] completed? 1. Primary 2. Secondary 3. Teritary 4. Agricultural College 5. Other (please specify)	What is the marital status of [name]? 1. Single 2. Married 3. Separated or divorced 4. Widowed 5. N/A	What is the main activity of [name]? [see activity codes on bottom of page]	
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

Note: The household is defined as a group of people who live and eat together most of the time. Each member must live with others at least 6 months of the year or 4 days out of the week. The head of the household is defined as the member who makes most of the economic decisions.

Activity codes for A9		
1	Farmer or fisherman	4 Unpaid family / community worker
2	Self Employed Other / Employer	5 Student
3	Wage /Salary employee	6 Unemployed / Retired
		7. Other (please specify below)

A. CHARACTERISTICS OF MEMBERS OF THE HOUSEHOLD (Not applicable to corporate farms)

	Please list the names of members of this household [list in order of age, from oldest to youngest]	Is [name] a male or female? 1. Male 2. Female	What Ethnicity is [name]? 1. itaukei 2. Indo-Fijian 3. Chinese 4. Expat (non pacific islander) 5. Other (including other pacific island countries)	What religion is [name]? 1. Muslim 2. Christian 3. Hindu 4. Other	What is the relationship between [name] and the head of the household? 1. Head 2. Spouse 3. Son/daughter 4. Stepchild/Adopted Child 5. Son-in-law/Daughter-in-law 6. Mother/Father of the respondent 7. Mother-in-law/Father-in-law 8. Brother/Sister 9. Grandchild 10. Grandparent 11. Other related 12. Other unrelated	How old is [name]? [age at last birthday, use 0 if less than 1 year old]	Ask this question for members 6 years or older		Ask these questions for members 17 years or older.		On average how many hours a week does he/she work in this activity)
							What level of education has [name] completed? 1. Primary 2. Secondary 3. Teritary 4. Agricultural College 5. Other (please specify)	What is the marital status of [name]? 1. Single 2. Married 3. Separated or divorced 4. Widowed 5. N/A	What is the main activity of [name]? [see activity codes on bottom of page]		
	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

Note: The household is defined as a group of people who live and eat together most of the time. Each member must live with others at least 6 months of the year or 4 days out of the week. The head of the household is defined as the member who makes most of the economic decisions.

Activity codes for A9		
1 Farmer or fisherman	4 Unpaid family / community worker	7. Other (please specify below)
2 Employer	5 Student	
3 Wage /Salary employee	6 Unemployed / Retired	

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If farm is a corporate farm, ask questions B16-B19 ONLY

Agricultural Task														
#														
Household Member (older than 10 years)	Land Preparation	Planting Seedlings	Managing Nursery	Applying fertiliser/ pesticides etc	Weeding	Irrigation/Water Management	Harvesting commercial crops	Harvesting subsistence crops	Marketing crops	Feeding/ Sheperding livestock	Gathering firewood	Gathering wild fruits/food	Hunting wildlife/a nimals	Managing flower nurseries
B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15

If farm is a corporate farm, ask questions B16-B19

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C. FARM AND HOUSEHOLD ASSETS (Not applicable to corporate farms)

[[If house owned] What is the approximate value (FJD) of your house without farmland? C1

What is the main source of drinking water for your household?

1 Indoor tap	5 Collected rainwater	<input type="text"/> C2
2 Outdoor private tap	6 River, lake, or pond	
3 Outdoor shared tap	7 Spring	
4 Covered well	8 Aqua/bottled water	
	9 Other	

What is the main type of toilet used by your household?

1 Flush toilet	4 Latrine over water	<input type="text"/> C3
2. Latrine with pipe	5 Public toilet (all types)	
3 Pit latrine	6 Other or none	

What is the main type of lighting used by your household?

1 Electric lights	4 Others	<input type="text"/> C4
2 Oil lamps	5 None	
3. Candles		

What is the main type of fuel is used by your household for cooking?

1 Electricity	4 Kerosene	<input type="text"/> C5
2 LPG	5 Wood/charcoal	
3 Biogas	6 Other	

How many of each of the following assets did your household own five years ago? How many of each of the following assets does your household currently own?
[[If household does not own any, write "0"] *[[If household does not own any, write "0"]*

	Number		Number
a radio?	<input type="text"/>	C6	<input type="text"/> C20
a television?	<input type="text"/>	C7	<input type="text"/> C21
a computer?	<input type="text"/>	C8	<input type="text"/> C22
a washing machine?	<input type="text"/>	C9	<input type="text"/> C23
a refrigerator?	<input type="text"/>	C10	<input type="text"/> C24
landline telephone?	<input type="text"/>	C11	<input type="text"/> C25
a mobile phone?	<input type="text"/>	C12	<input type="text"/> C26
internet (0=no, 1=yes)	<input type="text"/>	C13	<input type="text"/> C27
a motorbike?	<input type="text"/>	C14	<input type="text"/> C28
a car?	<input type="text"/>	C15	<input type="text"/> C29
a truck?	<input type="text"/>	C16	<input type="text"/> C30
a bank account?	<input type="text"/>	C17	<input type="text"/> C31
a credit card?	<input type="text"/>	C18	<input type="text"/> C32
a tractor?	<input type="text"/>	C19	<input type="text"/> C33

How long does it take you (minutes) to reach the following from your house by vehicle....

...road of any type?	<input type="text"/>	C34
...main sealed road?	<input type="text"/>	C35
...market?	<input type="text"/>	C36
...district or city (municipal) market?	<input type="text"/>	C37
...hospital or doctor?	<input type="text"/>	C38
...school?	<input type="text"/>	C39
...agricultural extension office?	<input type="text"/>	C40

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If D9= 1 or 4, Skip to Section E. If D9=2 or 3, ask Questions D10 and D11. If D9=5 ask Question D12.

Tract/Plot Number	What is the total area?	1. Hectares 2. Acres 3. Square Chains	How has this changed over the last three years?	What is the total area of land under horticulture?	1. Hectares 2. Acres 3. Square Chains	How has this changed over the last three years?	How was this land acquired?	What is the current land tenure for this land?	When was the lease last renewed?	When will the lease expire?	Who do you share farm with?
	(Total area)		See Code			See Code	See Code	(Year)	(Year)	See Code	
))))))))))))

- Codes for D4 and D7**
1. Increased significantly
 2. Increased a little
 3. Stayed the same
 4. Decreased a little
 5. Decreased significantly
 6. Fluctuate

- Codes for D8**
1. Inherited
 2. Gift
 3. Purchased
 4. Allocated by government
 5. Forest/wild land
 6. Lease

- Codes for D9**
1. Freehold
 2. Crown Lease
 3. NTLB Lease (short term)
 4. Mataqali
 5. Share farming
 6. Squatter
 7. Other, specify

- Codes for D12**
1. Family
 2. Landowner
 3. Friend
 4. International firm
 5. Group Farm
 6. Other, please specify

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Please refer to Crop Codes Page 8

temporary		permanent					
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Of the total amount you grow of these 5 crops what percentage is:								
What are the 5 main commercial crops you grow?	How many years have you been growing this crop?	Quantity Harvested	Local Unit	Commercial % (Amount Sold)	Subsistence % (Amount kept for Consumption)	Exchange/ Gifts/ Barter %	Lost at farm level %	Main Reason for loss
Use crop codes page 9			see code					see code
E7	E8	E9	E10	E11	E12	E13	E14	E15
				Columns E11 to E14 must = 100%				

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Have you grown sugar cane in the last 5 years?	Are you still growing sugar cane?	If E17=2, Have you replaced sugar cane with another crop?	If E18=1, what crop have you replaced sugar cane with?
1. Yes, 2. No	1. Yes, 2. No	1. Yes, 2. No	Use crop codes page 8
E16	E17	E18	E19

Codes for E10
1. Kg
2. Bundle
3. Heap
4. Plastic Bag
5. Sack
6. Box/Crate
7. Dozens
7. Other, specify below:

Codes for E15
1. Theft
2. Rats/Pests
3. Floods
4. Cyclone
5. Weather
6. Poor quality graded out on farm
7. Lack of storage/ storage problems

CROP CODES

Temporary Crops	
	Code
Amaranthus (Baji)	501
Long Beans	502
Bora Beans	503
French Beans	504
Broccoli	505
Broomcorn	506
Capsicum	507
Carrot	508
Cassava	509
Cauliflower	510
Celery	511
Chinese Cabbage	512
Cow Pea	513
Cucumber	514
Dalo (Taro)	515
Dalo ni tana	516
Dhal (all types)	517
Eggplant	518
English Cabbage	519
Garlic	520
Ginger	521
Gourd/Karela (Bitter)	522
Gourd (Others)	523
Herbs (all types)	524
Kumala (Sweet Potatoes)	525
Lettuce	526
Maize	527
Okra (Bhindi)	528
Pumpkin	529
Pigeon Pea	530
Peanuts	531
Radish	532
Rice	533
Spring Onion	535
Squash	536
Tomatoes	537
Tobacco	539
Turnip	540
Tumeric	541
Yams	542
Watercress	543
Watermelon	544
Zucchini	
Other fruit	
Other vegetable	

Permanent Crops	
	Code
Avocado	401
Banana	402
Bele	403
Breadfruit	404
Cardamom	405
Chillies	406
Cocoa (Wet Beans)	407
Coconut (Copra) Nuts	408
Coffee	409
Custard Apple	410
Dhania	411
Duruka	412
Guava	413
Jackfruit	414
Kavika	415
Kura	416
Lemon	417
Mandarin and Tangerine	418
Mango	419
Melons	420
Oil Palms	421
Oranges	422
Ota	423
Other Citrus	424
Passionfruit	425
Papaya	426
Pawpaw	430
Pineapple	431
Plaintain	432
Rourou	433
Sourlime	434
Soursop	435
Spring onion	436
Star Apple	437
Sugarcane	438
Tamarind	439
Vanilla	440
Wi (Fruit)	442
Yaqona	443
Other fruit	444
Other vegetable	445

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Over the last 5 years, have you started growing a new crop for the first time? (Please note that you don't need to be growing this crop now)

	F1
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Codes fo F1
1. Yes
2. No

IF F1=2 (NO), THEN SKIP TO SECTION G

IF F1= 1 (YES), COMPLETE THE FOLLOWING TABLE

No	List the crop codes of the most important new commodities see crop codes page 9	What are the main reasons you decided to grow the crop? see codes below	Are you still growing this crop? 1.Yes (go to F7) 2.No (go to F6)	[If F5=2] What are the main reasons you stopped growing the crop? see codes
F2	F3	F4	F5	F6
1				
2				
3				
4				
5				
6				

Has your household or company adopted any new production technologies in the last five years? (Can be more than one answer) see codes below	Are there any commodities you would like to grow that you can't? 1. Yes (go to F9) 2. No (go to next page)	List commodities you would like to grow:	What is the reason/s preventing you from growing this commodity? see codes
7	7	7	7

Codes for F4 (reasons for adopting)
1. Cheaper to produce
2. Less risky
3. To earn higher prices or returns
4. New technology become available
5. Saw neighbours adopting with good results
6. Recommended by other farmers
7. Recommended by government official
8. Recommended by buyer
9. Recommended by others (specify)
10. Adopted for subsistence (consumption)
11. Market availability

Codes for F6 (reasons for discontinuing)
1. Costs too high
2. Returns too low
3. Lack of buyers
4. Lower yield
5. Too labour intensive
6. Limited availability of inputs
7. Found better crop
8. Didn't grow well
9. Natural Disaster
10. Other, specify below:

Codes for F7
1. New seeds
2. New varieties
3. Raised Beds
4. Plant Tresllising
5. Irrigation
6. Organic Farming Systems
7. Other specify below:

Codes for F10
1. Limited availability of inputs
2. Too risky
3. Would like more information
4. Too labour intensive
5. Growing conditions unsuitable
6. No land available
7. No market to sell commodity to
8. Other, specify below:

G. INPUTS

Were the following inputs used in the last 12 months?						
1. Yes, 2. No						
Crop Codes (5 main commerical crops)	Seeds Saved	Seeds Purchased	Seedlings purchased	Fertiliser	Pesticide/ Herbicide	Irrigation
G1	G2	G3	G4	G5	G6	G7

Ask for CORPORATE FARMS ONLY:

How has revenue for horticultural crops changed in the last five years? 8

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If farm is a corporate farm skip to Question G18

Was labour used in the last 12 months?
(see codes)

G8

If G8=2, skip to Section H. If G8=1, fill table below

Labour			Average time spent per week in labour (hours)			Has average labour time per week changed in the last five years?		
Family	Hired	In-Kind	Family	Hired	In-Kind	Family	Hired	In-Kind
G9	G10	G11	G12	G13	G14	G15	G16	G17

Codes G8-G11
1. Yes
2. No

Codes G15-G17
1. Increased
2. Stayed the same
3. Decreased

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If H8=(1), If H8=(2) skip to H11

Crop Codes (For 5 main commercial crops only)	What time of day do you harvest your produce? 1. Early Morning 2. Mid morning 3. Afternoon 4. Evening	Did you do any postharvest handling activities for this [crop]? (I.e. sorting, grading, drying, cleaning, packaging) 1. Yes 2.No, >>skip to Section I	If any postharvest activities undertaken, what type of postharvest handling did you do for this [crop], over the last 12 months?						If produce is packaged, what is the main type of packaging used? 1. Wooden box 2. Plastic crate 3. Plastic bag 4. Nylon bag 5.Other, specify:	Why did you do these post harvest handling activities [H4-H9] for this [crop]? 1. Yes; 2. No				Are you carrying out more or less postharvest activities on this crop than you were five years ago?	Do you receive a premium price (price above normal rate) for these activities [H4-H9]?	
			sorting	grading	drying	cleaning	packaging	others please specify		1. Price premium	2. Buyer Request	3. Learned from extension	4. Other			1. More 2. Same 3. Less 4. NA [e.g. just started]
			1. Yes, 2. No													

H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	H11	H12	H13	H14	H15	H16

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	Crop Codes (5 main commercial crops only)	Average price received (FJD\$)	Average price received per 1.Kg 2.Bundle 3.Heap 4.Bag	How have prices changed for this crop over the past 12 months? 1. Increased 2.Stayed the same 3. Decreased 4. Fluctuated	How have prices changed for this crop over the last five years? 1. Increased 2.Stayed the same 3. Decreased 4. Fluctuated	In the last year, how many different buyers did you...		When in the crop production cycle do you usually first communicate with a buyer?	How do you usually communicate with your crop buyer(s)?	When are you usually paid for the crop harvest?	How are you usually paid? 1. Cash 2. Direct to bank account 3.Exchange for credit 4. Exchange with friend	Where does the buyer take possession of the produce?	What is the distance from the farm to the collection place? (km)	How is the produce transported there?
						Speak to about the selling of this [crop]?	Sell your [crop] to?							
	J1	J2	J3	J4	J5	J6	J7	J8	J9	J10	J11	J12	J13	J14

- Codes J8**
1. Before planting
 2. Between planting & early stages of production
 3. Close to harvest
 4. After the harvest begins

- Codes J9**
1. Mobile phone
 2. Landline phone
 3. Buyer comes to the farm
 4. Marketplace
 5. Farmer goes to buyer 's place
 6. Meet buyer elsewhere
 7. Through intermediary person
 8. Through cooperative/group
 9. Email

- Codes J10**
1. Before harvest
 2. At delivery
 3. 1-14 days later
 4. 15-30 days
 5. 30 days or more
 6. Multiple payments

- Codes J12**
1. At farm
 2. At house
 3. Roadside
 4. Municipal Market
 5. Other (Specify)

Codes J13
Enter 99 if doesn't know

- Codes J14**
1. On foot
 2. Bicycle/Motorbike
 3. Van/Car
 4. Truck
 5. Taxi
 6. Bus
 7. Animal
 8. Boat
 6. Other (Specify)

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Crop code (5 main commercial Crops only)	How long have you been dealing with the main buyer for this crop? (Years)	How many times have you sold to this buyer over the last 12 months?	Do you sell more or less often to this buyer than you did 5 years ago?	Do you usually have an agreement with this crop buyer?	What is specified in the agreement with the buyer?	In the last 12 months that you grew this crop, did your main buyer provide [...]?						Do you negotiate with this [crop] buyer over the price?	Why do you choose to sell to this buyer?	Have you had any problems with your [crop] buyer?	[If K15=1] What were the main problems? (list up to three in order of importance)			Did any of these problems (K16-K18) cause you to change your [crop] buyer?
	see code		1. Increased 2. Stayed the same 3. Decreased 4. N/A (if not produced 5 years ago)	If K5 = (3) skip to K7	1. Price 2. Quantity 3. Grade /Quality 4. Variety 5. Time of payment 6. Inputs on credit	Seeds	Fertiliser	Pesticide/Herbicide	Labour	Information (growing, marketing)	Financial assistance	see code	see code	1. Yes	see code			1. Yes 2. No
						1. Yes, 2. No								2. No, >> Skip to next page	1st	2nd	3rd	
K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13	K14	K15	K16	K17	K18	K19

Codes for K2	
1. Less than a year	2. 1-2 years
3. 3-5 years	4. More than 5 years

Codes K13
1. No, I always accept the price the buyer offers
2. Yes, I sometimes bargain over price with the buyer
3. Yes, I usually bargain over price with the buyer
4. No, I set the price and don't bargain.

Codes for K14
1. Best Price
2. Only available buyer
3. Pays cash
4. Is a friend, relative or neighbour
5. Takes full range of quality
6. Takes multiple products
7. We have a good relationship
8. Provides transport
9. Grades quality for me
10. They were the first buyer to ask me
11. Takes whole quantity

Codes for K16-K18
1. Issues with inputs provided by buyer
2. Buyer did not give promised price
3. Delay in collecting harvest
4. Delay in paying for harvest
5. Change in price
6. Change in requirements
7. Product rejected for low quality
8. Market price higher than fixed price
9. Other, specify

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Crop Code (5 main commercial crops)	Does your product go to? (You can answer yes as many times as applicable)								
	Municipal Market	Roadside stall	Village Market	Next door neighbour	Supermarket	Processor	Exporter	Hotels/Resorts/ Restaurants	Other (please specify)
	1. Yes, 2. No, 3. Don't know								
K20	K21	K22	K23	K24	K25	K26	K27	K28	K29

Do you keep records of?	1. Yes 2. No
K30	K31
The prices received for crops sold?	
The quantities of crops sold?	
Cost of seeds purchased?	
Cost of fertiliser purchased?	
Cost of pesticides/herbicides purchased?	
Cost of labour hired?	
Cost of transport?	

If records are kept, how long are they kept for? (years) M

If no records are kept write "0"

L. PRODUCTION AND MARKETING INFORMATION

Crop code (5 main commercial Crops only)	Over the last five years, what have been your main sources of information about PRODUCTION METHODS ? (ask for up to 3 sources, rank in order of importance)			[For these 3 sources] How would you rate the quality of the production information? 1. Good 2. OK/Moderate 3. Poor			Over the last five years, what have been your main sources of information about [crop] PRICES & MARKETS? (ask for up to 3 sources, rank in order of importance)			[For these 3 sources] How would you rate the quality of the price & market information? 1. Good 2. OK/Moderate 3. Poor			Is there anything specifically related to production or marketing you would like more information on? see codes
	see code			see code			see code						
	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd	
L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14

- Codes for L2-L4 and L8-L10**
1. Department of Agriculture
 2. Researcher/Donor
 3. Farmer/relative/neighbour
 4. Buyer
 5. Input Companies
 6. Cooperative
 7. Farmer group
 8. NGO
 9. Media (mobile text)
 10. Own research

L. COLLECTIVE ACTION

Do you/ your family members currently belong to any of the following? 1. Yes 2. No >> Go to Section M	Did the group provide benefits in the following activities?										How satisfied are you / your family members with the group? 1. Very satisfied 2. Satisfied 3. Not satisfied
	supply of inputs	equipment sharing	supply of credit	managing irrigation (sharing water)	knowledge sharing and other technical assistance	planting	harvesting	post harvest handling	marketing		
	1 Yes; 2 No; 3 Don't know										
	L15	L16	L17	L18	L19	L20	L21	L22	L23	L24	L25
Farmer group											
Cooperative/Association											
Women Farmer's group											
Village Members											
Other group (specify)											
Other group (specify)											

- Codes for L14**
1. Choosing a new crop
 2. Use of inputs
 3. New varieties
 4. Production methods and new technology
 5. Post harvest methods and new technology
 6. Market prices
 7. Buyer options
 8. Where our product finishes up
 9. Consumer insights
 10. Finance options
 11. Government extensions services
 12. Other, Specify below:

Event	Did it occur? 1. Yes 2. No	Year event occurred (1. Yes, 2. No)			Impact 1. Minor impact 2. Moderate impact 3. Major/catastrophic impact 4.No impact
		2011	2012	2013	
M1	M2	M3	M4	M5	M6
Lower crop yields due to the following natural disasters:					
Floods					
Cyclone					
Drought (Water Shortage)					
Earthquake/Tsunami					
Heavy seasonal fluctuation (change in weather conditions)					
Production and marketing events:					
Low crop yields due to poor soil fertility					
Death or theft of livestock					
Theft of crops					
Large fall in sale price for crops					
Household member events:	<i>Do not ask household member events for corporate farms</i>				
Illness/accident/death/aging of HH member					
Birth of HH member					
Reduced wage rates					
Increased expenditure demands (eg. school fees, medical bills)					
House damaged or destroyed					
End of regular assistance, aid, remittances from outside HH					
Marriage, Funeral or other social events					
Loss of off-farm income					
Policy events:					
Policy changes - (e.g. tax, import duties, farmer assistance)					
Land Tenure					
Other events:					
Please specify:					
Please specify:					

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Income Activities	Were any members of your household involved in [activity] in ...?		Who in the household is currently mainly responsible for this activity?	If N2 and N3 are "yes"
	2009	2013	1. Head 2. Spouse 3. Son/daughter 4. Son/daughter in-law 5. Mother/Father of the respondent 6. Mother/Father-in-law 7. Other related 8. Other non-related	Has income for this activity increased or decreased over the last five years?
	1. Yes 2.No	1. Yes 2.No		1. Increased 2. Stayed the same 3. Decreased

Code	N1	N2	N3	N4	N5
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Expense Item	How much does your household spend (FJD\$) on [item] in a typical week, month, year?	Time period: 1=Weekly 2=Monthly 3=Yearly 4=N/A	Has expenditure on this item increased or decreased in the last five years? (see code)
O2	O3	O4	O5
Purchasing Food			
Non-food items			
Rent			
Education			
Transport			
Household Bills (maitenance, utility, communication)			
Health			
Church/Temple			
Gifts			
Community/Village donations			
Leisure activities and items			
Other (specify)			

Codes for O5
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P. PERCEPTION OF CHANGE (Not applicable for corporate farms)

How has the standard of living in your household changed in the last five years? P1

1. Improved significantly (>30%)
2. Improved somewhat (10-20%)
3. No change (-10% to 10%)
4. Deteriorated somewhat (-10-30%)
5. Deteriorated significantly (>30%)

Over the last five years, is more or less time being spent by family members in agricultural activities? P3

1. More time
2. Same
3. Less time

How has the primary health status of your household changed in the last five years? P5

For Adults

For Children

1. Improved significantly
2. Improved somewhat
3. No change
4. Deteriorated somewhat
5. Deteriorated significantly

If P1 = 1,2,4,5 what is the primary reason for the change in standard of living? P2

1. Change in crop prices
2. Change in crop yields
3. Change in crops grown
4. Growing horticulture crops
5. Change in livestock income
6. Change in non-farm income
7. Change in health of family members
8. Change in level of crime in area
9. Change of crop buyer
10. Other, specify _____

If P3 = (1), what is the main reason why? P4

1. Change in crop prices
2. Change in crops grown
3. Change in non-farm income
4. Access to credit
5. Access to more land
6. Changes to amount of family members in household
7. Changes in health of family members in household
8. Other, specify _____

j 'uk° Vo7\ kU @8'ouky#uyk-o° V) 'hk\ #-oo-o

In the last five years have you been involved in any of the following types of interventions/assistance?

Codes for Q2 and Q3
 1. Yes 2.No
 3. Don't know

	Provided by Government	Provided by NGO
Q1	Q2	Q3
1. Horticultural		
2. Livestock		
3. Dairy		
4. Sugar		
5. Crops		
6. Aquaculture		
7. Disaster relief		
8. Other, specify		

In the last five years have you received credit for agricultural inputs?

Q4

1. Yes
2. No

If Q4=(1), who did you receive credit from?

Q5

1. Bank
2. Money lender
3. Government/Donor Agency
4. Other, specify _____

Is it harder or easier now to get credit for agricultural inputs than it was five years ago?

Q6

1. Easier
2. Same
3. Harder

How often are you visited by agricultural extension officers?

Q7

1. Weekly
2. Monthly
3. Quaterly
4. Yearly
5. Never

How often do you visit an agricultural extension office?

Q8

1. Weekly
2. Monthly
3. Quaterly
4. Yearly
5. Never

Would you like to to be visited or visit an agricultural extension office more often?

Q9

1. Yes
2. No

SURVEY OF FEMALE HORTICULTURAL PRODUCERS FIJI

THE UNIVERSITY OF ADELAIDE IN COLLABORATION WITH THE UNIVERSITY OF THE SOUTH PACIFIC AND THE MINISTRY OF AGRICULTURE FIJI

CONFIDENTIAL

Objective: The purpose of this survey is to improve our understanding of the patterns, determinants, and effects of participation of farmers in evolving horticultural value chains.

Use of data: The data collected as part of this survey are for research purposes **ONLY**.
Household-level data will not be shared with non-research organizations. .
Only summary results will be included in published report.

Name of head family
Name of respondent

Address/location

Phone number
Name of Area

Enumerator Code

Division	
Province	
District	

--	--

Interview
Field check
Office Check
Data Entry - Start
Data Entry - Finish

Date			Name	Sign
Day	Month	Year		
		2014		
		2014		
		2014		
		2014		
		2014		

Research funded by a grant from the Australian Centre for International Agricultural Research (ACIAR)



Australian Government
Australian Centre for International Agricultural Research

A. AGRICULTURAL ACTIVITIES

What are the five main crops you are responsible for? (see crop codes on page 4)	Are these crops used for: 1. Cash sale 2. Consumption 3. Both	Do you carry out any of the following production activities on this crop?									Do you carry out any of the following post-harvest activities on this crop?					Do you carry out any of the following marketing activities on this crop?			
		1. Yes 2. No									1. Yes, 2. No					1. Yes, 2. No			
		Land preparation	Planting seedlings	Managing nursery	Applying fertiliser /pesticide /herbicide	Weeding	Irrigation/Water management	Harvesting commercial crops	Harvesting subsistence crops	Cleaning	Sorting	Grading	Processing	Packaging	Negotiate price	Transport produce	Sell to trader	Sell to consumer	
A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	
1																			
2																			
3																			
4																			
5																			

If A16=(1) yes please ask for the following questions:

How do you negotiate with your buyer...? A20

1. In person

2. Over the phone

3. Both

4. Other, specify _____

Do you check the prices of products before negotiating with your buyer using your mobile phone? A22

1. Yes

2. No

When do you negotiate with your buyer? A21

1. Before harvest

2. After harvest

3. Other, specify _____

CROP CODES

Temporary Crops	
	Code
Amaranthus (Baji)	501
Long Beans	502
Bora Beans	503
French Beans	504
Broccoli	505
Broomcorn	506
Capsicum	507
Carrot	508
Cassava	509
Cauliflower	510
Celery	511
Chinese Cabbage	512
Cow Pea	513
Cucumber	514
Dalo (Taro)	515
Dalo ni tana	516
Dhal (all types)	517
Eggplant	518
English Cabbage	519
Garlic	520
Ginger	521
Gourd/Karela (Bitter)	522
Gourd (Others)	523
Herbs (all types)	524
Kumala (Sweet Potatoes)	525
Lettuce	526
Maize	527
Okra (Bhindi)	528
Pumpkin	529
Pigeon Pea	530
Peanuts	531
Radish	532
Rice	533
Spring Onion	535
Squash	536
Tomatoes	537
Tobacco	539
Turnip	540
Tumeric	541
Yams	542
Watercress	543
Watermelon	544

Permanent Crops	
	Code
Avocado	401
Banana	402
Bele	403
Breadfruit	404
Cardamom	405
Chillies	406
Cocoa (Wet Beans)	407
Coconut (Copra) Nuts	408
Coffee	409
Custard Apple	410
Dhania	411
Duruka	412
Guava	413
Jackfruit	414
Kavika	415
Kura	416
Lemon	417
Mandarin and Tangerine	418
Mango	419
Melons	420
Oil Palms	421
Oranges	422
Ota	423
Other Citrus	424
Passionfruit	425
Papaya	426
Pawpaw	430
Pineapple	431
Plaintain	432
Rourou	433
Sourlime	434
Soursop	435
Spring onion	436
Star Apple	437
Sugarcane	438
Tamarind	439
Vanilla	440
Wi (Fruit)	442
Yaqona	443
Other fruit	444
Other vegetable	445

B. ROLE IN DECISION MAKING AND ACCESS TO DECISION MAKING

Do you contribute or have any say into the following decisions?

Decisions about what commodities to grow?	<input type="text"/>	B1
Decisions about who to sell to?	<input type="text"/>	B2
Decisions on how income is spent?	<input type="text"/>	B3
Decisions about household livelihood strategies?	<input type="text"/>	B4
Decisions about child health and education?	<input type="text"/>	B5
Do you own your own mobile phone? 1. Yes 2. No	<input type="text"/>	B6
If B6=(1) How long have you had your own mobile phone (years)?	<input type="text"/>	B7
Do you own or have access to the following assets*: 1. Yes, 2.No		
a computer?	<input type="text"/>	B8
the Internet?	<input type="text"/>	B9
a car?	<input type="text"/>	B10
a truck?	<input type="text"/>	B11
a bank account?	<input type="text"/>	B12
a credit card?	<input type="text"/>	B13

Codes B1-B5:
1. No contribution
2. Decisions made by my spouse and I
3. Decisions made by myself exclusively
4. Decisions made by someone else

***If female is answering both surveys, do not ask questions B8-B13.**

C.BMI

Please use the scales and measuring tape provided to weigh and measure all members of the household present.

If household members are not present, but have been weighed and measured in the last 2 months, please use these measurements.

	Please list members of household from oldest to youngest	Is [name] a male or female? 1. Male 2. Female	Age of household member (age at last birthday)	Record height and weight of each household member.		Was height and weight based on measurement or estimation? (see codes)
				Weight (kgs)	Height (cm)	
	C1	C2	C3	C4	C5	C6
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Codes for C
1. Estimated by respondent
2. Provided by medical records
3. Measured by enumerator

D. PERSON RESPONSIBLE FOR SHOPPING

Who is the person usually responsible for the household food shopping?

1. You
2. Spouse
3. Other, specify below:

 D1

If D1 = (1) please continue completing sections E and F with the respondent.

If D1 = (2) please ask the male HH to complete sections E and F.

If D1 = (3) please ask person who is well informed about shopping decisions to complete sections E and F.

E. SHOPPING BEHAVIOUR

Code	Type of outlet (*See Outlet definitions below)	How much TIME does it take you to get to the nearest [outlet type]?	What is the DISTANCE (km) to the nearest [outlet type]?	How frequently does your household shop for NON-FOOD items at a [outlet type]? e.g.clothes, petrol etc	How frequently does your household shop for FOOD at a [outlet type]? (**See Definition of Food Below)	Answer only if E5 = 1-6 (Household shops for FOOD at this outlet)		
		(minutes)	(km) Code to nearest km (e.g. 0.5 = 0km) 999=don't know	1. Every day 2. 2-6 times per week 3. Once a week 4. 2-3 times per month 5. Once a month 6. Only a few times a year 7. Never	1. Every day 2. 2-6 times per week 3. Once a week 4. 2-3 times per month 5. Once a month 6. Only a few times a year 7. Never	How do you normally get to the nearest [...]?	What are the main reasons that you purchase food at this outlet?	
						1. On foot 2. Bicycle 3. Car 4. Public transport 5. Taxi 6. Other, (specify)	[Do NOT Prompt. Categorize response using codes on back of page. If cannot respond then show list. Ask if second reason, but do not force.]	
E1		E2	E3	E4	E5	E6	E7	E8
1	Supermarket							
2	Roadside stall / Hawker/ Mobile Market							
3	Corner shop							
4	Butcher/Bakery							
5	Fish Market			N/A				
6	Main Market in town/city							
7	Restaurants			N/A				
8	Fast Food (e.g McDonalds)			N/A				
9	Service Station							

Definitions: **Food includes anything eaten or drunk, including unprocessed food, processed food, meals, and beverages. It does not include tobacco/kava or betel nut.

*Supermarkets include MH's, CostULess, RB Patel etc (2-9 cash registers).

*Corner shop include modern fruit stores and speciality stores like butchers and bakeries (1-2 cash registers).

*Hawker is a mobile vendor that sells produce to your door

Codes for E7 and E8

Note: Ask respondent questions without prompting answers.
Then code using table below

1. Low prices (good value)
2. Fixed price (no negotiation)
3. Flexible prices (able to negotiate)
4. Store provides discount (sales)
5. Ability to purchase on credit
6. High-quality food products
7. Food is safe to eat
8. Food products are fresh
9. Availability of Frozen and processed food
10. Food product information (weight, labels, expiry, etc)
11. Product display is good (easy to find products)
12. Wide variety of food products (good selection)
13. Availability of produce all year round
14. Can purchase small amounts
15. Product is unpackaged (can see and feel)
16. Store is easy to get to
17. Store is close to other non-food shopping
18. Store is close to toilets
19. Fast service (no waiting in lines)
20. Cleanliness (including environment) of store
21. Better opening hours
22. Air-conditioning
23. Friendly staff/good relationship and service
24. Delivery service
25. Store sells locally produced food product
26. Store sells imported products

F. FOOD CONSUMPTION (staples and animal products)

		ASK ONLY IF F2 = 1								
		Food Consumption	Change in Consumption	Purchased food			Home Grown		Food Exchange	
Food product (fruit, vegetables, meat, staples, value added)		During the past 12 months, has your household consumed any [...]? 1. Yes 2. No	Are members of your household consuming smaller or larger quantities of [...] on a <u>per person basis</u> than 5 years ago? 1. Smaller quantities 2. About the same 3. Larger quantities 4. Never consumed	During the past month, how many times did your household purchase [...]? Number of times	For each purchase, what is the normal value of [...] bought for household consumption? FJD\$ per KG	Where do you buy <u>most</u> of the [...]?	How much[...] did your household consume from your own production during the past 12 months?		How much[...] did you exchange or transfer during the past 12 months?	
						1. Supermarket 2. Roadside Stall / Hawker 3. Corner Shop 4. Butcher 5. Bakery 6. Fish Market 7. Main Market in town 8. Restaurants 9. Fast Food (eg Mc Donalds) 10. Service Stations	Quantity	Frequency	Quantity	Frequency
F1		F2	F3	F4	F5	F6	F7	F8	F9	F10
1	Fresh Pawpaw									
2	Fresh Banana									
3	Fresh Lemons (Moli)									
4	Fresh Mango									
5	Fresh Melons (including watermelon)									
6	Fresh Pineapple									
7	Fresh Apples									
8	Fresh Oranges									
9	Fresh Grapes									
10	Fresh Breadfruit									
11	Fresh Coconut									
12	Other Fresh Fruits									
13	Processed or Frozen Fruits									
14	Fresh Eggplant									
15	Fresh Mushrooms									
16	All sorts of Fresh Beans									
17	Fresh Otta									
18	Fresh Brassica / Cabbage									
19	Fresh RouRou									
20	Other fresh leafy vegetables									
21	Fresh Tomatoes									
22	Fresh Capsicum									
23	Fresh Brocoli									
24	Fresh Celery									

F. Continued

		ASK ONLY IF F2 = 1								
		Food Consumption	Change in Consumption	Purchased food		Home Grown	Food Exchange			
During the past 12 months, has your household consumed any [...]?		Are members of your household consuming smaller or larger quantities of [...] on a <u>per person</u> basis than 5 years ago?	During the past month, how many times did your household purchase [...]?	For each purchase, what is the normal value of [...] bought for household consumption?	Where do you buy most of the [...]?	How much[...] did your household consume from your own production during the past 12 months?		How much[...] did you exchange or transfer during the past 12 months?		
1. Yes 2. No		1. Smaller quantities 2. About the same 3. Larger quantities 4. Never consumed	Number of times	FJD\$ per KG	1. Supermarket 2. Roadside Stall / Hawker 3. Corner Shop 4. Butcher 5. Bakery 6. Fish Market 7. Main Market in town 8. Restaurants 9. Fast Food (eg Mc Donalds) 10. Service Stations	Quantity	Frequency	Quantity	Frequency	
F1	Food product (fruit, vegetables, meat, staples, value added)	F2	F3	F4	F5	F6	F7	F8	F9	F10
26	Fresh Lettuce									
27	Fresh Cucumber									
28	Fresh Carrots									
29	Fresh Chillies									
30	Fresh Okra / Bhindi									
31	Fresh Cassava									
32	Fresh Taro (Dalo)									
33	Fresh Sweet Yams (Kumala)									
34	Fresh Potato									
35	Fresh Onion									
36	Fresh Garlic									
37	Fresh Ginger									
38	Other fresh vegetables									
39	Processed or Frozen Vegetables									
40	Poultry – Chicken not processed									
41	Beef not processed									
42	Lamb and Mutton not processed									
43	Duck not processed									
44	Pork not processed									
45	Other meats (e.g Goat not processed)									
46	Processed Meat (Sausages, smallgoods, seasoned, breaded etc)									
47	Fresh Tilapia (Maleya), not processed									
48	Fresh Nama (Sea Grapes, Caulerpa), not processed									
49	Fresh water prawns (ura dina), not processed									
50	Fresh Milkfish (yawa), not processed									
51	Fresh kai, not processed									
52	Other Fresh Fish and Seafood not processed									

F. Continued

		ASK ONLY IF F2 = 1								
		Food Consumption	Change in Consumption	Purchased food			Home Grown		Food Exchange	
		During the past 12 months, has your household consumed any [...]?	Are members of your household consuming smaller or larger quantities of [...] on a per person basis than 5 years ago?	During the past month, how many times did your household purchase [...]?	For each purchase, what is the normal value of [...] bought for household consumption?	Where do you buy most of the [...]?	How much[...] did your household consume from your own production during the past 12 months?		How much[...] did you exchange or transfer during the past 12 months?	
	1. Yes 2. No	1. Smaller quantities 2. About the same 3. Larger quantities 4. Never consumed	Number of times	FJD\$ per KG	1. Supermarket 2. Roadside Stall / Hawker 3. Corner Shop 4. Butcher 5. Bakery 6. Fish Market 7. Main Market in town 8. Restaurants 9. Fast Food (eg Mc Donalds) 10. Service Stations	Quantity	Frequency	Quantity	Frequency	
F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	
53	Processed seafood (breaded, salted, dried, tinned etc)									
54	Rice									
55	Wheat and Flour									
56	Bread and bread products									
57	Noodles (Instant and other)									
58	Sugar, Salt									
59	Nuts									
60	Tamarind									
61	Fresh Milk									
62	Other milk (powered, longlife)									
63	Eggs									
64	Other dairy products (yogurt, cheese, cream etc)									
65	Spreads- Jam, Butter & Margarine									
66	Snacks, Potato chips and Pastries									
67	Chocolate and sweets									
68	Breakfast crackers and other biscuits									
69	Cooking oil, Vegetable, Canola /Soya Bean Oil / Coconut									
70	Breakfast Cereals (Weetbix, Cornflakes, Muesli, Oats etc)									
71	Chili sauce and other soya sauces									
72	Coffee, Milo, Tea									
73	Alcohol beverages (Beer, wine, spirits)									
74	Kava									
75	Bottled Water									
76	Soda, Fruit juice & Soft drinks									
77	Coconut Milk- Fresh/ tinned									
78	Herbs, Spices & seasonings									
79	Ready to eat meals (takeaway or supermarket or restaurant)									

FIJI SURVEY OF URBAN CONSUMERS

June 2012

USP - THE UNIVERSITY OF THE SOUTH PACIFIC IN COLLABORATION WITH THE UNIVERSITY OF ADELAIDE AND THE FIJI BUREAU OF STATISTICS

---CONFIDENTIAL---

Objective: The purpose of this survey is to improve our understanding of urban food consumption patterns, particularly the role of supermarkets and other "modern" outlets.
Use of data: The data collected as part of this survey are for research purposes **ONLY**. Household-level data will not be shared with non-research organizations. Only summary results will be included in published report.

Household ID number		
City/Town	EAS number	Household number

- 1. Suva [See Codes on back cover]
- 2. Nadi

Name of head family			
Name of respondent			
Address/location			
Phone number			
Name of Area			
Enumerator Code			See Codes on back cover

Hello, my name is _____. I work for the Fiji Bureau of Statistics and we are carrying out a survey on food shopping habits. The survey is intended to improve our understanding of how food shopping patterns are changing and how to help farmers adapt to those changes. You are one of 1000 household in Suva and Nadi selected to participate. The individual results are confidential - only summary results will be included in the report. We would like about 90 - 120 minutes of your time to ask you some questions. Please accept this gift as a small token of our appreciation and we will also enter you in a raffle with multiple prizes to be drawn when all the surveys are complete. Vinaka, thank you very much for your time.

	Date			Name	Sign
	Day	Month	Year		
Interview			2012		
Field check			2012		
Office Check			2012		
Data Entry - Start			2012		
Data Entry - Finish			2012		

Research funded by a grant from the Australian Centre for International Agricultural Research (ACIAR)

Version: 1 June 19th 2012



No.	EAS Code	HH Number
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
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23		
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25		
26		
27		
28		
29		
30		

Role	Code	Name
Suva Supervisor	01	Salesh Kumar
Suva Supervisor	02	Karishma Devi
Suva Supervisor	03	Kritika Devi
Suva Supervisor	04	Lenora D.
Suva enumerator	05	Niraj Chandra
Suva enumerator	06	Ronal Chand
Suva enumerator	07	Kinijgi Karokavawa
Suva enumerator	08	Anushka Maharaj
Suva enumerator	09	Taniela Ravubale
Suva enumerator	10	Semi Ratulele
Suva enumerator	11	Tupou Roiroi
Suva enumerator	12	Rafaele Maivalemisau
Suva enumerator	13	Alzima Elisha Bano
Suva enumerator	14	Antonio Sokomuri
Suva enumerator	15	Kasanita Tuimavanua
Suva enumerator	16	Sereimei Rokobuli
Suva enumerator	17	Venina Suguturaga
Suva enumerator	18	Monisha Sharon Lal
Suva enumerator	19	Jiutatia Seru Ravulo
Suva enumerator	20	Kushneel Prakash
	21	
Nadi Supervisor	22	Saimoni Nabukavou
Nadi enumerator	23	Shavneet Pravitesh Narayan
Nadi enumerator	24	Bailuma Yabakidrau
Nadi enumerator	25	Waisale Cava
Nadi enumerator	26	Litiana Seruvatu
	27	
	28	
	29	
	30	

A. CHARACTERISTICS OF MEMBERS OF THE HOUSEHOLD

	Please list the names of members of this household. [[list in order of age, from oldest to youngest]]	Is [name] a male or female? 1. Male 2. Female	What is the relationship between [name] and the head of household? 1. Head 2. Spouse 3. Son/daughter 4. Son/daughter in law 5. Grandchild 6. Parent or in-law 7. Other related 8. Other unrelated	How old is [name]? [age at last birthday, use 0 if less than 1 yr old] Years	Ask this question only for members 6 years or older	Ask these questions only for members 17 yrs and older		
					How many years of schooling has [name] completed? (Year)	What is the marital status of [name]? [Select first correct response] 1. Single 2. Married 3. Separated or divorced 4. Widowed	What is the main activity of [name]? [See activity codes on bottom of page]	On average how many hours a week does he/she work in this activity? [If A7 = 4, 5, or 6 then use '99' hours to save them estimating an answer for A8]
	A1	A2	A3	A4	A5	A6	A7	A8
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								

1
2
3
4
5
6
7
8
9
10
11
12
13
14

Note: The household is defined as a group of people who live and eat together most of the time. Each member must live with others at least 6 months of the year or 4 days out of the week. The head of the household is defined as the member who makes most of the economic decisions.

Activity codes for A7	
1	Farmer or fisherman
2	Self Employed Other / Employer
3	Wage /Salary employee
4	Unpaid family / community worker
5	Student
6	Unemployed / Retired
7	Other (please specify)

B. HOUSING and ASSETS

Codes for B1	Codes for B2 & B3
1. Muslim	1. Indigenous Fijian / i-Taukei
2. Christian	2. Indo-Fijian
3. Hinduism	3. Routumans
4. Others	4. Chinese
	5. Expats (non Pacific Island born)
	6. Other (includes other Pacific Island countries)

What is the main religion of the household? B1

What is the ethnicity of the head of household? B2

What is the ethnicity of the spouse of the head of household? (If no spouse then write '10') B3

Do you have an indoor tap connected to the towns water supply?
 1 Yes B4
 2 No

What type of fuel is used by your household for cooking?
 1 Electricity 3 Kerosene/Benzine B5
 2 Gas 4 Wood / Coal
 5 Other, (specify)

What is the distance (in meters) to the nearest public transport? (that is bus, taxis., etc) B6 meters

B7. How many of each of the following items do members of your household currently own or have in household?
 [If household does not own any, write "0"]

	Number
1 a refrigerator?	<input type="text"/> 1
2 a microwave oven?	<input type="text"/> 2
3 a rice cooker?	<input type="text"/> 3
4 a stove?	<input type="text"/> 4
5 a car or truck?	<input type="text"/> 5
6 a mobile phone?	<input type="text"/> 6
7 a landline telephone?	<input type="text"/> 7
8 a computer or laptop?	<input type="text"/> 8
9 Internet access? (incl. mobile)	<input type="text"/> 9
10 a radio?	<input type="text"/> 10
11 a television?	<input type="text"/> 11
12 an outboard motor?	<input type="text"/> 12
13 a generator?	<input type="text"/> 13
14 a bank account?	<input type="text"/> 14
15 a credit card?	<input type="text"/> 15

C. COOKING AND SHOPPING ATTITUDES AND BEHAVIOUR

Who in the household is primarily responsible for...

- C 1 ...deciding what food products to purchase for the family meals?
- C 2 ...doing the majority of food shopping for family meals?
- C 3 ...deciding what food the family will have for a meal?
- C 4 ...cooking the majority of the family meals?

- C 1 1. Male adult family member
- C 2 2. Female adult family member
- C 3 3. Children in family
- C 4 4. No one

- C 5 How many times per WEEK does the majority of your household eat dinner together?
[Number should not be greater than 7]

--

- C 5 0 to 7 (times)

In an average MONTH, how often is the food for the evening meal ...

- C 6 ..."ready-to-eat" meals purchased outside the house, brought home, and eaten at home?
- C 7 ...purchased from a delivery service and eaten at home?
- C 8 ...purchased and eaten at restaurants?
- C 9 ...purchased from street stalls or vendors and eaten away from home?
- C 10 ...purchased and cooked at home?

- C 6 1. Every day
- C 7 2. 2-6 times per week
- C 8 3. Once a week
- C 9 4. 2-3 times per month
- C 10 5. Once a month
- 6. Few times per year
- 7. Never

On a scale of 1 to 5, how important is each of the following characteristics when deciding where you will purchase food? (USE PINK CARD on back of survey)

1 = Not at all important; 2 = Somewhat important; 3 = Moderately important; 4 = Important; 5 = Extremely important

		Importance			Importance		
C 11	Low prices (good value)		C 11	C 24	Can purchase small amounts		C 24
C 12	Fixed price (no negotiation)		C 12	C 25	Product is unpackaged (can see and feel)		C 25
C 13	Flexible prices (able to negotiate)		C 13	C 26	Store is easy to get to		C 26
C 14	Store provides discount (sales)		C 14	C 27	Store is close to other non-food shopping		C 27
C 15	Ability to purchase on credit		C 15	C 28	Store is close to toilets		C 28
C 16	High-quality food products		C 16	C 29	Fast service (no waiting in lines)		C 29
C 17	Food is safe to eat		C 17	C 30	Cleanliness (including environment) of store		C 30
C 18	Food products are fresh		C 18	C 31	Better opening hours		C 31
C 19	Availability of Frozen and processed food		C 19	C 32	Air-conditioning		C 32
C 20	Food product information (weight, labels, expiry, etc)		C 20	C 33	Friendly staff / good relationship and service		C 33
C 21	Product display is good (easy to find products)		C 21	C 34	Delivery Service		C 34
C 22	Wide variety of food products (good selection)		C 22	C 35	Store sells locally produced food product		C 35
C 23	Availability of produce all year round		C 23	C 36	Store sells imported products		C 36

D. SHOPPING BEHAVIOUR

Code	Type of outlet (*See Outlet definitions below)	How much TIME does it take you to get to the nearest [outlet type]? (minutes)	What is the DISTANCE (km) to the nearest [outlet type]? (km) Code to nearest km (e.g. 0.5 = 0km) 999=don't know	How frequently does your household shop for NON-FOOD items at a [outlet type]? e.g. clothes, petrol etc 1. Every day 2. 2-6 times per week 3. Once a week 4. 2-3 times per month 5. Once a month 6. Only a few times a year 7. Never	How frequently does your household shop for FOOD at a [outlet type]? (**See Definition of Food Below) 1. Every day 2. 2-6 times per week 3. Once a week 4. 2-3 times per month 5. Once a month 6. Only a few times a year 7. Never	Answer only if D5 = 1-6 (Household shops for FOOD at this outlet)		
						How do you normally get to the nearest [...]?	What are the main reasons that you purchase food at this outlet?	
							1st reason	2nd reason
D1		D2	D3	D4	D5	D6	D7	D8
1	Supermarket							
2	Roadside stall / Hawker							
3	Corner shop / Butcher / Bakery							
4	Fish Market			N/A				
5	Main Market in town/city							
6	Restaurants			N/A				
7	Fast Food (e.g McDonalds)			N/A				
8	Service Station							

Definitions: **Food includes anything eaten or drunk, including unprocessed food, processed food, meals, and beverages. It does not include tobacco/kava or betel nut.

*Supermarkets include MH's, CostU Less, RB Patel etc (2-9 cash registers).

*Corner shop include modern fruit stores and speciality stores like butchers and bakeries (1-2 cash registers).

*Hawker is a mobile vendor that sells produce to your door

Back of D.

Codes for D7 and D8

Note: Ask respondent questions without prompting answers. Then code using table below.

- 1 Low prices (good value)
- 2 Fixed price (no negotiation)
- 3 Flexible prices (able to negotiate)
- 4 Store provides discount (sales)
- 5 Ability to purchase on credit
- 6 High-quality food products
- 7 Food is safe to eat
- 8 Food products are fresh
- 9 Availability of Frozen and processed food
- 10 Food product information (weight, labels, expiry, etc)
- 11 Product display is good (easy to find products)
- 12 Wide variety of food products (good selection)
- 13 Availability of produce all year round
- 14 Can purchase small amounts
- 15 Product is unpackaged (can see and feel)
- 16 Store is easy to get to
- 17 Store is close to other non-food shopping
- 18 Store is close to toilets
- 19 Fast service (no waiting in lines)
- 20 Cleanliness (including environment) of store
- 21 Better opening hours
- 22 Air-conditioning
- 23 Friendly staff / good relationship and service
- 24 Delivery Service
- 25 Store sells locally produced food product
- 26 Store sells imported products

E. FOOD CONSUMPTION (staples and animal products)

		ASK ONLY IF E2 = 1								
		Food Consumption	Change in Consumption	Purchased food			Home Grown		Food Exchange	
				During the past 12 months, has your household consumed any [...]?	Are members of your household consuming smaller or larger quantities of [...] on a per person basis than 5 years ago?	During the past month, how many times did your household purchase [...]?	For each purchase, what is the normal value of [...] bought for household consumption?	Where do you buy most of the [...]?	How much[...] did your household consume from your own production during the past 12 months?	
E1	Food product (fruit, vegetables, meat, staples, value added)	E2	E3	E4	E5	E6	E7	E8	E9	E10
1	Fresh Pawpaw									
2	Fresh Banana									
3	Fresh Lemons (Moli)									
4	Fresh Mango									
5	Fresh Melons (including watermelon)									
6	Fresh Pineapple									
7	Fresh Papaya									
8	Fresh Apples									
9	Fresh Oranges									
10	Fresh Grapes									
11	Fresh Breadfruit									
12	Fresh Coconut									
13	Other Fresh Fruits									
14	Processed or Frozen Fruits									
15	Fresh Eggplant									
16	Fresh Mushrooms									
17	All sorts of Fresh Beans (long bean, French & butter bean, etc)									
18	Fresh Otta									
19	Fresh Brassica / Cabbage									
20	Fresh RouRou									
21	Other fresh leafy vegetables									
22	Fresh Tomatoes									
23	Fresh Capsicum									
24	Fresh Brocoli									
25	Fresh Celery									

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		ASK ONLY IF E2 = 1								
		Food Consumption	Change in Consumption	Purchased food			Home Grown	Food exchange		
		During the past 12 months, has your household consumed any [...]?	Are members of your household consuming smaller or larger quantities of [...] on a per person basis than 5 years ago?	During the past month, how many times did your household purchase [...]?	For each purchase, what is the normal value of [...] bought for household consumption?	Where do you buy most of the [...]?	How much[...] did your household consume from your own production during the past 12 months?		How much[...] did you exchange or transfer during the past 12 months?	
		1. Yes 2. No	1. Smaller quantities 2. About the same 3. Larger quantities 4. Never consumed	Number of times	Value in FIJIAN DOLLARS	1. Supermarket 2. Roadside Stall / Hawker 3. Corner Shop / Butcher and Bakery 4. Fish Market 5. Main Market in town / city 6. Restaurants 7. Fast Food (eg Mc Donalds) 8. Service Stations	Quantity Frequency	Quantity Frequency	Quantity Frequency	
							Kgs	1. Daily 2. Weekly 3. Monthly 4. Yearly	Kgs	1. Daily 2. Weekly 3. Monthly 4. Yearly
E1	Food product (fruit, vegetables, meat, staples, value added)	E2	E3	E4	E5	E6	E7	E8	E9	E10
26	Fresh Lettuce									
27	Fresh Cucumber									
28	Fresh Carrots									
29	Fresh Chillies									
30	Fresh Okra / Bhindi									
31	Fresh Cassava									
32	Fresh Taro (Dalo)									
33	Fresh Sweet Yams (Kumala)									
34	Fresh Potato									
35	Fresh Onion									
36	Fresh Garlic									
37	Fresh Ginger									
38	Other fresh vegetables									
39	Processed or Frozen Vegetables									
40	Poultry – Chicken not processed									
41	Beef, Lamb and Mutton not processed									
42	Duck not processed									
43	Pork not processed									
44	Other meats (e.g Goat not processed)									
45	Processed Meat (Sausages, smallgoods, seasoned, breaded etc)									
46	Fresh Tilapia (Maleya),not processed									
47	Fresh Nama (Sea Grapes, Caulerpa), not processed									
48	Fresh water prawns (ura dina), not processed									
49	Fresh Milkfish (yawa), not processed									
50	Fresh kai, not processed									
51	Other Fresh Fish and Seafood not processed									
52	Processed seafood (breaded, salted, dried, tinned etc)									

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ASK ONLY IF E2 = 1										
		Food Consumption	Change in Consumption	Purchased food			Home Grown		Food Exchange	
		During the past 12 months, has your household consumed any [...]?	Are members of your household consuming smaller or larger quantities of [...] on a per person basis than 5 years ago?	During the past month, how many times did your household purchase [...]?	For each purchase, what is the normal value of [...] bought for household consumption?	Where do you buy most of the [...]?	How much[...] did your household consume from your own production during the past 12 months?		How much[...] did you exchange or transfer during the past 12 months?	
						1. Yes 2. No				
E1	Food product (fruit, vegetables, meat, staples, value added)	E2	E3	E4	E5	E6	E7	E8	E9	E10
53	Rice									
54	Wheat and Flour									
55	Bread and bread products									
56	Noodles (Instant and other)									
57	Sugar, Salt									
58	Nuts									
59	Tamarind paste									
60	Other Tamarind products									
61	Fresh Milk									
62	Other milk (powered, longlife)									
63	Eggs									
64	Other dairy products (yogurt, cheese, cream etc)									
65	Spreads- Jam, Butter & Margarine									
66	Snacks, Potato chips and Pastries									
67	Chocolate and sweets									
68	Breakfast crackers and other biscuits									
69	Cooking oil, Vegetable, Canola /Soya Bean Oil / Coconut									
70	Breakfast Cereals (Weetbix, Cornflakes, Muesli, Oats etc)									
71	Chili sauce and other soya sauces									
72	Coffee, Milo, Tea									
73	Alcohol beverages (Beer, wine, spirits)									
74	Kava									
75	Bottled Water									
76	Soda, Fruit juice & Soft drinks									
77	Coconut Milk- Fresh/ tinned									
78	Herbs, Spices & seasonings									
79	Ready to eat meals (takeaway or supermarket or restaurant)									

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F. NON-FOOD EXPENDITURE

How much does your household spend on [item] in a typical week, month, or year? [do not include food, durable goods, taxes, or business expenses]		Time period 1=weekly 2=monthly 3=yearly 4= N/A	Value (\$) Code as "0" if no expenditure	
F1		F2	F3	
1	Household equipment and maintenance			1
2	Utilities; Electricity, water, gas, and kerosene			2
3	Communication (phone, computer etc)			3
4	Body products, cleaning supplies, cosmetics, tissue, etc			4
5	Health expenditures (insurance hospital, clinic, doctor, medicine, etc)			5
6	Education expenditures (school fees, tutors, books, uniforms, etc)			6
7	Transportation (bus fare, petrol, etc)			7
8	Domestic employees (housekeeper, driver, etc)			8
9	Clothing (including shoes)			9
10	Tobacco (cigarettes, cigars, leaves, etc)			10
11	Recreation and leisure spending (excluding food)			11
12	Misc; Other non-food consumption spending (e.g. gifts, life insurance)			12

Note: Do not include food, durable goods, taxes, or business expenses.

House details;

F4 What is the ownership status of your house?
1. Rented; 2. Owned; 3. Use without paying rent

F4

F5 [If F4=1] How much rent does your household pay per month?
(in Fijian Dollars per month)

F5

F6 [if F4=2 or 3] How much would it cost to rent housing like this
in this neighborhood? (in Fijian Dollars per month)

F6

G. RETAIL OUTLET USE, PREFERENCES QUALITY, SAFETY AND CONVENIENCE

		If G1 = 1-9 then Ask							
Where do you usually buy [food type]?		What is the primary reason that you buy [food type] at this outlet?	In the last 5 years have you bought smaller or larger quantities of [food type] from the outlet specified in G1?	Only ask if G3 = 1 or 3 What is the primary reason your purchasing habits have changed?	Which is the best type of outlet to buy [food type] at a good price?	Which is the best type of outlet to buy [food type] that is quality?	Which is the best type of outlet to buy [food type] that is safe and hygienic to eat?	Which is the best type of outlet to buy [food type] where you trust the product information?	
1. Supermarket		Please use codes on the next page			1. Supermarket	1. Supermarket	1. Supermarket	1. Supermarket	
2. Roadside Stall / Hawker			1. Household income has changed	2. Roadside Stall / Hawker	2. Roadside Stall / Hawker	2. Roadside Stall / Hawker	2. Roadside Stall / Hawker	2. Roadside Stall / Hawker	
3. Corner shop / Butcher and Bakery			1. Smaller quantities	2. Food preferences have changed	3. Corner shop / Butcher and Bakery	3. Corner shop / Butcher and Bakery	3. Corner shop / Butcher and Bakery	3. Corner shop / Butcher and Bakery	
4. Fish Market			2. About the same	3. New Outlet	4. Fish Market	4. Fish Market	4. Fish Market	4. Fish Market	
5. Main market in Town /City			3. Larger quantities	4. Outlet has improved	5. Main market in Town /City	5. Main market in Town /City	5. Main market in Town /City	5. Main market in Town /City	
6. Restaurants				5. Outlet has deteriorated	6. Restaurants	6. Restaurants	6. Restaurants	6. Restaurants	
7. Fast Food (e.g. Mc Donalds)				6. Other (please specify)	7. Fast Food (e.g. Mc Donalds)	7. Fast Food (e.g. Mc Donalds)	7. Fast Food (e.g. Mc Donalds)	7. Fast Food (e.g. Mc Donalds)	
8. Service Station					8. Service Station	8. Service Station	8. Service Station	8. Service Station	
9 From Producer					9 From Producer	9 From Producer	9 From Producer	9 From Producer	
10. Never buy									
Food product categories		G1	G2	G3	G4	G5	G6	G7	G8
1	Breadfruit								
2	Tomatoes								
3	Melons								
4	Other fresh fruits								
5	Lettuce								
6	Capsicum								
7	Eggplant								
8	Brassica								
9	Taro								
10	Cucumber								
11	Beans								
12	Other fresh vegetables								
13	Fresh meat and poultry								
14	Tilapia (maleya)								
15	Nama (sea grapes, Caulerpa)								
16	Fresh water prawns (ura dina)								
17	kai								
18	Milkfish (yawa)								
19	Other fresh fish and seafood								
20	Tamarind Products								
21	Processed food items								

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Codes for G2	1	Low prices (good value)
	2	Fixed price (no negotiation)
	3	Flexible prices (able to negotiate)
	4	Store provides discount (sales)
	5	Ability to purchase on credit
	6	High-quality food products
	7	Food is safe to eat
	8	Food products are fresh
	9	Availability of Frozen and processed food
	10	Food product information (weight, labels, expiry, etc)
	11	Product display is good (easy to find products)
	12	Wide variety of food products (good selection)
	13	Availability of produce all year round
	14	Can purchase small amounts
	15	Product is unpackaged (can see and feel)
	16	Store is easy to get to
	17	Store is close to other non-food shopping
	18	Store is close to toilets
	19	Fast service (no waiting in lines)
	20	Cleanliness (including environment) of store
	21	Better opening hours
	22	Air-conditioning
	23	Friendly staff / good relationship and service
	24	Delivery Service
	25	Store sells locally produced food product
	26	Store sells imported products

H. FACTORS IN FOOD CHOICE

In choosing the food products you purchase, what are the 3 most important factors influencing your decision (apart from halal)?

	Most important H1	2nd most H2	3rd most H3
1. Food in general	<input type="text"/>	<input type="text"/>	<input type="text"/>

In choosing each of the following types of products, what are the 3 most important factors influencing your decision (apart from halal)?

	Most H1	2nd Most H2	3rd Most H3
2. Breadfruit	<input type="text"/>	<input type="text"/>	<input type="text"/>
3. Tomatoes	<input type="text"/>	<input type="text"/>	<input type="text"/>
4. Melons	<input type="text"/>	<input type="text"/>	<input type="text"/>
5. Other fresh fruits	<input type="text"/>	<input type="text"/>	<input type="text"/>
6. Lettuce	<input type="text"/>	<input type="text"/>	<input type="text"/>
7. Capsicum	<input type="text"/>	<input type="text"/>	<input type="text"/>
8. Eggplant	<input type="text"/>	<input type="text"/>	<input type="text"/>
9. Brassica	<input type="text"/>	<input type="text"/>	<input type="text"/>
10. Taro	<input type="text"/>	<input type="text"/>	<input type="text"/>
11. Cucumbers	<input type="text"/>	<input type="text"/>	<input type="text"/>
12. Beans	<input type="text"/>	<input type="text"/>	<input type="text"/>
13. Other fresh vegetables	<input type="text"/>	<input type="text"/>	<input type="text"/>
14. Fresh meat and poultry	<input type="text"/>	<input type="text"/>	<input type="text"/>
15. Tilapia (maleya)	<input type="text"/>	<input type="text"/>	<input type="text"/>
16. Nama (sea grapes)	<input type="text"/>	<input type="text"/>	<input type="text"/>
17. Fresh water prawns	<input type="text"/>	<input type="text"/>	<input type="text"/>
18. Kai	<input type="text"/>	<input type="text"/>	<input type="text"/>
19. Milkfish (yawa)	<input type="text"/>	<input type="text"/>	<input type="text"/>
20. Other fresh fish and seafood	<input type="text"/>	<input type="text"/>	<input type="text"/>
21. Tamarind Products	<input type="text"/>	<input type="text"/>	<input type="text"/>
22. Processed food items	<input type="text"/>	<input type="text"/>	<input type="text"/>

H4. How often do you use food labels when shopping for food? H4

[If H4 is 1-3]
H5 What type of information do you use or look for the most (apart from price)? H5

Codes for H1 - H3	
1	Price
2	Nutritional content
3	Food safety
4	Quality
5	Taste
6	Freshness
7	Easy to prepare
8	Production method (e.g. organic)
9	Brand
10	Fiji Grown
11	Grade, Class, Size
12	Diversity
13	Smell
14	Colour
15	Appearance
16	Firmness/texture
17	Variety (e.g. apples)
18	Convenient packaging (size/type)
19	Expiry date
20	Other labelling info
21	Never purchase this item
22	Other (please specify)

Codes for H4	
1	Always
2	Often
3	Sometimes
4	Never
Codes for H5	
1	Nutritional information
2	Use by / Best before date
3	Local Origin
4	Other (please specify)

I. FOOD CONCERNS

SHOW RESPONDENT GREEN "AGREEMENT" SCALE PROVIDED ON CARD. RESPONDENT SHOULD POINT TO LEVEL OF AGREEMENT

I am concerned about;		Agreement
I 1	having enough food available (adequate access to food and /or affording food)	I 1
I 2	the safety of my food	I 2
I 3	the nutritional content of my food	I 3
I 4	the use of pesticides to produce my food	I 4
I 5	the use of additives, preservatives and artificial colours in my food	I 5
I 6	bacterial contamination of my food	I 6
I 7	the accuracy of information on food labels and food displays	I 7
I 8	the accuracy of information regarding halal certification	I 8
I 9	food imported from outside Fiji	I 9
I 10	whether the food was stored properly (kept refrigerated)	I 10
I 11	availability of certain foods all year around	I 11
I 12	local growers being able to sell their products	I 12
I 13	the price of food	I 13
I 14	the quality of my food	I 14

LEVEL OF AGREEMENT				
STRONGLY DISAGREE	SOMEWHAT DISAGREE	INDIFFERENT/ UNSURE	SOMEWHAT AGREE	STRONGLY AGREE
1	2	3	4	5
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J. OTHER

J1. How has the **size** your household changed in the last 5 years?

- 1. Increased (more members)
- 2. No change
- 3. Decreased (fewer members)

 J1

J2. What is the approximate **income** of the household?

[This includes the income of all household members including children, but NOT domestic employees. For self-employed members, we want the net income, i.e. business revenue minus business expenses.]

- 1 Less than 100 \$/month
- 2 101 to 500 \$/month
- 3 501 to 1000 \$/month
- 4 1001 to 1500 \$/month
- 5 1501 to 2000 \$/month
- 6 2001 to 3000 \$/month
- 7 3001 to 4000 \$/month
- 8 > 4001 \$/month

 J2

J3. How has the **health status** of household members changed in the last 5 years?

- 1. Improved
- 2. No change
- 3. Deterioration
- 4. Don't know/not applicable

 J3

[If J3=1 or 3]

J4. What is the primary reason for the change in the health status of household members?

- 1. Household member had an accident
 - 2. Household member fell ill due to disease
 - 3. Medical intervention improved status
 - 4. Change in diet
 - 5. Change in lifestyle (e.g. exercise more, stopped smoking)
 - 6. Other (specify)
- _____

 J4

J5. How has the **standard of living** of your household changed in the last 5 years?

- 1 Improved significantly (>30%)
- 2 Improved somewhat (10-20%)
- 3 No change (-10% to 10%)
- 4 Deteriorated somewhat (-10-30%)
- 5 Deteriorated significantly (>-30%)

 J5

[If J5=1,2,4,5]

J6. What is the primary **reason** for the change in the standard of living?

- 1 Household member(s) found/lost job(s)
- 2 Household member(s) earning more/less from same job(s)
- 3 Change in health of household members
- 4 Losses associated with crime (e.g. theft)
- 5 Losses associated with natural disaster
- 6 New expenses associated with illness
- 7 New expenses associated with newborn
- 8 New expenses associated with education
- 9 Inheritance
- 10 Other (specify) _____

 J6

LEVEL OF IMPORTANCE				
NOT AT ALL IMPORTANT	A LITTLE IMPORTANT	SOMEWHAT IMPORTANT	IMPORTANT	EXTREMELLY IMPORTANT
1	2	3	4	5
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Thesis Reference List

- Abarca-Gómez, L., Abdeen, Z.A., Hamid, Z.A., Abu-Rmeileh, N.M., Acosta-Cazares, B., Acuin, C., Adams, R.J., Aekplakorn, W., Afsana, K., Aguilar-Salinas, C.A. and Agyemang, C., 2017. Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128· 9 million children, adolescents, and adults. *The Lancet*, 390(10113), pp.2627-2642.
- Ahima, R.S. and Lazar, M.A., 2013. The health risk of obesity—better metrics imperative. *Science*, 341(6148), pp.856-858.
- Anderson I. The Economic Costs of Noncommunicable Diseases in the Pacific Islands. A Rapid Stocktake of the Situation in Samoa, Tonga and Vanuatu. Health, Nutrition, and Population (HNP) Discussion Paper. Washington (DC): World Bank Group; 2013.
- Appelhans, B.M., Milliron, B.J., Woolf, K., Johnson, T.J., Pagoto, S.L., Schneider, K.L., Whited, M.C. and Ventrelle, J.C., 2012. Socioeconomic status, energy cost, and nutrient content of supermarket food purchases. *American Journal of Preventive Medicine*, 42(4), pp.398-402.
- Appelhans, B.M., French, S.A., Tangney, C.C., Powell, L.M. and Wang, Y., 2017. To what extent do food purchases reflect shoppers' diet quality and nutrient intake?. *International Journal of Behavioural Nutrition and Physical Activity*, 14(1), p.46.
- Arimond, M., Wiesmann, D., Becquey, E., Carriquiry, A., Daniels, M.C., Deitchler, M., Fanou-Fogny, N., Joseph, M.L., Kennedy, G., Martin-Prevel, Y. and Torheim, L.E., 2010. Simple Food Group Diversity Indicators Predict Micronutrient Adequacy of Women's Diets in 5 Diverse, Resource-Poor Settings. *The Journal of Nutrition*, 140(11), pp.2059S-2069S.
- Asfaw, A., 2008. Does supermarket purchase affect the dietary practices of households? Some empirical evidence from Guatemala. *Development Policy Review*, 26(2), pp.227-243.
- Asfaw, A., 2011. Does consumption of processed foods explain disparities in the body weight of individuals? The case of Guatemala. *Health Economics*, 20(2), pp.184–195.

- Atkinson, A.B., Gomulka, J. and Stern, N.H., 1990. Spending on alcohol: evidence from the Family Expenditure Survey 1970-1983. *The Economic Journal*, 100(402), pp.808-827.
- Australian Trade and Investment Commission, 2018. Export Markets Fiji. Accessed in July 2018, available at: <https://www.austrade.gov.au/Australian/Export/Export-markets/Countries/Fiji/Industries>.
- Ayaya, S.O., Esamai, F.O., Rotich, J. and Olwambula, A.R., 2004. Socio-economic factors predisposing under five-year-old children to severe protein energy malnutrition at the Moi Teaching and Referral Hospital, Eldoret, Kenya. *East African Medical Journal*, 81(8), pp.415-421.
- Backholer, K., Spencer, E., Gearon, E., Magliano, D.J., McNaughton, S.A., Shaw, J.E. and Peeters, A., 2016. The association between socio-economic position and diet quality in Australian adults. *Public Health Nutrition*, 19(3), pp.477-485.
- Bamman, H., 2007. Participatory value chain analysis for improved farmer incomes, employment opportunities and food security. *Pacific Economic Bulletin*, 22(3), pp.113-125.
- Banwell, C., Dixon, J., Seubsman, S. A., Pangsap, S., Kelly, M., and Sleight, A., 2013. Evolving food retail environments in Thailand and implications for the health and nutrition transition. *Public Health Nutrition*, 16(04), pp.608-615.
- Barquera, S., Peterson, K.E., Must, A., Rogers, B.L., Flores, M., Houser, R., Monterrubio, E. and Rivera-Dommarco, J.A., 2007. Coexistence of maternal central adiposity and child stunting in Mexico. *International journal of obesity*, 31(4), pp.601.
- Barreiro-Hurlé, J., Gracia, A. and T. De-Magistris., 2010. Does nutrition information on food products lead to healthier food choices?. *Food Policy*, 35(3), pp.221-229.
- Becker, A.E., Gilman, S.E. and Burwell, R.A., 2005. Changes in prevalence of overweight and in body image among Fijian women between 1989 and 1998. *Obesity Research*, 13(1), pp.110-117.
- Bere, E., Lenthe, F., Klepp, K. and Brug, J., 2008. Why do parents' education level and income affect the amount of fruits and vegetables adolescents eat?. *The European Journal of Public Health*, 18(6), pp.611-615.

- Bhutta, Z. A., Ahmed, T., Black, R. E., Cousens, S., Dewey, K., Giugliani, E. and Batoool, A., 2008. What works? Interventions for maternal and child undernutrition and survival. *The Lancet*, 371(9610), pp. 417-440.
- Binkley, J.K. and Golub, A., 2011. Consumer demand for nutrition versus taste in four major food categories. *Agricultural Economics*, 42(1), pp.65-74.
- Black, R.E., Victora, C.G., Walker, S.P., Bhutta, Z.A., Christian, P., De Onis, M., Ezzati, M., Grantham-McGregor, S., Katz, J., Martorell, R. and Uauy, R., 2013. Maternal and child undernutrition and overweight in low-income and middle-income countries. *The Lancet*, 382(9890), pp.427-451.
- Black, R.E., Morris, S.S. and Bryce J., 2003. Where and why are 10 million children dying every year?. *The Lancet*, 361(9376), pp.2226–2234.
- Bloom, D.E., Chisholm, D., Jané-Llopis, E., Prettner, K., Stein, A. and Feigl, A., 2011. *From burden to "best buys": reducing the economic impact of non-communicable disease in low-and middle-income countries* (No. 7511). Program on the Global Demography of Aging.
- Boselie, D., Henson, S. and Weatherspoon, D., 2003. Supermarket procurement practices in developing countries: Redefining the roles of the public and private sectors. *American Journal of Agricultural Economics*, 85(5), pp.1155-1161.
- Branca, F., Nikogosian, H. and Lobstein, T. eds., 2007. *The challenge of obesity in the WHO European region and the strategies for response: summary*. Copenhagen, World Health Organization European Region.
- Bray, G., Popkin, B., 1998. Dietary fat intake does affect obesity! *American Journal Clinical Nutrition*, 68(6), pp.1157-73.
- Brewis, A.A., McGarvey, S.T., Jones, J. and Swinburn, B.A., 1998. Perceptions of body size in Pacific Islanders. *International Journal of Obesity*, 22(2), p.185.
- Brewis, A.A. and McGarvey, S.T., 2000. Body image, body size, and Samoan ecological and individual modernization. *Ecology of Food and Nutrition*, 39(2), pp.105-120.
- Brewis, A.A., Wutich, A., Falletta-Cowden, A. and Rodriguez-Soto, I., 2011. Body norms and fat stigma in global perspective. *Current Anthropology*, 52(2), pp.269-276.

- Brian, G., Ramke, J., Maher, L., Page, A., Fischer-Harder, K. and Sikivou, B., 2011. Body mass index among Melanesian and Indian Fijians aged ≥ 40 years living in Fiji. *Asia-Pacific Journal of Public Health*, 23(1), pp.34-43.
- Brown, O., 2005. *Supermarket buying power, global commodity chains and smallholder farmers in the developing world*. Human Development Report Office (HDRO), United Nations Development Programme (UNDP).
- Burlingame, B. and Dernini, S., 2012. Sustainable Diets and Biodiversity: Directions and Solutions for Policy, Research and Action. International Scientific Symposium, Biodiversity and Sustainable Diets United Against Hunger, FAO Headquarters, Rome, Italy, 3-5 November 2010. *In Sustainable Diets and Biodiversity: Directions and Solutions for Policy, Research and Action. International Scientific Symposium, Biodiversity and Sustainable Diets United Against Hunger, FAO Headquarters, Rome, Italy, 3-5 November 2010*. Food and Agriculture Organization of the United Nations (FAO).
- Cairns, G., Angus, K. and Hastings, G., 2009. *The extent, nature and effects of food promotion to children: a review of the evidence to December 2008*. World Health Organization, World Press.
- Cameron, A. and Trivedi, P., 2013. *Regression Analysis of Count Data* (Vol. 53). Cambridge University Press.
- Cannon, G. The fate of nations. The Caroline Waker Lecture 2003. Given at the Royal Society, London. St Austell, Cornwall: Caroline Walker Trust, 2003.
- Cappellari, L. and Jenkins, S., 2006. Calculation of multivariate normal probabilities by simulation, with applications to maximum simulated likelihood estimation. *Stata Journal*, 6(2), pp.156-189.
- Capstick, S., Norris, P., Sopoaga, F. and Tobata, W., 2009. Relationships between health and culture in Polynesia—A review. *Social Science & Medicine*, 68(7), pp.1341-1348.
- Carletto, G., Ruel, M., Winters, P. and Zezza, A., 2015. Farm-Level Pathways to Improved Nutritional Status: Introduction to the Special Issue. *The Journal of Development Studies*.
- Cassidy, J.T., 1985. *Diabetes in Fiji*. Fiji Medical Journal, 13(7-8), pp. 292-297.

- Cattaneo, Olivier, Gary Gereffi and Cornelia Staritz. 2010. "Global Value Chains in a Postcrisis World: Resilience, Consolidation, and Shifting Markets." In *Global Value Chains in a Postcrisis World: A Development Perspective*, edited by Olivier Cattaneo, Gary Gereffi and Cornelia Staritz, 3-20. Washington D.C.: The World Bank
- Cesare, M.D., Bentham, J., Stevens, G.A., Zhou, B., Danaei, G., Lu, Y., Bixby, H., Cowan, M.J., Riley, L.M., Hajifathalian, K. and Fortunato, L., 2016. Trends in adult body-mass index in 200 countries from 1975 to 2014: a pooled analysis of 1698 population-based measurement studies with 19.2 million participants. *The Lancet*, 387(10026), pp.1377-1396.
- Chege, C.G., Andersson, C.I. and Qaim, M., 2015. Impacts of supermarkets on farm household nutrition in Kenya. *World Development*, 72, pp.394-407.
- Chow, C.K., Naidu, S., Raju, K., Raju, R., Joshi, R., Sullivan, D., Celermajer, D.S. and Neal, B.C., 2008. Significant lipid, adiposity and metabolic abnormalities amongst 4535 Indians from a developing region of rural Andhra Pradesh. *Atherosclerosis*, 196(2), pp.943-952.
- Coates, J., Swindale, A. and Bilinsky, P., 2007. Household Food Insecurity Access Scale (HFIAS) for measurement of food access: indicator guide. *Washington, DC: food and nutrition technical assistance project, academy for educational development*, 34.
- Collins, V., Dowse, G., Cabealawa, S., Ram, P. and P. Z. Zimmet., 1996. High mortality from cardiovascular disease and analysis of risk factors in Indian and Melanesian Fijians. *International Journal of Epidemiology*, 25(1), pp.59-69.
- Coneus, K. and Spiess, C.K., 2012. The intergenerational transmission of health in early childhood—Evidence from the German Socio-Economic Panel Study. *Economics & Human Biology*, 10(1), pp.89-97.
- Connell, J. and Soutar, L., 2007. Free trade or free fall? Trade liberalization and development in the Pacific and Caribbean. *Social and Economic Studies*, 56, pp.41–66.
- Cornwell B, Villamor E, Mora-Plazas M, Marin C, Monteiro CA, Baylin A., 2018. Processed and ultra-processed foods are associated with lower-quality nutrient profiles in children from Colombia. *Public Health Nutrition*, 21(1), pp.142-147.

- Coyne, T., Hughes, R (ed)., and Langi, Sarah, (ed) and Secretariat of the Pacific Community (contributor.), 2000. *Lifestyle Diseases in Pacific Communities*. Secretariat of the Pacific Community, Noumea, New Caledonia.
- Cragg, J. G., 1971. Some statistical models for limited dependent variables with application to the demand for durable goods. *Econometrica: Journal of the Econometric Society*, pp.829-844.
- Cunningham, S.A., Kramer, M.R. and Narayan, K.M., 2014. Incidence of childhood obesity in the United States. *New England Journal of Medicine*, 370(5), pp.403-411.
- D'Haese, M. and Huylenbroeck, G. V., 2005. The Rise of Supermarkets and Changing Expenditure Patterns of Poor Rural Households Case Study in the Transkei Area, South Africa. *Food Policy*, 30 (1), pp.97-113.
- Darmon, N. and A. Drewnowski., 2008. Does social class predict diet quality?. *The American Journal of Clinical Nutrition*, 87(5), pp.1107-1117.
- Demmler, K.M., Klasen, S., Nzuma, J.M. and Qaim, M., 2017. Supermarket purchase contributes to nutrition-related non-communicable diseases in urban Kenya. *PloS one*, 12(9), p.e0185148.
- Demmler, K.M., Ecker, O. and Qaim, M., 2018. Supermarket shopping and nutritional outcomes: A panel data analysis for urban Kenya. *World Development*, 102, pp.292-303.
- De Onis, M., Dewey, K.G., Borghi, E., Onyango, A.W., Blössner, M., Daelmans, B., Piwoz, E. and Branca, F., 2013. The World Health Organization's global target for reducing childhood stunting by 2025: rationale and proposed actions. *Maternal & Child Nutrition*, 9, pp.6-26.
- De Onis, M. and Branca, F., 2016. Childhood stunting: a global perspective. *Maternal & Child Nutrition*, 12, pp.12-26.
- Department of Town Planning Fiji., 2017. Land Tenure. Available at: <http://www.townplanning.gov.fj/index.php/planning/planning-issues/land-tenure>.
- Dietz, W.H., 2017. Double-duty solutions for the double burden of malnutrition. *The Lancet*, 390(10113), pp.2607-2608.

- Doak, C., Adair, L., Monteiro, C. and Popkin, B., 2000. Overweight and underweight coexist within households in Brazil, China and Russia. *The Journal of Nutrition*, 130(12), pp.2965-2971.
- Doss, C., 2006. The effects of intrahousehold property ownership on expenditure patterns in Ghana. *Journal of African economies*, 15, pp.149–180.
- Drewnowski, A. and Popkin B.M., 1997. The nutrition transition: new trends in the global diet. *Nutrition Reviews*, 55(2), pp.31-43.
- Duckett, S.J. and Swerissen, H., 2016. *A sugary drinks tax: recovering the community costs of obesity*. Grattan Institute.
- Duflo, E. and Udry, C., 2004. *Intrahousehold resource allocation in Cote d'Ivoire: Social norms, separate accounts and consumption choices* (Working Paper No. w10498). Cambridge, MA: National Bureau of Economic Research.
- Duncan, R. and Sing, Y., 2009. The failure of agricultural policy making in Fiji. *Pacific Economic Bulletin*, 24(2), pp.168-184.
- Dwyer, T. and D. A. Briggs. 1983. NHMRC workshop on non-pharmacological methods of lowering blood pressure. The role of physical activity. *The Medical Journal of Australia*, 2(1 Suppl), pp.S9-12.
- Ecker, O., Breisinger, C., Pauw, K., Fan, S. and Pandya-Lorch, R., 2012. Growth is good, but is not enough to improve nutrition. In *Leveraging Agriculture for Improving Nutrition and Health*. Proceedings of the IFPRI International Conference, New Delhi, India, 10-12 February 2011. (pp. 47-54). International Food Policy Research Institute.
- Ellis, F., 2000. *Rural livelihoods and diversity in developing countries*. Oxford University Press, USA.
- Estimé, M., Lutz, B. and F. Strobel., 2014. Trade as a Structural Driver of Dietary Risk Factors for Noncommunicable Diseases in the Pacific: An Analysis of Household Income and Expenditure Survey Data. *Globalization and Health*, 10(1), pp.48.
- Evans, A., Tolonen, H., Hense, H.W., Ferrario, M., Sans, S., Kuulasmaa, K. and WHO Monica Project, 2001. Trends in coronary risk factors in the WHO MONICA project. *International Journal of Epidemiology*, 30(suppl_1), p.S35-40.

- Evans, M., Sinclair, R., Fusimalohi, C. and Liava'a, V., 2001. Globalization, diet, and health: an example from Tonga. *Bulletin of the World Health Organization*, 79(9), pp.856-862.
- Faiguenbaum, S., Berdegue, J., and Reardon, T., 2002. The rapid rise of supermarkets in Chile: Effects on dairy, vegetable, and beef chains. *Development Policy Review*, 20(4), pp.459-471.
- Farina, E. and Reardon, T., 2000. Agrifood grades and standards in the extended Mercosur: Their role in the changing agrifood system. *American Journal of Agricultural Economics*, 82(5): 1170-1176.
- Feeley, A.B., Ndeye Coly, A., Sy Gueye, N.Y., Diop, E.I., Pries, A.M., Champeny, M., Zehner, E.R. and Huffman, S.L., 2016. Promotion and consumption of commercially produced foods among children: situation analysis in an urban setting in Senegal. *Maternal and Child Nutrition*, 12, pp.64-76.
- Fiji Bureau of Statistics, 2007. Population Census. Fiji Bureau of Statistics. Accessed May 2015. Available at: <http://www.statsfiji.gov.fj/statistics/population-censuses-and-surveys>.
- Fiji Bureau of Statistics, 2012. Key Statistics National Income. Available at: <http://www.statsfiji.gov.fj/index.php/economic/45-economic-statistics/national-accounts/100-fiji-national-accounts-summary-table>.
- Fiji Bureau of Statistics, 2015. Household Income and Expenditure Survey 2013-2014. Accessed November 2017. Available at: <http://www.statsfiji.gov.fj>.
- Fiji Bureau of Statistics, 2017. Population Census. Fiji Bureau of Statistics. Accessed December 2018. Available at: <http://www.statsfiji.gov.fj/statistics/population-censuses-and-surveys>.
- Fiji Ministry of Health, 2006. Annual Report 2006. Accessed May 2015. Available at <http://www.health.gov.fj/PDFs/Annual%20Report/Annual%20Report%202006.pdf>.
- Fiji Ministry of Health. 2010. The Fiji Plan of Action for Nutrition 2010-2014. Suva: Government of Fiji. Accessed May 2015. Available at: http://www.health.gov.fj/?page_id=739#2.
- Fiji Ministry of Health, 2013. Annual Report 2013. Accessed May 2015. Available at <http://www.health.gov.fj/PDFs/Annual%20Report/Annual%20Report%202013.pdf>.

- Fiji Ministry of Health. 2013. Fiji: Tracking Progress in Maternal and Child Survival. A Case Study Report, 2013. Suva: Government of Fiji. Accessed December 2017. Available at [https://www.unicef.org/pacificislands/14_-_02-2014_Fiji_Case_Study_For_Delivery_to_UNICEF_8-29-2013_conversion_\(1\).pdf](https://www.unicef.org/pacificislands/14_-_02-2014_Fiji_Case_Study_For_Delivery_to_UNICEF_8-29-2013_conversion_(1).pdf).
- Fiji Ministry of Health. 2015. Guide to Healthy Eating. Fiji Ministry of Health. Accessed May 2015. Available at: http://www.health.gov.fj/?page_id=1123
- Fiji Ministry of Health. 2015. Obesity. Fiji Ministry of Health. Accessed May 2015. Available at: http://www.health.gov.fj/?page_id=739#2.
- Finke, M. S., and S. J. Huston., 2003. Healthy Eating Index scores and the elderly. *Family Economics and Nutrition Review*, 15(1), pp.67.
- Finucane, M.M., Stevens, G.A., Cowan, M.J., Danaei, G., Lin, J.K., Paciorek, C.J., Singh, G.M., Gutierrez, H.R., Lu, Y., Bahalim, A.N. and Farzadfar, F., 2011. National, regional, and global trends in body-mass index since 1980: systematic analysis of health examination surveys and epidemiological studies with 960 country-years and 9· 1 million participants. *The Lancet*, 377(9765), pp.557-567.
- Fischer, E. and Qaim, M., 2012. Linking smallholders to markets: determinants and impacts of farmer collective action in Kenya. *World Development*, 40(6), pp.1255-1268.
- Fischer, E., and Qaim, M., 2012. Gender, agricultural commercialization, and collective action in Kenya. *Food Security*, 4(3), pp.441–453.
- Flegal, K.M. and Graubard, B.I., 2009. Estimates of excess deaths associated with body mass index and other anthropometric variables. *The American Journal of Clinical Nutrition*, 89(4), pp.1213-1219.
- Foliaki, S. and Pearce, N., 2003. Changing pattern of ill health for indigenous people: control of lifestyle is beyond individuals and depends on social and political factors. *British Medical Journal*, 327(7412), pp.406-407.
- Food and Agricultural Organisation of the United Nations. 2011. Guidelines for measuring household and individual dietary diversity. Food and Agriculture Organisation of the United Nations. Accessed June 2017. Available at: http://www.actioncontrelafaim.org/fileadmin/contribution/8_publications/pdf/Ouvrag

[es et fascicules techniques/Secu alimentaire/Annex 4 FAO guidelines dietary diversity 2011.PDF.](#)

Food and Agricultural Organisation of the United Nations. 2018. Pacific Strategic Plan for Agricultural and Fisheries Statistics. Food and Agriculture Organisation of the United Nations. Accessed November 2018. Available at: <http://www.fao.org/3/I8344EN/i8344en.pdf>.

Food and Agriculture Organisation of the United Nations, International Fund for Agricultural Development, United Nations Children's Fund, World Food Programme, World Health Organization, 2017. *The State of Food Security and Nutrition in the World 2017: Building Resilience for Peace and Food Security*. Rome: Food and Agriculture Organisation of the United Nations.

Food and Nutrition Centre Fiji, 2012. Fiji Food Balance Sheet 2009. Accessed May 2015. Available at <http://www.nutrition.gov.fj/wp-content/uploads/2013/02/2009-FBS-Report-JGEd-print.pdf>.

Ford, N.D., Patel, S.A., and Narayan, K.V., 2017. Obesity in low-and middle-income countries: burden, drivers, and emerging challenges. *Annual Review of Public Health*, 38, pp.145-164.

Francis, M., Simons, D., and Bourlakis, M., 2008. Value chain analysis in the UK beef foodservice sector. *Supply Chain Management: An International Journal* 13(1), pp.83-91.

Frazao, E., and J. Allshouse., 2003. Strategies for intervention: commentary and debate. *The Journal of Nutrition*, 133(3), pp.844S-847S.

Fanzo, J., Hunter, D., Borelli, T. and Mattei, F. eds., 2013. *Diversifying food and diets: using agricultural biodiversity to improve nutrition and health*. Routledge, London.

Freedman, D.S., Horlick, M. & Berenson, G.S., 2013. A comparison of the Slaughter skinfold-thickness equations and BMI in predicting body fatness and cardiovascular disease risk factor levels in children. *American Journal of Clinical Nutrition*, 98(6), pp.1417–1424.

Freedman, D.S., Katzmarzyk, P.T., Dietz, W.H., Srinivasan, S.R. and Berenson, G.S., 2009. Relation of body mass index and skinfold thicknesses to cardiovascular disease risk

- factors in children: The Bogalusa Heart Study. *The American Journal of Clinical Nutrition*, 90(1), pp.210-216.
- Frelat, R., Lopez-Ridaura, S., Giller, K.E., Herrero, M., Douxchamps, S., Djurfeldt, A.A., Erenstein, O., Henderson, B., Kassie, M., Paul, B.K. and Rigolot, C., 2016. Drivers of household food availability in sub-Saharan Africa based on big data from small farms. *Proceedings of the National Academy of Sciences*, 113(2), pp.458-463.
- French, S.A., Wall, M. and Mitchell, N.R., 2010. Household income differences in food sources and food items purchased. *International Journal of Behavioural Nutrition and Physical Activity*, 7(1), p.77.
- Garrow, J.S. and Webster, J., 1985. Quetelet's index (W/H²) as a measure of fatness. *International Journal of Obesity*, 9(2), pp.147-153.
- Gewertz, D.B. and Errington, F.K., 2010. *Cheap meat: flap food nations in the Pacific Islands*. University of California Press; 2010.
- Gibson, L.Y., Byrne, S.M., Davis, E.A., Blair, E., Jacoby, P. and Zubrick, S.R., 2007. The role of family and maternal factors in childhood obesity. *Medical Journal of Australia*, 186(11), pp.591.
- Gillespie, S., Harris, J., and Kadiyala, S., 2012. The agriculture-nutrition disconnect in India: what do we know? IFPRI Discussion Paper 1187. Washington, DC: International Food Policy Research Institute.
- Gina K., A. Berardo, C. Papavero, P. Horjus, T. Ballard, M. Dop, J. Delbaere, Brouwer, I. D., 2010. Proxy measures of household food consumption for food security assessment and surveillance: comparison of the household dietary diversity and food consumption scores. *Public Health Nutrition*, 13(12).
- Giskes, K., Turrell, G., Patterson, C. and Newman, B., 2002. Socioeconomic differences among Australian adults in consumption of fruit and vegetables and intakes of vitamins A, C and folate. *Journal of Human Nutrition and Dietetics*, 15(5), pp.375-385.
- Glanz, K., and A. L. Yaroch. 2004. Strategies for increasing fruit and vegetable intake in grocery stores and communities: policy, pricing, and environmental change. *Preventive Medicine*, 39, pp.75-80.

- Glanz, K., Sallis, J.F., Saelens, B.E. and Frank, L.D., 2005. Healthy nutrition environments: concepts and measures. *American Journal of Health Promotion*, 19(5), pp.330-333.
- Godfray, H.C.J., Crute, I.R., Haddad, L., Lawrence, D., Muir, J.F., Nisbett, N., Pretty, J., Robinson, S., Toulmin, C. and Whiteley, R., 2010. The future of the global food system. *Philosophical Transactions of the Royal Society B: Biological Science*, 365, pp.2769-2777.
- Goldman, A., Ramaswami, S. and Krider, R. E., 2002. Barriers to the advancement of modern food retail formats: theory and measurement. *Journal of Retailing*, 78(4), pp.281-295.
- Gortmaker, S.L., Swinburn, B.A., Levy, D., Carter, R., Mabry, P.L., Finegood, D.T., Huang, T., Marsh, T. and Moodie, M.L., 2011. Changing the future of obesity: science, policy, and action. *The Lancet*, 378(9793), pp.838-847.
- Government of Fiji. Developments in Rotuma. Prime Minister's Office: 2011. Accessed in May 2018. Available at: <http://www.pmooffice.gov.fj/index.php/projects/rotuma-development> (accessed March 2013).
- Greene, W. H., 2003. *Econometric Analysis* (International edition). Pearson Education Inc.
- Greene, W. H., 2012. *Econometric Analysis* (Prentice Hall, Upper Saddle River, NJ), 7th Ed.
- Grosh, M., and Glewwe, P., 2000. Designing household survey questionnaires for developing countries: Lessons from 15 Years of the living standards measurement study. *World Bank Publications*. Washington DC, World Bank.
- Groth, M., S. Fagt, and L. Brondsted., 2001. Social determinants of dietary habits in Denmark. *European Journal of Clinical Nutrition*, 55, pp.959–966.
- Grunert, K.G., 2005. Food quality and safety: consumer perception and demand. *European Review of Agricultural Economics*, 32(3), pp.369-391.
- Guo, X., Popkin, B.M., Mroz, T.A. and Zhai, F., 1999. Food price policy can favorably alter macronutrient intake in China. *The Journal of Nutrition*, 129(5), pp.994-1001.
- Gutin, I., 2018. In BMI we trust: reframing the body mass index as a measure of health. *Social Theory & Health*, 16(3), pp.256-271.

- Habte, T.Y. and Krawinkel, M., 2016. Dietary Diversity Score: A Measure of Nutritional Adequacy or an Indicator of Healthy Diet. *Journal of Nutritional Health Science*, 3(3), p.303.
- Haden, R. Food Culture in the Pacific Islands. Denver: Greenwood Press; 2009.
- Hammond, P. 2012. Religious dietary guidelines and restrictions. Accessed June 2017. Available at: <http://www.chewfo.com/philosophical-reasons-for-food-choices/religious-dietary-restrictions/>.
- Handsley, E. and Reeve, B., 2018. Holding food companies responsible for unhealthy food marketing to children: Can international human rights instruments provide a new approach? *UNSW Law Journal*, 41(1).
- Harris, P., Wate, J. and Friel, S., 2016. *A Health Impact Assessment (HIA) on the draft regulation 'Advertising and Promotion of Unhealthy Foods and Non-Alcoholic Beverages to Children Regulation in Fiji'*.
- Worku, I.H., Dereje, M., Minten, B. and Hirvonen, K., 2017. Diet transformation in Africa: The case of Ethiopia. *Agricultural economics*, 48(S1), pp.73-86.
- Hawkes, C., 2006. Uneven dietary development: linking the policies and processes of globalization with the nutrition transition, obesity and diet-related chronic diseases. *Global Health* 2(1), p.4.
- Hawkes, C., 2008. Dietary implications of supermarket development: a global perspective. *Development Policy Review*, 26(6), pp.657–692.
- Hawkes, C. and Ruel, M., 2008. From Agriculture to Nutrition: Pathways, Synergies and Outcomes. Accessed May 2015. Available at: <http://siteresources.worldbank.org/INTARD/825826-1111134598204/21608903/January2008Final.pdf>.
- Hawkes, C., Smith, T.G., Jewell, J., Wardle, J., Hammond, R.A., Friel, S., Thow, A.M. and Kain, J., 2015. Smart food policies for obesity prevention. *The Lancet*, 385(9985), pp.2410-2421.
- Hawkes, C., Demaio, A.R. and Branca, F., 2017. Double-duty actions for ending malnutrition within a decade. *The Lancet Global Health*, 5(8), pp.e745-e746.

- Hawkes, C., Harris, J. and Gillespie, S., 2017. Urbanization and the Nutrition Transition. In Global Food Policy Report, 4, 34-41. Washington, DC: International Food Policy Research Institute.
- Hawley, N.L. and McGarvey, S.T., 2015. Obesity and diabetes in Pacific Islanders: the current burden and the need for urgent action. *Current Diabetes Reports*, 15(5), p.29.
- Hazell, P. and Wood, S., 2008. Drivers of change in global agriculture. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 363(1491), pp.495-515.
- Helble, M. and K. Francisco., 2017. The Upcoming Obesity Crisis in Asia and the Pacific: First Cost Estimates. ADBI Working Paper 743. Tokyo: Asian Development Bank Institute. Available at: <https://www.adb.org/publications/imminent-obesity-crisis-asia-and-pacific-firstcost-estimates>.
- Hendriks, A.M., Delai, M.Y., Thow, A.M., Gubbels, J.S., De Vries, N.K., Kremers, S.P. and Jansen, M.W., 2015. Perspectives of Fijian policymakers on the obesity prevention policy landscape. *BioMed Research International*, 2015.
- Herforth, A., 2010. Promotion of traditional African vegetables in Kenya and Tanzania: a case study of an intervention representing emerging imperatives in global nutrition. (PhD Dissertation), Cornell University, Cornell, NY, USA.
- Hirotsu, C., Tufik, S. and Andersen, M.L. ,2015. Interactions between sleep, stress, and metabolism: from physiological to pathological conditions. *Sleep Science*, 8(3), pp.143-152.
- Hirvonen, K. and Hoddinott, J., 2017. Agricultural production and children's diets: evidence from rural Ethiopia. *Agricultural Economics*, 48(4), pp.469-480.
- Hoddinott, J. and Haddad, L., 1995. Does female income share influence household expenditures? Evidence from Côte d'Ivoire. *Oxford Bulletin of Economics and Statistics*, 57(1), pp.77-96.
- Hoddinott, J. and Y. Yohannes., 2002. Dietary diversity as a food security indicator. *Food Consumption and Nutrition Division Discussion Paper*, 136(136), p.2002.
- Hoddinott, J. and Haddad, L.,1995. Does female income share influence household expenditures? Evidence from Côte d'Ivoire. *Oxford Bulletin of Economics and Statistics*, 57, pp.77-96.

- Hone, P., 2003. *Food Choice and Nutrition in Fiji*. School of Accounting, Economics and Finance, Deakin University.
- Hone, P., Haszler, H. and Natasiwai, T., 2008. Agricultural supply response in Fiji. *Pacific Economic Bulletin*, 23(2), pp.40-52.
- Hope, S.F., Snowdon, W., Carey, L.B. and Robinson, P., 2013. 'Junk food' promotion to children and adolescents in Fiji. *Fiji Journal of Public Health*, 2(1), pp.27-35.
- Hornik, J. and E. Shmuel., 1988. Strategies to secure compliance for a mall intercept interview. *Public Opinion Quarterly*, 52(4), pp.539-551.
- Hossain, P., Kavar, B. and El Nahas, M., 2007. Obesity and diabetes in the developing world—a growing challenge. *New England Journal of Medicine*, 356(3), pp.213-215.
- Hoy, D., Roth, A., Viney, K., Souares, Y. and Lopez, A.D., 2014. Peer Reviewed: Findings and Implications of the Global Burden of Disease 2010 Study for the Pacific Islands. *Preventing Chronic Disease*, 11, pp. 130-144.
- Hou, X., Anderson, I. and Burton-Mckenzie, E.J., 2016. Pacific Possible: Health & Non-Communicable Diseases. Background Paper. World Bank.
- Hughes, R., 2003. Diet, Food Supply and Obesity in the Pacific. World Health Organisation Regional Office for the Western Pacific, Suva.
- Hughes, R., 2003. A review of diet, the food supply and obesity in the Pacific. A background paper presented at the FAO/SPC/WHO Pacific Islands food safety and quality consultation, 11-15 November 2002. Mocambo Hotel, Nadi, Fiji. Paper ref. WPR/ICP/HSE/4.4/001NUT-FOS (1) 2002. 11. Manila: WHO/WPRO.
- Hughes, R. and Lawrence, M., 2005. Globalisation, food and health in Pacific Island countries. *Asia Pacific Journal of Clinical Nutrition*, 14(4), pp.298-305.
- Iannotti, L.L., Robles, M., Pachón, H. and Chiarella, C., 2012. Food Prices and Poverty Negatively Affect Micronutrient Intakes in Guatemala. *The Journal of Nutrition*, 142(8), pp.1568-1576.
- Irala-Estevez, J., M. Groth, L. Johansson, U. Oltersdorf, Prattala, R. and Martinez-Gonzalez, M., 2000. A Systematic review of socioeconomic differences in food habits in Europe. *European Journal of Clinical Nutrition*, 54, pp.706–714.

- Jaacks, L., Slining, M. and Popkin, B., 2015. Recent underweight and overweight trends by rural-urban residence among women in low- and middle-income countries. *The Journal of Nutrition*, 145(2), pp352–57.
- Jones, A. D., Shrinivas, A. and Bezner-Kerr, R., 2014. Farm production diversity is associated with greater household dietary diversity in Malawi: Findings from nationally representative data. *Food Policy*, 46, pp.1-12.
- Jones-Smith, J. C., Gordon-Larsen, P., Siddiqi, A. and Popkin, B. M., 2012. Is the burden of overweight shifting to the poor across the globe & quest; Time trends among women in 39 low-and middle-income countries (1991–2008). *International Journal of Obesity*, 36(8), pp.1114-1120.
- Kadiyala, S., Harris, J., Headey, D., Yosef, S. and Gillespie, S., 2014. Agriculture and nutrition in India: mapping evidence to pathways. *Annals of the New York Academy of Sciences*, 1331(1), pp.43-56.
- Kamal, S.M., 2011. Socio-economic determinants of severe and moderate stunting among under-five children of rural Bangladesh. *Malaysian Journal of Nutrition*, 17(1).
- Kaplinsky, R. and Morris, M., 2001. *A Handbook for Value Chain Research* (Vol. 113). Ottawa: IDRC.
- Kearney, J., 2010. Food consumption trends and drivers. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 365(1554), p.2793.
- Keding, G.B., Msuya, J.M., Maass, B.L. and Krawinkel, M.B., 2012. Relating dietary diversity and food variety scores to vegetable production and socio-economic status of women in rural Tanzania. *Food Security*, 4(1), pp.129-140.
- Kelly, M., Seubsman, S., Banwell, C., Dixon, J. and Sleigh, A., 2014. Thailand's Food Retail Transition: Supermarket and Fresh Market Effects on Diet Quality and Health. *British Food Journal*, 116 (7), pp.1180–1193.
- Kelsey, J. Pacific Islands and the WTO power politics of accession. 2004. *South Bull*, 86, pp.406–412.
- Kennedy, E. T. and Cogill, B., 1987. Income and nutritional effects of the commercialization of agriculture in southwestern Kenya. Research Report No. 63. Washington DC: International Food Policy Research Institute.

- Kessaram, T., McKenzie, J., Girin, N., Merilles, O., Pullar, J., Roth, A., White, P. and Hoy, D., 2015. Overweight, obesity, physical activity and sugar-sweetened beverage consumption in adolescents of Pacific islands: results from the Global School-Based Student Health Survey and the Youth Risk Behavior Surveillance System. *BMC Obesity*, 2(1), p.34.
- Kesteloot, H. and J. V. Joosens, eds. 1980. *Epidemiology of Arterial Blood Pressure Volume 8*. Springer: Netherlands.
- Kim, D.M., Ahn, C.W. and Nam, S.Y., 2005. Prevalence of obesity in Korea. *Obesity Reviews*, 6(2), pp.117-121.
- Kimenju, S.C., Rischke, R., Klasen, S. and Qaim, M., 2015. Do supermarkets contribute to the obesity pandemic in developing countries?. *Public Health Nutrition*, 18(17), pp.3224-33.
- Kirkpatrick, S. and Tarasuk, V., 2003. The relationship between low income and household food expenditure patterns in Canada. *Public Health Nutrition*, 6, pp.589–597.
- Kokoski, M. F., 1986. An Empirical Analysis of Intertemporal and Demographic Variations in Consumer Preferences. *American Journal of Agricultural Economics*, 68, pp.894–907.
- Komlos, J., Breitfelder, A. and Sunder, M., 2009. The transition to post - industrial BMI values among US children. *American Journal of Human Biology: The Official Journal of the Human Biology Association*, 21(2), pp.151-160.
- Koppmair, S., Kassie, M. and Qaim, M., 2017. Farm production, market access and dietary diversity in Malawi. *Public Health Nutrition*, 20(2), pp.325-335.
- Koppmair, S. and Qaim, M., 2017. Farm production diversity and individual-level dietary diversity. Response to: ‘Not all dietary diversity scores can legitimately be interpreted as proxies of diet quality’ by Verger et al. *Public Health Nutrition*, 20(11), pp.2070-2072.
- Kroker-Lobos, M.F, Pedroza-Tobías, A., Pedraza, L.S. and Rivera, J.A., 2014 The double burden of undernutrition and excess body weight in Mexico. *The American Journal of Clinical Nutrition*, 100(6), pp.1652S–1658S.
- Kuh, D. and Shlomo, Y.B. eds., 2004. *A life course approach to chronic disease epidemiology* (No. 2). Oxford University Press.

- Kumar, A., 2000. Fair Trading Decree 1992 (Decree no. 25 of 1992)(Section 102): Order prohibiting the supply of lamb flaps. Ministry of Commerce, Business Development and Investment (ed.). Government of Fiji.
- Kumar, N., Harris, J. and Rawat, R., 2015. If They Grow It, Will They Eat and Grow? Evidence from Zambia on Agricultural Diversity and Child Undernutrition. *The Journal of Development Studies*, 51(8), pp.1060-1077.
- Kurer, O., 2001. Land and politics in Fiji: of failed land reforms and coups. *Journal of Pacific History*, 36(3), pp.299-315.
- Lanakan, A. 1989. Low Grade Meat Dumping Claimed. The Fiji Times. May 23, 1989.
- Lawlor, D.A., Benfield, L., Logue, J., Tilling, K., Howe, L.D., Fraser, A., Cherry, L., Watt, P., Ness, A.R., Smith, G.D. and Sattar, N., 2010. Association between general and central adiposity in childhood, and change in these, with cardiovascular risk factors in adolescence: prospective cohort study. *BMJ*, 341, p.c.6224.
- Ledikwe, J.H., Blanck, H.M., Khan, L.K., Serdula, M.K., Seymour, J.D., Tohill, B.C. and Rolls, B.J., 2006. Low-energy-density diets are associated with high diet quality in adults in the United States. *Journal of the American Dietetic Association*, 106(8), pp.1172-1180.
- Lin, S., Tukana, I., Linhart, C., Morrell, S., Taylor, R., Vatucawaqa, P and Zimmet, P., 2015. Diabetes and obesity trends in Fiji over 30 years. *Journal of Diabetes*, 8(4), pp. 533-543.
- Lobstein T. and Frelut, M., 2003. Prevalence of overweight among children in Europe. *Obesity Reviews*, 4(4), pp.195–200.
- Locke, J.T., 2009. Climate change induced migration in the Pacific Region: sudden crisis and longterm developments. *Geographical Journal*, 175(3), pp.171-180.
- McKay, A., 2000. Should the Survey Measure Total Household Income? *Designing household survey questionnaires for developing countries: lessons from*, 15, pp. 83-104.
- Maestre, M., Poole, N. and Henson, S., 2017. Assessing food value chain pathways, linkages and impacts for better nutrition of vulnerable groups. *Food Policy*, 68, pp.31-39.

- Malapit, H. J., Kadiyala, S., Quisumbing, A. R., Cunningham, K. and Tyagi, P., 2013. Women's Empowerment in Agriculture, Production Diversity, and Nutrition: Evidence from Nepal. IFPRI Discussion Paper. Washington: International Food Policy Research Institute.
- Malapit, H. J. L., Kadiyala, S., Quisumbing, A. R., Cunningham, K., and Tyagi, P., 2015. Women's empowerment mitigates the negative effects of low production diversity on maternal and child nutrition in Nepal. *The Journal of Development Studies*, 51(8), pp.1097-1123.
- Malapit, H.J.L. and A. R. Quisumbing., 2015. What dimensions of women's empowerment in agriculture matter for nutrition in Ghana?. *Food Policy*, 52, pp.54-63.
- Malik, V., Willett, W. and Hu, F., 2013. Global obesity: trends, risk factors and policy implications. *Nature Reviews Endocrinology*, 9(1), pp.13-27.
- Malua, M. and UNCTAD, 2003. The Pacific Islands. UNCTAD: Turning Losses into Gains: SIDS and Multilateral Trade Liberalisation in Agriculture. United Nations, New York and Geneva, pp.171-204.
- Mancino, L. and Kinsey, J., 2004. Diet Quality and Calories Consumed: The Impact of Being Hungrier, Busier, and Eating Out. Working Paper 04-02, The Food Industry Center, University of Minnesota, St. Paul.
- Martorell, R., Kettel Khan, L., Hughes, ML. and Grummer-Strawn LM., 2000. Overweight and obesity in preschool children from developing countries. *International Journal of Obesity Related Metabolic Disorders*, 24(8), pp.959 –967.
- Matheson, D., Park, K. and Soakai, T.S., 2017. Pacific island health inequities forecast to grow unless profound changes are made to health systems in the region. *Australian Health Review*, 41(5), pp.590-598.
- Maxwell, D., Watkins, B., Wheeler, R. and Collins, G., 2003. The coping strategies index: A tool for rapidly measuring food security and the impact of food aid programs in emergencies. *Nairobi: CARE Eastern and Central Africa Regional Management Unit and the World Food Programme Vulnerability Assessment and Mapping Unit.*
- McCormick, DP., Sarpong, K., Jordan, L., Ray, LA. and Jain S., 2010. Infant obesity: Are we ready to make this diagnosis? *The Journal of Paediatrics*, 157(1), pp.15–19.

- Mendez, M. and Popkin, B., 2004. Globalization, urbanization and nutritional change in the developing world. *Electronic Journal of Agricultural and Development Economics*, 1(2), pp.220–241.
- Mendez, M., Monteiro, C. and Popkin, B., 2004. Overweight now exceeds underweight among women in most developing countries. *American Journal of Clinical Nutrition*, 81(3), pp.714-721.
- Miao, Z., Beghin, J.C. and Jensen, H.H., 2012. Taxing sweets: sweetener input tax or final consumption tax? *Contemporary Economic Policy*, 30(3), pp.344-361.
- Micronutrient Initiative, 2009. Investing in the Future: A United call to Action on Vitamin and Mineral Deficiencies. Global Report 2009. Micronutrient Initiative.
- Miller, V., Yusuf, S., Chow, C.K., Dehghan, M., Corsi, D.J., Lock, K., Popkin, B., Rangarajan, S., Khatib, R., Lear, S.A. and Mony, P., 2016. Availability, affordability, and consumption of fruits and vegetables in 18 countries across income levels: findings from the Prospective Urban Rural Epidemiology (PURE) study. *The Lancet Global Health*, 4(10), pp.e695-e703.
- Ministry of Agriculture Fiji, 2009. Report on the Fiji National Agricultural Census 2009. Accessed January 2013. Available at <http://www.agriculture.org.fj>.
- Ministry of Agriculture Fiji. 2015. Crop and Livestock Production Performance. Available at <http://www.agriculture.org.fj>.
- Ministry of Finance. Budget Statement for 2012. Government of Fiji: Suva, 2011.
- Ministry of Finance. Budget Statement for 2013. Government of Fiji: Suva, 2012.
- Minten, B., and Reardon, T., 2008. Food prices, quality, and quality's pricing in supermarkets versus traditional markets in developing countries. *Review of Agricultural Economics*, 30(3), pp.480-490.
- Misra, A. and Khurana, L., 2008. Obesity and the metabolic syndrome in developing countries. *The Journal of Clinical Endocrinology & Metabolism*, 93(11_supplement_1), pp.s9-s30.

- Monteiro, C., Moura, E., Conde, W. and Popkin, B., 2004. Socioeconomic status and obesity in adult populations of developing countries: a review. *Bulletin of the World Health Organization*, 82(12), pp. 940-946.
- Monteiro, C., Conde, W. and Popkin, B., 2007. Income-specific trends in obesity in Brazil: 1975–2003. *American Journal of Public Health*, 97(10), pp.1808-1812.
- Monteiro, C., 2009. Nutrition and health. The issue is not food, nor nutrients, so much as processing. *Public Health Nutrition*, 12(5), pp.729.
- Monteiro, C., Moubarac, J.C., Cannon, G, Ng, S.W., and Popkin B., 2013. Ultra-processed products are becoming dominant in the global food system. *Obesity Reviews*, 14(S2), pp. 21–28.
- Morgan, J., 2015. Country in Focus: turning the tide of diabetes in Fiji. *The Lancet Diabetes and Endocrinology*, 3(1), pp.15-16.
- Mora, T. and Gil, J., 2013. Peer effects in adolescent BMI: evidence from Spain. *Health Economics*, 22(5), pp.501-516.
- Moubarac, J.C., Batal, M., Louzada, M.L., Steele, E.M. and Monteiro, C.A., 2017. Consumption of ultra-processed foods predicts diet quality in Canada. *Appetite*, 108, pp.512-520.
- Murray, C. and Majeed, F.A., 2017. Health effects of overweight and obesity in 195 countries over 25 years. *New England Journal of Medicine*, 377, pp.13-27.
- Murasko, J.E., 2017. Height, BMI, and relative economic standing in children from developing countries. *American Journal of Human Biology*, 29(3).
- Murendo, C., Nhau, B., Mazvimavi, K., Khanye, T. and Gwara, S., 2018. Nutrition education, farm production diversity, and commercialization on household and individual dietary diversity in Zimbabwe. *Food and Nutrition Research*, 62.
- Mytton, O.T., Clarke, D. and Rayner, M. 2012. Taxing unhealthy food and drinks to improve health. *BMJ*, 344, p.e2931.
- Narsey, W., 2011. Report on the 2008-9 household income and expenditure Survey, Fiji Bureau of Statistics, Vanuavou Publications, Suva.

- National Food and Nutrition Committee., 1995. 1993 national nutrition survey main report. Suva: Government of Fiji.
- National Food and Nutrition Committee., 2005. 2004 National nutrition survey preliminary findings. Suva: Government of Fiji.
- National Heart Foundation of Australia, 2008. The Heart Foundation Tick – making healthier choices stand out from the crowd. Available at: <http://www.heartfoundation.org.au/healthyeating/heart-foundation-tick/Pages/default.aspx>.
- Nayga, R., Tepper, B. and Rosenzweig, L., 1999. Assessing the importance of health and nutrition related factors on food demand: a variable preference investigation. *Applied Economics*, 31, pp.1541–1549.
- Neill, D., 2007. Indo-Fijian Children’s BMI In the context of Urbanisation, Embodied Capital, and Food Choice Trade-offs. *Human Nature*, 18(3), pp.209-224.
- Neven, D., Reardon, T., Chege, J. and Wang, H., 2006. Supermarkets and consumers in Africa: the case of Nairobi, Kenya. *Journal of International Food and Agribusiness Marketing*, 18(1-2), pp.103-123.
- Nguyen, M.D., Beresford, S.A. and Drewnowski, A., 2007. Trends in overweight by socio-economic status in Vietnam: 1992 to 2002. *Public Health Nutrition*, 10(2), pp.115-121.
- Ni Mhurchu, C. and Gorton. D., 2007. Nutrition labels and claims in New Zealand and Australia: a review of use and understanding. *Australian and New Zealand Journal of Public Health*, 31(2), pp.105–12.
- Ni Mhurchu, C., Rodgers, A., Pan WH., Gu, GF. and Woodward, M., 2004. Body mass index and cardiovascular disease in the Asia-Pacific Region: an overview of 33 cohorts involving 310 000 participants. *International Journal of Epidemiology*, 33(4), pp.751-758.
- O’Donnell, O., Doorslaer, V.E. and Wagstaff, A., 2007. Quantitative Techniques for Health Equity Analysis. *Washington DC: The World Bank*.
- Ogden, CL., Fryar, CD., Carroll, MD. and Flegal, KM., 2004. *Mean body weight, height, and body mass index, United States 1960-2002*. Washington, DC: Department of Health

and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics.

- Ogutu, S.O., Gödecke, T. and Qaim, M., 2017. *Agricultural commercialization and nutrition in smallholder farm households* (No. 97). GlobalFood Discussion Papers.
- Onis, M.D., Onyango, A.W., Borghi, E., Siyam, A., Nishida, C. and Siekmann, J., 2007. Development of a WHO growth reference for school-aged children and adolescents. *Bulletin of the World health Organization*, 85(9), pp.660-667.
- Patel, IC., Gopalkrishnan, KE. and Ram, P., 1983. Acute myocardial infarction in Labasa. *Fiji Medical Journal*, 11(7-8), pp.110-12.
- Pawlowski, T. and Breuer, C., 2012. Expenditure elasticities of the demand for leisure services. *Applied Economics*, 44(26), pp.3461-3477.
- Pereira, M.A., Kartashov, A.I., Ebbeling, C.B., Van Horn, L., Slattery, M.L., Jacobs Jr, D.R. and Ludwig, D.S., 2005.. Fast food habits, weight gain and insulin resistance (the CARDIA study): 15 year prospective analysis. *The Lancet*, 365(9453), pp.36-42.
- Pérez, C.E., 2002. Fruit and vegetable consumption. *Health Reports*, 13(3), pp.23-31.
- Pingali, P., 2007. Westernization of Asian diets and the transformation of food systems: Implications for research and policy. *Food Policy*, 32(3), pp.281-298.
- Pinstrup-Andersen, P., 2002. Food and agricultural policy for a globalizing world: preparing for the future. *American Journal of Agricultural Economics*, 84(5), pp.1201-1214.
- Pinstrup-Andersen, P., 2007. Agricultural research and policy for better health and nutrition in developing countries: a food systems approach. *Agricultural Economics*, 37, pp.187-198.
- Pinstrup-Andersen, P., 2013. Guiding food system policies for better nutrition. *Background paper for the State of Food and Agriculture*. Rome: Food and Agricultural Organisation. .
- Pollard, C.M., Miller, M.R., Daly, A.M., Crouchley, K.E., O'Donoghue, K.J., Lang, A.J. and Binns, C.W., 2008. Increasing fruit and vegetable consumption: success of the Western Australian Go for 2&5® campaign. *Public Health Nutrition*, 11(3), pp.314-320.

- Popkin, B., 1999. Urbanization, lifestyle changes and the nutrition transition. *World Development*, 27(11), pp.1905-1916.
- Popkin, B., 2006. Global nutrition dynamics: the world is shifting rapidly toward a diet linked with noncommunicable diseases. *The American Journal of Clinical Nutrition*, 84(2), pp.289-298.
- Popkin, B., 2014. Nutrition, agriculture and the global food system in low and middle income countries. *Food Policy*, 47, pp.91-96.
- Popkin, B., 2017. Relationship between shifts in food system dynamics and acceleration of the global nutrition transition. *Nutrition Reviews*, 75(2), pp.73-82.
- Popkin, B. and Hawkes, C., 2016. Sweetening of the global diet, particularly beverages: patterns, trends, and policy responses. *The Lancet Diabetes and Endocrinology*, 4(2), pp.174-186.
- Popkin, B., Adair, L. and Ng, S., 2012. Global nutrition transition and the pandemic of obesity in developing countries. *Nutrition Reviews*, 70(1), pp.3-21.
- Popkin, B. and Reardon, T., 2018. Obesity and the food system transformation in Latin America. *Obesity Reviews*.
- Popkin, B. and Slining, M., 2013. New dynamics in global obesity facing low- and middle-income countries. *Obesity Reviews*, 14(S2), pp.11–20.
- Popkin, B., Conde, W., Hou, N. and Monteiro, C., 2006. Is there a lag globally in overweight trends for children compared with adults?. *Obesity*, 14(10), pp.1846–1853.
- Powell, B., Thilsted, S.H., Ickowitz, A., Termote, C., Sunderland, T. and Herforth, A., 2015. Improving diets with wild and cultivated biodiversity from across the landscape. *Food Security*, 7(3), pp.535-554.
- Prasad, B., 2012. Fiji Economy: Muddling Through. *The Round Table*, 101(6), pp.557-573.
- Prentice, A., 2006. The emerging epidemic of obesity in developing countries. *International Journal of Epidemiology*, 35(1), pp.93-99.
- Prentice, A., 2009. Obesity in emerging nations: evolutionary origins and the impact of a rapid nutrition transition. In *Emerging Societies-Coexistence of Childhood Malnutrition and Obesity* (Vol. 63, pp.47-57). Karger Publishers.

- Pries, A., Huffman, S., Mengkheang, J, Kroeun, H., Champeny, M., Roberts, M. and Zehner, E., 2016. High use of commercial food products among infants and young children and promotions for these products in Cambodia. *Maternal and Child Nutrition*, 12(S2), pp.52–63.
- Procter-Gray, E., Olendzki, B., Kane, K., Churchill, L., Hayes, R.B., Aguirre, A., Kang, H.J. and Li, W., 2017. Comparison of Dietary Quality Assessment Using Food Frequency Questionnaire and 24-hour-recalls in Older Men and Women. *AIMS Public Health*, 4(4), p.326.
- Qaim, M., 2017. Globalisation of agrifood systems and sustainable nutrition. *Proceedings of the Nutrition Society*, 76(1), pp.12-21.
- Qaim, M. and Sibhatu, K.T., 2018. On the Link between Production Diversity and Dietary Quality in Smallholder Farm Households. In *Hidden Hunger: Strategies to Improve Nutrition Quality* (Vol. 118, pp. 102-111). Karger Publishers.
- Quazi, R., 2007. Economic freedom and foreign direct investment in East Asia. *Journal of the Asia Pacific Economy*, 12(3), pp.329-344.
- Raj, A., Snowdon, W. and Drauna, M., 2013. Exposure to advertising of ‘junk food’ in Fiji. *Fiji Journal of Public Health*, 2(1), pp.36-7.
- Ralston, K., 1999. How government policies and regulations can affect dietary choices. *America’s Eating Habits: Changes and Consequences. Agriculture Information Bulletin*, 750, pp.331-70.
- Ram, P., Banuve, S., Zimmet, P., Taylor, R., Raper, L. and Sloman G., 1982. Diabetes in Fiji – the results of the 1980 National Survey. *Fiji Medical Journal*, 10(1-2), pp.4-12.
- Ram, P., 1983. Diabetes mellitus: how does this concern Fiji? *Fiji Medical Journal*, 11(12), pp.186-194.
- Ram, P. and Olakowski, T., 1983. Trends in cardiovascular diseases in Fiji. *Fiji Medical Journal*, 11(7), pp.96-9.
- Ram, P., Collins, V., Zimmet, P., Taylor, R., King, H., Sloman, G. and Hunt, D., 1983. Cardiovascular disease risk factors in Fiji: the results of the 1980 Survey. *Fiji Medical Journal*, 11(7/8), pp.88-94.

- Ravuvu, A., Friel, S., Thow, A.M., Snowdon, W. and Wate, J., 2017. Protocol to monitor trade agreement food-related aspects: the Fiji case study. *Health Promotion International*.
- Reardon, T., Barrett, C., Berdegue, J. and Swinnen, J., 2000. Agroindustrialisation, globalisation, and international development: An overview of issues, patterns, and determinants. *Agricultural Economics*, 23(3), pp.195-205.
- Reardon, T., Barrett, C., Berdegúe, J. and Swinnen, J., 2009. Agrifood industry transformation and small farmers in developing countries. *World Development*, 37(11), pp.1717-1727.
- Reardon, T., Chen, K., Minten, B. and Adriano, L., 2012. *The quiet revolution in staple food value chains: Enter the dragon, the elephant and the tiger*. Asian Development Bank(ADB)/International Food Policy Research Institute (IFPRI): Manila/Washington DC.
- Reardon, T. and Timmer, C.P., 2012. The economics of the food system revolution. *Annual Review Resource Economics*, 4(1), pp.225-264.
- Reardon, T. and Timmer, C.P., 2014. Five Inter-linked Transformations in the Asian Agrifood Economy: Food Security Implications. *Global Food Security*, 3(2), pp.108-117.
- Reardon, T., Timmer, C.P., Barrett, C. and Berdegúe, J., 2003. The rise of supermarkets in Africa, Asia, and Latin America. *American Journal of Agricultural Economics*, 85(5), pp.1140-1146.
- Reardon, T., Timmer, C.P. and Berdegue, J., 2004. The rapid rise of supermarkets in developing countries: induced organizational, institutional, and technological change in agrifood systems. *Electronic Journal of Agricultural and Development Economics*, 1(2), pp.168-183.
- Reardon, T., Timmer, C.P. and Minten, B., 2012. Supermarket revolution in Asia and emerging development strategies to include small farmers. *Proceedings of the National Academy of Sciences*, 109(31), pp.12332-12337.
- Remans, R., Wood, S.A., Saha, N., Anderman, T.L. and DeFries, R.S., 2014. Measuring nutritional diversity of national food supplies. *Global Food Security*, 3(3-4), pp.174-182.
- Rennie, K.L. and Jebb, S.A., 2005. Prevalence of obesity in Great Britain. *Obesity Reviews*, 6(1), pp.11-12.

- Resnick, D., Babu, S., Haggblade, S., Hendriks, S. and Mather, D., 2015. Conceptualizing drivers of policy change in agriculture, nutrition, and food security: The kaleidoscope model. Food Security Policy Discussion paper; 2015. Available from: http://fsg.afre.msu.edu/fsp/Resnick_DP.pdf.
- Ricciardelli, L.A., McCabe, M.P., Mavoja, H., Fotu, K., Goundar, R., Schultz, J., Waqa, G. and Swinburn, B.A., 2007. The pursuit of muscularity among adolescent boys in Fiji and Tonga. *Body Image*, 4(4), pp.361-371.
- Ringrose, H. and Zimmet, P., 1979. Nutrient intakes in an urbanized Micronesian population with a high diabetes prevalence. *The American Journal of Clinical Nutrition*, 32(6), pp.1334-1341.
- Rischke, R., Kimenju, S.C., Klasen, S. and Qaim, M., 2015. Supermarkets and food consumption patterns: the case of small towns in Kenya. *Food Policy*, 52, pp.9-21.
- Rivera J, de Cossío, T, Pedraza, L., Aburto, T., Sánchez, T. and Martorell, R., 2014. Childhood and adolescent overweight and obesity in Latin America: a systematic review. *The Lancet Diabetes and Endocrinology*, 2(4), pp.321–332.
- Rivera, J.A., Barquera, S., Gonzalez-Cossio, T., Olaiz, G. and Sepulveda, J., 2004. Nutrition transition in Mexico and in other Latin American countries. *Nutrition Reviews*, 62(suppl_2), pp.S149-S157.
- Rivera, J., Pedraza, L., Martorell, R. and Gil, A., 2014. Introduction to the double burden of undernutrition and excess weight in Latin America. *The American Journal of Clinical Nutrition*, 100(6), pp.1613S–1616S.
- Roberto, C.A., Swinburn, B., Hawkes, C., Huang, T.T., Costa, S.A., Ashe, M., Zwicker, L., Cawley, J.H. and Brownell, K.D., 2015. Patchy progress on obesity prevention: emerging examples, entrenched barriers, and new thinking. *The Lancet*, 385(9985), pp.2400-2409.
- Rolls, B.J., Drewnowski, A. and Ledikwe, J.H., 2005. Changing the energy density of the diet as a strategy for weight management. *Journal of the American Dietetic Association*, 105(5), pp.98-103.

- Roth, J., Qiang, X., Marbán, S.L., Redelt, H. and Lowell, B.C., 2004. The obesity pandemic: where have we been and where are we going?. *Obesity Research*, 12(S11), pp.88S-101S.
- Ruel, M.T., 2003. Is dietary diversity an indicator of food security or dietary quality? A review of measurement issues and research needs. *Food and Nutrition Bulletin*, 24(2), pp.231-232.
- Ruel, M.T., Quisumbing, A.R. and Balagamwala, M., 2018. Nutrition-sensitive agriculture: What have we learned so far? *Global Food Security*.
- Sacks, G., Swinburn, B. and Lawrence, M., 2009. Obesity Policy Action framework and analysis grids for a comprehensive policy approach to reducing obesity. *Obesity Reviews*, 10(1), pp.76–86.
- Saito, S., 1995. 1993 National Nutrition Survey Main Report. Suva, National Food and Nutrition Committee.
- Sartorius, B., Sartorius, K., Taylor, M., Aagaard-Hansen, J., Dukhi, N., Day, C., Ndlovu, N., Slotow, R. and Hofman, K., 2017. Rapidly increasing body mass index among children, adolescents and young adults in a transitioning population, South Africa, 2008–15. *International Journal of Epidemiology*, 47(3), pp.942-952.
- Schroeter, C., Lusk, J. and Tyner, W., 2008. Determining the impact of food price and income changes on body weight. *Journal of Health Economics*, 27(1), pp.45-68.
- Schultz, J.T., 2004. Globalization, urbanization and nutrition transition in a developing country: a case study of Fiji. In Food, FAO, Nutrition Paper 83 (Eds.), Globalization of Food Systems in Developing Countries: Impact on Food Security and Nutrition. Food and Agriculture Organization of the United Nations, Rome.
- Semba, R.D., de Pee, S., Sun, K., Sari, M., Akhter, N. and Bloem, M.W., 2008. Effect of parental formal education on risk of child stunting in Indonesia and Bangladesh: a cross-sectional study. *The Lancet*, 371(9609), pp.322-328.
- Shankar, B., 2010. Obesity in China: the differential impacts of covariates along the BMI distribution. *Obesity*, 18(8), pp.1660-1666.

- Shibhatu, K., Krishna, V. and Qaim, M., 2015. Production diversity and dietary diversity in smallholder farm households. *Proceedings of the National Academy of Sciences*, 112(34), pp.10657-10662.
- Sibhatu, K. and Qaim, M., 2018. Farm production diversity and dietary quality: linkages and measurement issues. *Food Security*, 10(1), pp.47-59.
- Simons, D., Francis, M., Bourlakis, M. and Fearn, A., 2003. Identifying the determinants of value in the UK red meat industry: a value chain analysis approach. *Journal on Chain and Network Science*, 3(2), pp.109-121.
- Smith, R.D, Lee, K. and Drager, N., 2009. Trade and health: an agenda for action. *The Lancet*, 373, pp.768–773.
- Smith, A. and Baghurst, K., 1992. Public health implications of dietary differences between social status and occupational category groups. *Journal of Epidemiology and Community Health*, 46, pp.409–416.
- Smith, P.K., Bogin, B. and Bishai, D., 2005. Are time preference and body mass index associated?: Evidence from the National Longitudinal Survey of Youth. *Economics and Human Biology*, 3(2), pp.259-270.
- Snowdon, W. and Thow, A.M., 2013. Trade policy and obesity prevention: challenges and innovation in the Pacific Islands. *Obesity Reviews*, 14, pp.150-158.
- Snowdon, W., Lawrence, M., Schultz, J., Vivili, P. and Swinburn, B., 2010. Evidence-informed process to identify policies that will promote a healthy food environment in the Pacific Islands. *Public Health Nutrition*, 13(6), pp.886-892.
- Snowdon, W., Moodie, M., Schultz, J. and Swinburn, B., 2011. Modelling of potential food policy interventions in Fiji and Tonga and their impacts on noncommunicable disease mortality. *Food Policy*, 36(5), pp.597-605.
- Spruijt-Metz, D., 2011. Etiology, treatment, and prevention of obesity in childhood and adolescence: A decade in review. *Journal of research on Adolescence*, 21(1), pp.129-152.
- Sraboni, E., Malapit, H. J., Quisumbing, A. and Ahmed, A., 2014. Women’s empowerment in agriculture: What role for food security in Bangladesh?. *World Development*, 61, pp.11–52.

- Stamoulis, K., Pingali, P. and Shetty, P., 2004. Emerging challenges for food and nutrition policy in developing countries. *Electronic Journal of Agricultural and Development Economics*, 1(2), pp.154-167.
- Steinberger, J., Jacobs, D.R., Raatz, S., Moran, A., Hong, C.P. and Sinaiko, A.R., 2005. Comparison of body fatness measurements by BMI and skinfolds vs dual energy X-ray absorptiometry and their relation to cardiovascular risk factors in adolescents. *International Journal of Obesity*, 29(11), pp.1346-1352.
- Story, M., Kaphingst, K.M., Robinson-O'Brien, R. and Glanz, K., 2008. Creating healthy food and eating environments: policy and environmental approaches. *Annual Review of Public Health*, 29, pp.253-272.
- Suhrcke, M., Stuckler, D., Leeder, S., Raymond, S., Yach, D., Rocco, L. and Matthews, D. Economic Consequences of Chronic Diseases and the Economic Rationale for Public and Private Intervention [online] 2005 [cited 2014 Dec 12]. Available at: http://archive.oxha.org/meetings/knowledge/publications/05-meeting-documentation/economics_of_chronic_disease_26oct.pdf.
- Sun, Q., Van Dam, R.M., Spiegelman, D., Heymsfield, S.B., Willett, W.C. and Hu, F.B., 2010. Comparison of dual-energy x-ray absorptiometric and anthropometric measures of adiposity in relation to adiposity-related biologic factors. *American Journal of Epidemiology*, 172(12), pp.1442-1454.
- Swami, V., Knight, D., Tovée, M.J., Davies, P. and Furnham, A., 2007. Preferences for female body size in Britain and the South Pacific. *Body Image*, 4(2), pp.219-223.
- Swinburn, B.A., Sacks, G., Hall, K.D., McPherson, K., Finegood, D.T., Moodie, M.L. and Gortmaker, S.L., 2011. The global obesity pandemic: shaped by global drivers and local environments. *The Lancet*, 378 (9793), pp.804-814.
- Swindale, A. and Bilinsky, P., 2006. Household Dietary Diversity Score (HDDS) for Measurement of Household Food Access: Indicator Guide V.2 2006. *Washington, DC: Food and Nutrition Technical Assistance Project*.
- Tansel, A. and Bircan, F., 2006. Demand for education in Turkey: A tobit analysis of private tutoring expenditures. *Economics of education review*, 25(3), pp.303-313.

- Taylor, D., 2005. Value chain analysis: an approach to supply chain improvement in agri-food chains. *International Journal of Physical Distribution and Logistics Management*, 35(10), pp.744-761.
- Taylor, R. and Thoma, K., 1985. Mortality patterns in the modernized Pacific Island nation of Nauru. *American Journal of Public Health*, 75(2), pp.149–155.
- Taylor, R., Carter, K., Naidu, S., Linhart, C., Azim, S., Rao, C. and Lopez, A.D., 2013. Divergent mortality trends by ethnicity in Fiji. *Australian and New Zealand Journal of Public Health*, 37(6), pp.509-515.
- Teevale, T., 2011. Body image and its relation to obesity for Pacific minority ethnic groups in New Zealand: a critical analysis. *Pacific Health Dialog*, 17(1), pp.33-53.
- Tessier, S., Traissac, P., Maire, B., Bricas, N., Eymard-Duvernay, S., El Ati, J. and Delpeuch, F., 2008. Regular users of supermarkets in Greater Tunis have a slightly improved diet quality. *The Journal of Nutrition*, 138(4), pp. 768-774.
- Thaman, R. and Clarke, W., 1983. Food and national development in the South Pacific; Ray Parkinson memorial lectures, 1982.
- Thiele, S., Mensink, G. B. and R. Beitz., 2004. Determinants of diet quality. *Public Health Nutrition*, 7(1), pp.29-37.
- Thompson, O.M., Ballew, C., Resnicow, K., Must, A., Bandini, L.G., Cyr, H.D. and Dietz, W.H., 2004. Food purchased away from home as a predictor of change in BMI z-score among girls. *International Journal of Obesity*, 28(2), pp.282-289.
- Thow, A.M., Heywood, P., Schultz, J., Quedsted, C., Jan, S. and Colagiuri, S., 2011. Trade and the nutrition transition: strengthening policy for health in the Pacific. *Ecology of Food and Nutrition*, 50(1), pp.18-42.
- Thow, A.M, Jan, S., Leeder, S. and Swinburn, B., 2010. The effect of fiscal policy on diet, obesity and chronic disease: a systematic review. *Bulletin of the World Health Organization*, 88(8), pp.609–614.
- Thow, A.M., Jones, A., Hawkes, C., Ali, I. and Labonté, R., 2017. Nutrition labelling is a trade policy issue: lessons from an analysis of specific trade concerns at the World Trade Organization. *Health Promotion International*.

- Thow, A.M., Quesada, C., Juventin, L., Kun, R., Khan, A.N. and Swinburn, B., 2011. Taxing soft drinks in the Pacific: implementation lessons for improving health. *Health Promotion International*, 26(1), pp.55-64.
- Thow, A.M. and Snowdon W., 2010. The effect of trade and trade policy on diet and health in the Pacific Islands, in C. Hawkes, C. Blouin, S. Henson, N. Drager and L. Dubé, eds., *Trade, Food, Diet and Health: Perspectives and Policy Options*. Wiley Blackwell: Oxford.
- Thow, A. M., Snowdon, W., Schultz, J. T., Leeder, S., Vivili, P. and Swinburn, B. A., 2011. The role of policy in improving diets: experiences from the Pacific Obesity Prevention in Communities food policy project. *Obesity Reviews*, 12 (suppl. 2), pp.68–74.
- Thow, A. M., Swinburn, B., Colagiuri, S., Diligolevu, M., Quesada, C., Vivili, P., and Leeder, S., 2010. Trade and food policy: case studies from three Pacific Island countries. *Food Policy*, 35(6), pp.556-564.
- Tigga, P.L. and Sen, J., 2016. Maternal Body Mass Index Is Strongly Associated with Children's Scores for Height and BMI. *Journal of Anthropology*, available at <http://dx.doi.org/10.1155/2016/6538235>.
- Timmer, C.P., 2009. Do supermarkets change the food policy agenda?. *World Development*, 37(11), pp.1812–1819.
- Tobin, J., 1958, Estimation of relationships for limited dependent variables." *Econometrica: journal of the Econometric Society*, pp.24-36.
- Todd, J.E., Mancino, L. and Lin, B. H., 2010. The impact of food away from home on adult diet quality. US Department of Agriculture. Economic Research Service Report.
- Tohill, B., 2005. Dietary intake of fruit and vegetables and management of body weight. Geneva: World Health Organization.
- Toiba, H., Umberger, W., and Minot, N., 2015. Diet transition and supermarket shopping behaviour: is there a link?. *Bulletin of Indonesian Economic Studies*, 51(3), pp.389–403.
- Traill, W.B., 2006. The rapid rise of supermarkets?. *Development Policy Review*, 24(2), pp.163-174.

- Tremmel, M., Gerdtham, U., Nilsson, P. and Saha, S., 2017. Economic burden of obesity: a systematic literature review. *International Journal of Environmental Research and Public Health*, 14(4), p.435.
- Tuomilehto, J., Ram, P., Rausuvanua, E., Taylor, R., and Zimmet, P., 1984. Cardiovascular diseases and diabetes mellitus in Fiji: analysis of mortality, morbidity and risk factors. *Bulletin of the World Health Organisation*, 62(1), pp.133-143.
- Turrell, G. and Kavanagh, A. M., 2006. Socio-economic pathways to diet: modelling the association between socio-economic position and food purchasing behaviour. *Public Health Nutrition*, 9(3), pp.375-383.
- Tzioumis, E. and Adair, L., 2014. Childhood dual burden of under- and overnutrition in low- and middle-income countries: a critical review. *Food and Nutrition Bulletin*; 35(2), pp.230–243.
- Umberger, W., He, X., Minot, N. and Tobia, H., 2015. Examining the Relationship between the Use of Supermarkets and Over-nutrition in Indonesia. *American Journal of Agricultural Economics*, 97(2), pp.510-525.
- Underhill, S.J. and Singh-Peterson, L., 2017. Improving non-communicable disease remediation outcomes in Tonga: the importance of domestic fruit production systems: an analysis. *Journal of Agriculture and Rural Development in the Tropics and Subtropics*, 118(1), pp.91-103.
- Unicef., 2016. Child Info: Monitoring the Situation of Children and Women. 2014. Statistics by area/water and sanitation. Available at: <https://data.unicef.org/about-us/>.
- Vatucawaqa, P., 2012. Fiji Food Balance Sheet, 2009. Suva, Fiji: National Food and Nutrition Centre, Ministry of Health, Government of Fiji.
- Volpe, R., Okrent, A. and Leibtag, E., 2013. The effect of supercentre-format stores on the healthfulness of consumers' grocery purchases. *American Journal of Agricultural Economics*, 95(3), pp. 568-589.
- Von Braun, J., and Kennedy, E. 1994. Agricultural commercialization, economic development, and nutrition. Baltimore, MD: Published for the International Food Policy Research Institute (IFPRI) by John Hopkins University Press. Available at:

<http://www.ifpri.org/publication/agricultural-commercialization-economic-development-and-nutrition>.

- Wall, J., Mhurchu, C.N., Blakely, T., Rodgers, A. and Wilton, J., 2006. Effectiveness of monetary incentives in modifying dietary behavior: a review of randomized, controlled trials. *Nutrition Reviews*, 64(12), pp.518-531.
- Wang, H., Du, S., Zhai, F. and Popkin, B., 2007. Trends in the distribution of body mass index among Chinese adults, aged 20–45 years (1989–2000). *International Journal of Obesity*, 31(2), pp. 272-278.
- Wansink, B., 2004. Environmental factors that increase the food intake and consumption volume of unknowing consumers. *Annual Review of Nutrition*, 24, pp.455-59.
- Waqa, G., Bell, C., Snowdon, W. and Moodie, M., 2017. Factors affecting evidence-use in food policy-making processes in health and agriculture in Fiji. *BMC Public Health*, 17(1), p.51.
- Waqanivalu, T. K., 2010. Pacific islanders pay heavy price for abandoning traditional diet. *Bulletin of the World Health Organisation*, 88(7), pp.484-485.
- Wate, J.T., Snowdon, W., Millar, L., Nichols, M., Mavoa, H., Goundar, R., Kama, A. and Swinburn, B., 2013. Adolescent dietary patterns in Fiji and their relationships with standardized body mass index. *International Journal of Behavioural Nutrition Physical Activity*, 10(1), p.45.
- Webber, L., Kilpi, F., Marsh, T., Rtveldze, K., Brown, M. and McPherson, K., 2012. High rates of obesity and non-communicable diseases predicted across Latin America. *PloS one*, 7(8), p.e.39589.
- Willett, K., Jiang, R., Lenart, E., Spiegelman, D. and Willett, W., 2006. Comparison of Bioelectrical Impedance and BMI in Predicting Obesity-Related Medical Conditions. *Obesity*, 14(3), pp.480-490.
- Williams, L.K., Ricciardelli, L.A., McCabe, M.P., Waqa, G.G. and Bavadra, K., 2006. Body image attitudes and concerns among indigenous Fijian and European Australian adolescent girls. *Body Image*, 3(3), pp. 275-287.
- Winship, C. and Mare. R.D, 1992. Models for sample selection bias. *Annual Review of Sociology*, 18(1), pp.327-350.

- Wohlfahrt-Veje, C., Tinggaard, J., Winther, K., Mouritsen, A., Hagen, C.P., Mieritz, M.G., de Renzy-Martin, K.T., Boas, M., Petersen, J.H. and Main, K.M., 2014. Body fat throughout childhood in 2647 healthy Danish children: agreement of BMI, waist circumference, skinfolds with dual X-ray absorptiometry. *European Journal of Clinical Nutrition*, 68(6), pp.664–70.
- Wong, V., Taoka, S., Kuartei, S., Demei, Y. and Soaladaob, F., 2004. Cancer in the republic of Palau (Belau). *Pacific Health Dialog*, 11(2), pp.64-69.
- Worku, I.H., Dereje, M., Minten, B. and Hirvonen, K., 2017. Diet transformation in Africa: The case of Ethiopia. *Agricultural Economics*, 48(S1), pp.73-86.
- World Atlas, 2018. The Most Obese Countries in the World. Available at: <https://www.worldatlas.com/articles/29-most-obese-countries>.
- World Bank., 2007. From Agriculture to Nutrition: Pathways, Synergies and Outcomes. Agriculture and Rural Development Department, World Bank, Washington, DC.
- World Bank., 2014. Non-Communicable Disease (NCD) Roadmap Report. World Bank Group. Accessed June 2017. <http://documents.worldbank.org/curated/en/534551468332387599/Non-Communicable-Disease-NCD-Roadmap-Report>.
- World Health Organisation., 2002. Fiji STEPS Non-Communicable Disease Risk Factors Survey 2002. World Health Organisation. Available at: <http://www.who.int/chp/steps/fiji/en/index.html>.
- World Health Organisation., 2003. Diet, Nutrition and the Prevention of Chronic Diseases: Report of the Joint WHO/FAO Expert Consultation. WHO Technical Report Series 916. Geneva: WHO/FAO.
- World Health Organisation. 2003. Diet, Food Supply and Obesity in the Pacific. World Health Organisation Regional Office for the Western Pacific, Manila, Philippines.
- World Health Organization. 2004. Global strategy on diet, physical activity and health. Geneva, World Health Organization. Available at: http://www.who.int/dietphysicalactivity/strategy/eb11344/strategy_english_web.pdf.

- World Health Organization. 2008. Action plan for the global strategy for the prevention and control of noncommunicable diseases 2008–2013. *Geneva: World Health Organization.*
- World Health Organisation., 2009. Global health risks: Mortality and burden of disease attributable to selected major risks. Geneva: World Health Organisation.
- World Health Organisation. 2009. WHO child growth standards: growth velocity based on weight, length and head circumference: methods and development. Geneva: World Health Organisation.
- World Health Organisation., 2011. Honiara Communiqué on the Pacific Non-Communicable Disease (NCD) Crisis. World Health Organisation. Available at: http://www.wpro.who.int/noncommunicable_diseases/honiara_communique.pdf.
- World Health Organisation., 2011. Global status report on noncommunicable diseases 2010. Geneva, World Health Organisation. Available at: http://www.who.int/nmh/publications/ncd_report2010/en/.
- World Health Organisation., 2011. Scaling up action against noncommunicable diseases: how much will it cost? Geneva, World Health Organisation.
- World Health Organisation. 2012. Population-based approaches to childhood obesity prevention. Available at: http://www.who.int/dietphysicalactivity/childhood/WHO_new_childhoodobesity_PREVENTION_27nov_HR_PRINT_OK.pdf.
- World Health Organisation, 2013. Actions on the Social Determinants of Health in the Pacific Islands. Tenth Pacific Health Ministers Meeting, Apia Samoa 2-4 July 2013. Available at: http://www.wpro.who.int/southpacific/pic_meeting/2013/documents/PHMM_PIC10_7_SDH.pdf
- World Health Organisation. 2014. Multi-sectorial Collaboration to tackle the Pacific Non Communicable Disease Crisis. World Health Organisation. Available at: <http://www.wpro.who.int/southpacific/mediacentre/releases/2014/tackle-ncd-fiji/en/>.
- World Health Organisation., 2014. Global Health Observatory data repository. Available at: <http://apps.who.int/gho/data/view.main.2450A?lang=en>.

- World Health Organisation., 2015. Meeting Report: Pacific Workshop on Nutrition, Noncommunicable Disease and the Role of Codex. Nadi, Fiji. Available at http://iris.wpro.who.int/bitstream/handle/10665.1/11395/RS_2015_GE_13_FJI_eng.pdf?ua=1.
- World Health Organisation., 2018. Obesity and overweight. Available at: <http://www.who.int/mediacentre/factsheets/fs311/en/>.
- Wyber, R., Wilson, N. and Baker M., 2009, New Zealand's impact on health in the South Pacific: scope for improvement?. *New Zealand Medical Journal*, 122, pp.60–68.
- Yach, D. and Bettcher, D., 1998. The globalization of public health, I: Threats and opportunities. *American Journal of Public Health*, 88(5), pp.738-744.
- Yates, A., Edman, J. and Aruguete, M., 2004. Ethnic differences in BMI and body/self-dissatisfaction among Whites, Asian subgroups, Pacific Islanders, and African-Americans. *Journal of Adolescent Health*, 34(4), pp.300-307.
- Yoshiike, N., Seino, F., Tajima, S., Arai, Y., Kawano, M., Furuhashi, T. and Inoue, S., 2002. Twenty year changes in the prevalence of overweight in Japanese adults: The National Nutrition Survey 1976–95. *Obesity Reviews*, 3(3), pp.183-190.
- Zehner, E., 2016. Promotion and consumption of breastmilk substitutes and infant foods in Cambodia, Nepal, Senegal and Tanzania. *Maternal & child nutrition*, 12, pp.3-7.
- Zhai, L., Dong, Y., Bai, Y., Wei, W. and Jia, L., 2017. Trends in obesity, overweight, and malnutrition among children and adolescents in Shenyang, China in 2010 and 2014: a multiple cross-sectional study. *BMC Public Health*, 17(1), p.151.
- Zhang, X., van der Lans, I. and H. Dagevos., 2012. Impacts of fast food and the food retail environment on overweight and obesity in China: a multilevel latent class cluster approach. *Public Health Nutrition*, 15(01), pp.88-96.
- Zimmet, P., R. Taylor, P. Ram, H. King, G. Sloman, L.R. Raper. and D. Hunt., 1983. Prevalence of diabetes and impaired glucose tolerance in the biracial (Melanesian and Indian) population of Fiji: a rural-urban comparison. *American Journal of Epidemiology*, 118(5), pp. 673-688.
- Zimmet. P., Taylor, R., Ram, P., King, H., Sloman, G. and Robin Paper, L., 1985. Prevalence of diabetes and impaired glucose tolerance in the biracial (Melanesian and Indian)

population of Fiji: a rural-urban comparison. *Fiji Medical Journal*, 13(5-6), pp.110-123.