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Statement by Author

I, Anjana Arishma Singh, declare that this thesis is my own work and that, to the best of my knowledge, it contains no material previously published, or substantially overlapping with material submitted for the award of any other degree at any institution, except where due acknowledgment is made in the text.

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Statement by Supervisor

The research in this thesis was performed under my supervision and to my knowledge is the sole work of Ms. Anjana Arishma Singh.

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Lastly, I would like to thank everyone who has contributed towards the completion of my project in any possible way.
Rising global food price inflation in the recent past and declining agricultural production pose a concern for food security in many counties in the world. Fiji, being a small island country, has also been experiencing a declining share of agricultural production and heavily depending upon food imports. As a result, the economy is expected to be experiencing greater influence of external price shocks in the domestic inflation. The current work attempts to provide an understanding on the degree of responses of demand for foods across various socio-economic groups in response to such price changes and whether this leads to an increase in the food production gap in the near future. There have been very limited studies that have looked at Fiji’s food demand patterns and this research has estimated demand elasticities together with projections of the production gap that Fiji may experience in future. The household level consumption, expenditure survey data, compiled by the Fiji Islands Bureau of Statistics (HIES 2008-09) has been used for analysis. For the estimation of demand elasticities, Quadratic Ideal Demand System (QUAIDS), suggested by Banks, Blundell and Lewbel (1997), has been used. This is an extension of the AIDS model and is a fairly new and popular estimation model proved to provide close to more accurate results. All food items have been divided into four groups. The results suggest that out of the four food groups analyzed, the households spend most on meat, fish and seafood (15% of total expenditure) whilst the lowest expenditure is on milk, cheese and eggs (3%). The income elasticity proves that bread and cereals and meat, fish and seafood are normal foods with elasticities 0.74 and 0.77 respectively. Milk, cheese and eggs and fruits and vegetables are a luxury good for the country with income elasticity 1.9 and 1.77 respectively. The own price elasticities for all food groups are negatively correlated, except for milk, cheese and eggs which has an own price elasticity of 0.2. The production gap has been forecasted for the years 2020, 2025 and 2030 for eight food items. The projections show that at current levels of production, the production gap will widen even further. For example, it is observed that the production gap per capita for milk in 2009 was 95.42mt and is expected to increase to 116.87mt in 2020. Similarly, rice production gap was 45.50mt in 2009 but it will further increase to 54.93mt in 2020. This clearly shows that the
agricultural sector should be further strengthened for its increasing contribution to the economy.
ABBREVIATIONS

✓ AIDS – Almost Ideal Demand System
✓ FAO – Food Agricultural Organization
✓ FIBOS – Fiji Islands Bureau of Statistics
✓ GDP – Gross Domestic Product
✓ HIES – Household Income & Expenditure Survey
✓ QUAIDS – Quadratic Almost Ideal Demand System
✓ MMT – million metric tonnes
✓ MT – metric tonnes
✓ WHO – World Health Organization
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Chapter 1  Introduction

1.1  The Research Problem

Rising global food price inflation in the recent past and declining agricultural production pose a concern for food security in many counties in the world. Fiji, being a small island country, has also been experiencing a declining share of agricultural production and heavily depending upon food imports. As a result, the economy is expected to be experiencing greater influence of external price shocks on the domestic inflation. Food Security, as defined by the World Food Summit of 1996, exists when “all people at all times have access to sufficient, safe, and nutritious food to maintain a healthy and active life” (Jones, 2012). This definition entails people having physical and economic access to food that meets their dietary needs and is their choice of food. According to the World Health Organization, food security is built on three pillars, Food availability, Food access and Food use. Having an appropriate amount of food per person justifies that food is available. Food access is in terms of having the necessary resources to acquire food that is available and food use from the health aspect suggests that relevant nutritional requirements are met by the food that is consumed and useful to the human body (WHO, 2014).

It is an undoubted fact that Fiji has abundant land for agricultural production however, it is important at this point to establish whether Fiji is also experiencing food insecurity issues, if so what would be the tentative gap in agricultural production in future, what would be the shortages or surpluses in food production that may be encountered and what would be the best policies to address them is utmost significant now?

The issue of food security is seen to be linked to a country’s agricultural sector in terms of its capacity to produce food associated to its demand requirements. However, it becomes important to note that not only is food security a sustainable development or agricultural issue but it is also required for the need of sound health, trade and environment. It does not only have social or economic impacts because of insufficient
agricultural produce to meet national demand but also impacts by deteriorating health conditions for people as required nutrients are not consumed and hinders trade of agricultural goods that will eventually take the country backward and affect its growth rates and economy’s gross domestic product and outputs negatively.

In view of the above for the case of Fiji, similar to many other developing countries the issue of food security can be highly related to the overtime decline in Fiji’s agricultural sector. As opposed to around 13% contribution to Fiji’s gross domestic product in 1989, in 2012 the sectors contribution was around 8% only. This is a large decline in one of the very important sectors of the country and should be addressed urgently so pressure on food resources can be minimized in future.

**Figure 1.1.1: Graph showing the contribution of Fiji’s Agricultural sector to the Gross Domestic Product 1989-2013**

![Graph showing the contribution of Fiji’s Agricultural sector to the Gross Domestic Product 1989-2013](image)

**Source:** FIBOS- Key Statistics (various years)

The graph 1.1.1 above depicts the contribution of Fiji’s agricultural sector to the country’s gross domestic product. The figure for the year 2013 is projected and may be subject to change. It is important to note that the contribution of the agricultural sector to the GDP was the highest in 1989 and that was the highest contribution in the last 25 years. There have been fluctuations in the sectors contribution to GDP, one of the reasons for this is that Fiji is highly prone to natural disasters like cyclones and this
affects the agricultural sector the most. Over time with the influence of climate change and change in weather patterns these disasters have become even more frequent therefore the major declines in agricultural output in relation to GDP is due to cyclones as follows, cyclone Sina in 1990, Gavin in 1997, Susan in 1998, Paula in 2001, Ami in 2003, Mick in 2009 and Tomas in 2010 (Wikipedia, 2014). The graph clearly demonstrates that agricultural contribution has declined in the years of the cyclones. Agriculture is both a cause and victim of climate change (Magat, 2009) thus, it needs to be properly mitigated and managed. It is evident from the above graph from 2011-2013 that the agriculture sector contribution to the total economy output is increasing and this can be attributed to the fact that in these years there have not been any major cyclones.

One of the other reasons for the decline in the agriculture sector can be trade. That is as an economy opens up more, there is more trading which in many cases drives down the prices of domestic foods therefore with lower returns for their produce farmers opt to move out of the sector decreasing agricultural output even further. The overall world food prices also impact trade and domestic food prices, hence indirectly affecting the agriculture sector.

**Figure 1.1.2: Graph showing the trend of total World Food Price Index**

![Graph showing the trend of total World Food Price Index](source)

The above graph shows the trend of the world food price. It has to be noted that the world food price index was steadily increasing and then sharply declined in 2008. This
decline in 2008 was due to the contraction of markets in 2008 attributed to the global financial crisis. The price index steadily picked up in 2009 that is an inflation of food prices. The reason for this was the sudden increase in the prices of agricultural products due to shortage of food for human consumption, animal feed and biofuel (FAO, 2009). With climate change ongoing, the adverse weather patterns lead to more frequent supply shocks, impacting the agricultural sector in terms of production and making prices even more volatile (Wenzlau, 2014).

It is good to note for Fiji that the Government of the day has realized the importance of food security thus, states under Section (36) Subsection (1) of the 2013 Fijian Constitution “that the state must take reasonable measures within its available resources to achieve the progressive realization of the right of every person to be free from hunger, to have adequate food of acceptable quality and to clean and safe water in adequate quantities” (Fiji Constitution, 2013). Hence, it is evident that there is a need to improve Fiji’s resilience to food security and this can only be achieved if proper mitigation measures are undertaken through fully understanding the causes and factors affecting the country’s food security.

Defined according to the Fijian context, food security is the “ability to produce healthy and affordable food for all Fijians” (Fiji MSPNDS, 2014). This definition is centered around four (4) qualifications; the first involves having the domestic capability to produce and feed the local population, the second involves having a sufficiently diverse food production base to satisfy dietary needs, the third looks into the distributional systems in place that links people to markets in order to access foods and lastly, the required level of farm efficiency to be highlighted in order to ensure that local produce is competitively priced and is not above imported foods (Fiji MSPNDS, 2014).

As mentioned earlier, it becomes necessary to establish the reasons for the prolonged decline of the agricultural sector as this can be one of the major hindrance to food security. Fiji is a Pacific island country which is prone to a lot of natural calamities like hurricanes, cyclones and floods and as mentioned above, over the past 25 years, Fiji has been affected by many of these calamities. The agriculture sector is the most prone to the damages and losses that these events leave behind and this is the reason for the lack
of confidence by the farmers in the sector. Losing crops and yields on numerous occasions’ farmers opt to move out of the sector but they still have to earn for their families basic survival, consequently, moving to urban areas in search of safer jobs and a better lifestyle for their families, leaving behind less people to farm agricultural lands. In terms of this rural-urban migration, 51% of the population now stays in the urban centers (Fiji MSPNDS, 2014), putting now more than ever, increased pressure on food and demand for other resources such land, housing, water and electricity. Volatile commodity prices for agricultural items and loss of arable land through expiry of land leases have also contributed to the decline in agricultural output.

Westernization and urbanization have also added to the issue through education. Farmers who have remained in the rural areas have sent their children to school and opted for them to have white collar jobs instead of remaining in their farming backgrounds. An increase in incomes has caused people to consume more of the imported foods. In the last 5 years alone the food imports have increased as a percentage of GDP. In 2008, the food imports was 11.8% of GDP however, in 2013 it was forecasted to be 17.89% of GDP.

**Figure 1.1.3: Graph showing the trend of Food Imports into Fiji**

![](image)

**Source:** FIBOS, (2012 & 2014)
The figure 1.1.3 depicts that trend of food imports into Fiji over the last ten (10) years. This steady increase is anticipated to continue into the future and put more pressure on the country’s balance of payment and the terms of trade account. This increase has been due to many factors but highly linked to the declining agricultural sector and incompetency of the sector to increase production. It has been identified that Fiji imports a whole lot of agricultural foods as well, in 2006 alone Fiji imported more than $250 million of agricultural products (Martyn, 2011).

This continuous increase in imports imposes burden on the poor. Overtime when food production per capita will decline in relation to the domestic produce there will be an increase in imported foods to meet local demands which will be expensive and this will place most burdens on the poor people in terms of affordability and feeding their family.

The cereal import dependency is calculated by dividing the cereal imports by domestic cereal production and the net cereal exports (FAO, 2013). Cereal is a starchy food which is cheap and keeps people full longer therefore it mostly falls within the affordability of the poor in each country thus, assisting in comprehending food security.

**Figure 1.1.4: Graph showing Fiji’s Cereal Import Dependency Ratio**

![Graph showing Fiji’s Cereal Import Dependency Ratio](image)

**Source:** FAO, (2013)

The figure 1.1.4 above demonstrates the trend that Fiji has in terms of its dependency on cereal imports. It is seen that the import dependency is steadily rising which can be
considered a good effort for Fiji as on one hand people may be able to afford this thus being secure on food however, on the other hand it is placing more pressure on the country in terms of the import balance.

The population increase is also a threat to food security. The Thomas Malthus law of population and the Malthusian theory states that “in time population will grow at a quadratic rates and food production will grow at arithmetic rates” therefore in years to come food per person would decline and cause famine and starvation (McRae, 2014). The Malthusian theory of 1978 is even further justified now that population is expected to increase at a faster rate than the means of subsistence. On a global front this may become an even bigger problem especially when the current world population of 7 million is anticipated to increase to 9 million come 2050. With the sharp increase in food prices there is immense pressure on the poor who spend half of their income on food, this suggests that the world cannot properly feed its current population let alone the population that we are expected to have in 2050 (Parker, 2011).

Similarly, Fiji has a population of close to 840,000 people, this number is expected to increase to one million by the year 2030 (Fiji MSPNDS, 2014). Therefore, if Fiji does not take measures to secure it in the area of food sustainably, the issues may increase and the situation may worsen. Therefore, making it important for the advisors and policy makers to address food security issues and take proactive actions for future consequences.

In view of the above, the objective of this work is to study the current consumption patterns of the households in Fiji during the 2008-09 periods and examine the expenditure pattern. An investigation will also be made into finding facts on: What are the demand elasticities for food items? What is the impact of income rise on those? How demographic factors affect consumption patterns, if they do? What would likely be the gap in the recent future? This quantitative study will be based on the Household Income and Expenditure survey (HIES) data. A total of four (4) food groups will be studied, these include; group1 - total cereals and bread, group 2 –total meat, fish and seafood, group 3 - milk, cheese and eggs and group 4 – fruits and vegetables inclusive of root crops. Based on this data the Quadratic Almost Ideal Demand Systems (QUAIDS)
methodology will be utilized to commutate the demand elasticity’s. This elasticity’s will determine the degree of change in the response of consumers come a change in price of related goods or their income. The elasticity estimations will determine the impacts on the demand for food in the four groups once there is a change in the price of that food group, or price of other goods that affect consumers budge or a change in the consumer’s income. This would enable one to fully understand how responsive the consumers are to which particular foods through their behavioral change in consumption patterns. Hence, the cross price elasticity, own price and income elasticity will also be computed to see impacts on the differentiated population.

The data is divided into Fiji’s four (4) divisions; Central, Eastern, Western and Northern with partitioning in locality like rural and urban areas. This partition in the rural and urban population would enable better forecast and predict the impact of a change in price on the demand patterns of people of different income groups. The partition by division and locality would assist policy makers to direct their policies for improvements in the correct places of the country.

Secondly, the food demand for the future years would be forecasted to suggest and strategize to policy makers what agricultural areas should be invested in to ensure a future for the people that do not affect their livelihood because population would continue to increase and agricultural output is showing a decline. It also becomes important to study the supply side for the commodities being studied. The supply side data would be used to establish supply growth rates for the future and compare them with the demand projections to identify the gap in supply and demand for seven food items to determine the shortage and surpluses that the economy may face in future thus leading to the issues and lessons of how food security will be achieved in Fiji.

1.2 Importance of the study

The issue of food security is important for developing and small economies. There has been a lot of debate on food security and the problems that it poses. The issues persist because there always remains the problem of equal distribution. It is also important to note that countries import food to replenish and meet current food demands/needs and it
is predicted and evident from past practices that population trends especially in that of developing countries will continue to increase thus, if countries are unable to meet current food demands they will surely face the same problem in future but on a larger scale. The future food demand will definitely not be met with current levels of production thus; policies should be directed in the correct places to avoid future shortages and surpluses.

A country’s food security is utmost vital thus, it becomes important for countries to relook at their trade policies and see options for protection of their national food security. Poverty is an issue that will mostly affect rural people if proper food security appropriation measures are not undertaken (WHO, 2014).

The rationale for undertaking this study could be many. Firstly, the issue of food security is a very vital one. It is important to all small developing states like Fiji. Fiji is abundant with fertile land per capita and has a favorable climate; however, not much has been done with the agricultural sector for years. The country could not even secure a self-sufficient production in the rice and sugar industry which was once considered the country’s back bone. With declining agricultural trends there would be more reliance on food imports which would be expensive and may not be afforded by everyone. This will seriously put more pressure on the poor and further lower their standards of living. Food insecurity will further lead to health issues, government will incur greater health expenditure. The health services are expensive for the poor to afford as such the issue of food security will be indirectly affecting the health of the poor through consumption of low quality food.

The world food prices are increasing and if Fiji continues to rely on imported foods there will be greater burdens on the country’s balance of payments. This topic is important to study now to ensure that Fiji is relieved of such pressures in future and does not remain vulnerable in terms of fluctuations with international food prices.
Figure 1.2.1: Fiji’s Real Net Food Exports in US$

Source: WTO, (2014)

Figure 1.2.1 clearly depicts that Fiji’s net exports have declined over the past years in terms of the dollar value. The net exports have been the worst in 2011 and 2013 implying that the imports are exceeding exports. Observing the trend of net exports it can be forecasted that Fiji’s net export situation will take substantial time to improve in order to be restored to positive levels.

Figure 1.2.2: Graph showing the trend of the components of the World Food Price Index

Source: FAO, (2014)
Figure 1.2.2 shows the trends in the world food price index for meat, dairy, cereal, oil and sugar. It is important to note global trends as Fiji though a small pacific island economy is involved in a lot of trade. The food price index is a measure of the monthly change in international prices of a basket of food commodities (Manual, 2014). It is depicted by the graph that the price index of meat with a strong global demand has the price index lower than all other foods shown above from 2006. It is also noted that for all goods except for sugar the price index declined in the 2007-08 period. One of the reasons for this may be due to the contraction of economy after the global financial crisis. The sugar price index had steadily picked up after the global financial crisis and reached its ever highest in 2011. Such are the trends of the world prices of food.

There have not been many studies that have looked into the food security issues of Fiji and thus, this study has been undertaken to fill in this gap in the current literature. However, studies have been undertaken on demand elasticity estimation some time back but the methodology used has been different. Hone and Haszler (2007) estimated demand elasticity’s for Fiji but utilized the non-parametric approach for estimation. Seale, Regmi, & Bernstein (2003) had undertaken a study of 114 countries across 9 categories of food groups and Fiji was one of them. The method of estimation used was the two stage estimation technique. It has been noted that for Fiji’s case the QUAIDS estimation method has not been applied and this opportunity to see the results under QUAIDS to encourage comparisons with other studies would provide good insights and greater understanding about the topic.

For the case of Fiji the food security and demand estimation issues are more fascinating to study due to the unique consumption patterns and food eating habits. Due to being a multiracial society with people from different ethnic backgrounds living together, Fiji has diverse consumption patterns which may be interesting to study and analyze.

Table 1.2.1: Population in Fiji according to ethnicities as at September, 2007

<table>
<thead>
<tr>
<th>Ethnicities</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-taukei</td>
<td>475,739</td>
</tr>
<tr>
<td>Fijians</td>
<td>313,798</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td>-------</td>
</tr>
<tr>
<td>Others</td>
<td>47,734</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>837,271</strong></td>
</tr>
</tbody>
</table>

Source: FIBOS, (2014)

Fiji is a tourism economy and there is a tendency of tourism economies to consume more imported food. Scultz, Qiliho, & Thaman (2009), states that the change in Fiji’s consumption pattern is due to social change and dependence on imported foods in the country has increased through colonization, modern media and due to the millions of tourists that visit Fiji each year. The tourists generally demand food that is consistent with their dietary needs thus Fiji competes with its tourists demand and food import bills.

As discussed above global evidence suggests that agricultural output will decline due to impacts of climate change and Fiji is no different hence, it is important for Fiji to revive and strengthen its agricultural sector. The results of this study may just be the motivating tool for policy makers with evidence to invest in the right agricultural areas to give farmers back the confidence to remain in this business.

**Figure 1.2.3: Graph showing Fiji’s Agricultural sector Output from 1989-2014**

Source: FIBOS- Key Statistics (various years)
The Figure 1.2.3 portrays Fiji’s agricultural sector output for the years 1989 to 2013. Similar to the figure 1.1.1 in the above section, there are a lot of fluctuations in the agricultural output over the years. This is particularly due to the fact that the sector has been affected by many natural disasters and diseases in the industry during this period. For the last 25 years, year 2013 was projected to have the highest output in dollar terms however, this is not confirmed as yet. Nonetheless, it is good to note that together with the improvement in the agriculture sectors contribution to GDP, the output has also been steadily increasing from 2010. If this trend continues Fiji can be expected to improve it agricultural output further and assist in overcoming the impacts of climate change to an extent. On the other note the unfavorable situation that this sector faces in Fiji is basically the fear of natural disasters. And this is something that is diverting the population away from farming to other sources of employment.

Over the past years Fiji had been heavily depending upon its agricultural sector for the livelihood of its people. The country has been mostly popular in the pursuit of agriculture particularly because it is rich in resource base, there sufficient arable land with favorable climate for most agricultural products. The agriculture sector in Fiji vibrantly constitutes of fruits, vegetables, fish, livestock and forestry but for the purpose of this paper we have kept forestry aside and focused on food items.

The production of food in Fiji cannot be placed as a problem due to its enhanced resource base and sustainable arable land. However, the overtime decline in the Agricultural sector is due to many factors, namely, expiry of land leases and natural disasters that has forced farmers to lose confidence in the sector. This is one of the major causes of the recent increase in the rural – urban migration rates leaving behind less people to farm the land. The importance of Education realized by people has also led to a decline in the sector. Educated people nearly always opt for white collar jobs instead of choosing to go back to farm on family lands.

Policy makers have the view that if the trend of the agricultural sector continues to go down and the production continues to decline, it has an implication that demand for imported foods will go up, increasing our import quantity of edibles. This is connected to the fact that for small developing island countries like Fiji, there is a rich and healthy
resource base but production conditions and techniques are constrained, the vulnerability of the country to the natural disasters and pests and disasters also play a part in the reduced production of agricultural commodities. It is noted that over the past couple of years import dependency has risen and the reason to this is the overtime decrease of per capita production of food, caused by extensive rural-urban migration due to the causes listed above. At the same time we should be aware of the fact that as more urban development takes place and farmers become unsure of their future in the agriculture industry, they will opt to move out of production, further increasing imports of food items. These imported items will not be cheap and not all people will be able to afford them, thus, it will cause a problem of food security in the economy posing more risk on the low income earners.

This study is one that will address Fiji’s Food Security issues which is an upcoming problem of the country. Looking at the lack of confidence of the farmers in the agricultural industry Fiji can expect this issue from getting bad to worse in the near future.

This study of demand estimation and demand projection will assist policy makers at large and better prepares the economy for future proper policies can be devised from the findings of this study with Government pumping more funds in the Agricultural sectors if need be complying with the results. The demand elasticity’s itself provide accurate judgment about the responsiveness of consumers to changes in prices of food commodities in the four different locations of the country, again leading to implementation of well-structured policy decisions paving the way forward for good governance.

This study will enable the presentation of the findings to superiors with concrete evidence and work with other Ministries and departments to implement the much needed agricultural and price polices for the benefit of the consumers, the economy and the Government. Such an area of study has not been explored in the context of Fiji as yet thus, will get the attention of policy makers and enable a better environment for farmers and consumers.
1.3 Objective of the Study

The objective of the study sets:

- To estimate demand elasticity’s for major food items consumed in Fiji using QUAIDS model.
- To estimate variation of income, price and cross price elasticity’s across ethnicity, division and area
- To investigate the extent of food security to be faced in the near future

1.4 Salient features of the Economy

The Fiji Islands is located on the South of the equator and on the West of the international dateline (Willis, 1999). Fiji consists of approximately 330 remotely spread islands in the Pacific Ocean overlooking the Bligh Waters. It covers about 1.3 million kilometers of the South Pacific Ocean and has a total land area of 18,333 square kilometers (FijiHighCommissionUK, 2014). Out of the 330 islands around one-third are populated and the remaining two-thirds are uninhabited. The two major islands of Fare Viti-Levu and Vanua-Levu, these contain 93 percent of the total population and 87 percent of total land area. The other main islands of the country are Taveuni, Kadavu, Gau and Koro.

The true beauty of Fiji is in its smiling people, differentiated cultures, tropical climate and abundance of fertile and arable land. According to the 2012 estimates Fiji has a population of 858,038 people, purchasing power parity GDP income of $4786 per capita and total GDP (PPP) of $4.3 billion (theheritagefoundation, 2014). Fiji’s index of economic freedom, 2014 also indicates that Fiji has an unemployment rate of 7.0%, inflation rate of 4.3 % and the country’s FDI inflow and level of public debt is $267.9 million and 51.6% of GDP respectively. Fiji is a multi-racial society where people from lots of different cultures live together in peace and harmony. The population vastly consists of three ethnic groups; the I-Taukei comprises of 54.8% (predominantly Melanesian with a Polynesian admixture) of the total population, Indian (Fijian) 37.4%, other 7.9% (European, other Pacific Islanders, Chinese).
The I-Taukei people are the natives of Fiji and the first inhabitants on the Fiji island group. The Indian population had been brought into Fiji under the British rule. About 60,500 Indians were bought to Fiji between the years 1879 – 1916 on ten year indentured labor contracts to work specifically on sugar cane farms as the natives did not favor working on plantations. Together with indentured laborers, Fiji also saw the inflow of other Indians who came on their own will to Fiji. Other people from China also came into the country back in the years. It is important to note that the different backgrounds of people that came into Fiji played a major role in Fiji’s consumption patterns and agricultural progress to-date.

After the expiry of the indenture contracts many of the Indian people remained in Fiji to become farmers. The Gujarati’s moved on to own and run businesses and the Chinese were among the first market gardeners in Fiji (Scultz, Tapu Qiliho, & Thaman, 2009). After independence from Great Britain in 1970, people from other backgrounds also came and settled in Fiji from neighboring island nations and across the world in such of jobs, education, investment opportunities and a better home for their families.

**Table 1.3.1: Fiji’s Social and Economic Indicators**

<table>
<thead>
<tr>
<th>Indicators</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP growth (annual %)</td>
<td>1.03</td>
<td>-1.27</td>
<td>0.11</td>
<td>1.87</td>
<td>2.2</td>
<td>2.7</td>
</tr>
<tr>
<td>GDP per capita (current US$)</td>
<td>4301.63</td>
<td>3431.76</td>
<td>3747.67</td>
<td>4324.69</td>
<td>4613</td>
<td>4572</td>
</tr>
<tr>
<td>Population (Total)</td>
<td>843851</td>
<td>852479</td>
<td>860559</td>
<td>867921</td>
<td>874724</td>
<td>881065</td>
</tr>
<tr>
<td>Labor force, total</td>
<td>327874</td>
<td>332076</td>
<td>335875</td>
<td>339227</td>
<td>342174</td>
<td>-</td>
</tr>
<tr>
<td>Mortality rate, under-5 (per 1,000 live births)</td>
<td>22.5</td>
<td>22.6</td>
<td>22.7</td>
<td>22.6</td>
<td>4613</td>
<td>4572</td>
</tr>
<tr>
<td>Improved sanitation facilities (% of population with access)</td>
<td>85.7</td>
<td>87</td>
<td>87.1</td>
<td>87.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Birth rate, crude (per 1,000 people)</td>
<td>22.2</td>
<td>21.9</td>
<td>21.6</td>
<td>21.2</td>
<td>21</td>
<td>-</td>
</tr>
<tr>
<td>Indicators</td>
<td>2008</td>
<td>2009</td>
<td>2010</td>
<td>2011</td>
<td>2012</td>
<td>2013</td>
</tr>
<tr>
<td>Death rate, crude (per 1,000 people)</td>
<td>6.5</td>
<td>6.6</td>
<td>6.6</td>
<td>6.7</td>
<td>7</td>
<td>-</td>
</tr>
<tr>
<td>Life expectancy at birth, total (years)</td>
<td>69.02</td>
<td>69.20</td>
<td>69.38</td>
<td>69.56</td>
<td>70</td>
<td>-</td>
</tr>
<tr>
<td>Inflation, consumer prices (annual %)</td>
<td>7.73</td>
<td>3.69</td>
<td>5.54</td>
<td>8.67</td>
<td>3.4</td>
<td>2.9</td>
</tr>
<tr>
<td>Unemployment (% of Labor force)</td>
<td>9.0</td>
<td>8.7</td>
<td>8.6</td>
<td>8.4</td>
<td>8.4</td>
<td>-</td>
</tr>
</tbody>
</table>

**Source:** Worldbank, (2014)
The table 1.3.1 shows a summary of the economic and social indicators of Fiji for the past six (6) years for a better insight on how the country is performing economically and how stable it is socially.

Fiji is naturally endowed with forest, mineral, and fish resources. It is one of the most developed of the Pacific island economies, though still with a large subsistence sector. Traditionally, Pacific Island Countries like Fiji were highly dependent on subsistence economies; this included some specialization in production and had a self-dominated structure of barter system with no problems of unemployment. People consumed all that they produced and whatever surplus they had they exchanged it for goods which they intended to consume, the only problem of the barter system era was that there needed to exist a double coincidence of wants in order for the goods to be exchanged.

The table 1.3.2 shows a summary of Fiji’s agriculture sector for the past 5 years. It is noted that the crop production index and the food production index has been declining over the 4 years further confirming Fiji’s declining agricultural output.

**Table 1.3.2: Fiji’s Agricultural Statistics**

<table>
<thead>
<tr>
<th>Agricultural Statistics for Fiji</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land area (sq. km)</td>
<td>18270</td>
<td>18270</td>
<td>18270</td>
<td>18270</td>
<td>-</td>
</tr>
<tr>
<td>Forest area (sq. km)</td>
<td>10073.5</td>
<td>10107.2</td>
<td>10140.8</td>
<td>10174</td>
<td>-</td>
</tr>
<tr>
<td>Forest area (% of land area)</td>
<td>55.14</td>
<td>55.32</td>
<td>55.51</td>
<td>55.69</td>
<td>-</td>
</tr>
<tr>
<td>Agricultural land (sq. km)</td>
<td>4280</td>
<td>4276</td>
<td>4276</td>
<td>4276</td>
<td>-</td>
</tr>
<tr>
<td>Agricultural land (% of land area)</td>
<td>23.43</td>
<td>23.40</td>
<td>23.40</td>
<td>23.40</td>
<td>-</td>
</tr>
<tr>
<td>Arable land (hectares)</td>
<td>169000</td>
<td>167600</td>
<td>167600</td>
<td>167600</td>
<td>-</td>
</tr>
<tr>
<td>Arable land (hectares per person)</td>
<td>0.20</td>
<td>0.20</td>
<td>0.19</td>
<td>0.19</td>
<td>-</td>
</tr>
<tr>
<td>Arable land (% of land area)</td>
<td>9.25</td>
<td>9.17</td>
<td>9.17</td>
<td>9.17</td>
<td>-</td>
</tr>
<tr>
<td>Land under cereal production (hectares)</td>
<td>5397</td>
<td>4331</td>
<td>3315</td>
<td>3304</td>
<td>3491</td>
</tr>
<tr>
<td>Fertilizer consumption (kilograms per hectare of arable land)</td>
<td>41.12</td>
<td>21.81</td>
<td>16.10</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Cereal production (metric tons)</td>
<td>12231</td>
<td>12194</td>
<td>8625</td>
<td>10161</td>
<td>11033</td>
</tr>
<tr>
<td>Crop production index (2004-2006 = 100)</td>
<td>88.29</td>
<td>82.67</td>
<td>72.55</td>
<td>71.14</td>
<td>-</td>
</tr>
<tr>
<td>Food production index (2004-2006 = 100)</td>
<td>93.95</td>
<td>87.55</td>
<td>83.07</td>
<td>82.55</td>
<td>-</td>
</tr>
<tr>
<td>Livestock production index (2004-2006 = 100)</td>
<td>107.11</td>
<td>98.95</td>
<td>107.76</td>
<td>109.2</td>
<td>-</td>
</tr>
<tr>
<td>Surface area (sq. km)</td>
<td>18270</td>
<td>18270</td>
<td>18270</td>
<td>18270</td>
<td>-</td>
</tr>
<tr>
<td>----------------------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>----</td>
</tr>
<tr>
<td>Cereal yield (kg per hectare)</td>
<td>2266.3</td>
<td>2815.5</td>
<td>2601.8</td>
<td>3075.4</td>
<td>3160.4</td>
</tr>
<tr>
<td>Food imports (% of merchandise imports)</td>
<td>16.22</td>
<td>20.59</td>
<td>18.43</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Source:** Worldbank, (2014)

With Colonization, Indians were brought into Fiji to work on sugar cane farms and this is where Fiji’s agricultural sector started to thrive from and reach to where it is today. With sugar production, other crops were also farmed like palm, copra and coconut in order to produce pam and coconut oils etc. This is when the money economy came into effect with exports taking place. With globalization, people started eating more imported food and with Fiji’s thriving tourism sector there has been an increased demand for imported food. With such an increase in demand for imported food as opposed to consumption of more domestically consumed agricultural goods, formulates the basis for discussions of food security and the future of Fiji’s agricultural sector.

### 1.5 Chapterization

This thesis is organized as follows; Chapter 2 discusses about the background literature on this topic. Chapter 3 sheds light on the methodology and model used in this study, Chapter 4 discusses the demand estimation and production gap results, and Chapter 5 is the conclusion chapter with policy recommendations. Lastly, the bibliography is stated with the list of all references referred to in order to complete this study.
Chapter 2  Literature Review

2.0  Introduction

The purpose of this review is to define, describe and discuss the objectives of this paper in terms of what other authors have concluded whilst studying and researching on similar topics. This study is in fact undertaken as an attempt to fill up the gap in the current literature on issues prominent to food security and demand estimation in the Fijian context. This chapter is divided into four folds; firstly literature on food security will be examined followed by literature on the demand estimation, the third segment will include literature on the demand forecasting and the final section will see some literature on the importance of the QUAIDS methodology as is being used in this study. The literature on each of the above mentioned segments will be reviewed from the global context first, followed by the regional perspective and then the local relevance that is; Fiji’s case would be examined.

2.1  Food Security Issues and the causes of Food Insecurity

In the global context, there have been a huge number of studies undertaken in the area of food security, particularly due to the importance of the subject matter and seriousness of the issue. The world population at almost 7 million in 2011 is expected to be greater than 9 million in 2050 (Parker, 2011) and this requires the current food production to be increased by 70% (Dobermann & Nelson, 2013). As such with no major changes to food production technologies to improve yields and major price booms in the agricultural sector in the 2007-2008 period due to the global financial crisis and in 2011 due to the drought in China it becomes important to note that feeding the world population will become a problem in future if not addressed immediately.

Figure 2.1.1 Commodity Price Index for food

![Commodity Price Index for food](image-url)
With reference to figure 2.1.1, both the price spikes have occurred within an interval of close to four years and the gap may narrow further looking at the global climatic conditions and its impacts on the agricultural sector.

Braha (2012) researched on food security in Slovakia and Kosovo. He concluded that factors driving food insecurity in these two countries included rising and evolving food and energy demands, climate change, financial speculation, higher oil prices, governmental policies, poverty and inequality and other development challenges like malfunctioning markets and poor agricultural policies. Similar to Braha, Rose & Hibbert (2013) argue that drivers of food insecurity in Wales and UK include; climate change, competition for resources, changes in per capita demand, and population growth. The above authors indirectly state that pressure on resources and food due to climate change and population growth has posed greater burden on food insecurity.

However, contrary to the above studies, Salih (1994) and Olson, Rauschenbach, Edward A. Frongillo, & Kendall (1996) argue that food security is not threatened by low food production levels and population growth but by low and unstable levels of income. Salih studied food security in the East and Southern Africa whilst Olson et al. (1996) undertook the similar study for a rural upstate in New York. In addition to the low levels of income, Salih also noted that another factor affecting the issue was unemployment. In addition, Olson et al. (1996) further concluded that low education levels, lack of savings, unexpected expenses, having to add more money to the food vouchers in order to feed the family and low levels of food expenditures by households were some other igniting factors.

The table 2.1.1 summarizes the works of other authors in the Global context of food security and what the authors’ investigations reveal to be some to the factors contributing to food insecurity.
### Table 2.1.1: Literature on Factors affecting Food Security

<table>
<thead>
<tr>
<th>Country of Study</th>
<th>Factors affecting food security</th>
<th>Researcher/Author</th>
</tr>
</thead>
</table>
| India                  | ◆ Decline in food grain output growth rates.  
◆ Increasing levels of unemployment.  
◆ Impact of deflationary macro-economic policies on agriculture and rural economy.  
◆ Factors leading to a decline in the purchasing power of the people in India.                                                                                           | (Athreya, Bhavani, Anuradha, Gopinath, & Velan, 2008)                              |
| Bangladesh             | ◆ High population growth rates  
◆ Industrialization                                                                                                                                                                                                                       | (Begum & D'Haese, 2010)                                                           |
| Global                 | ◆ Increase in price of staple foods.  
◆ Declining agricultural production.                                                                                                                                                                                                     | (Headey, 2013)                                                                   |
| Urban African countries| ◆ The urban food economy (urban people purchase more food from outside as opposed to rural people)  
◆ The urban food livelihoods (urban dwellers need cash income and employment and jobs tend to be irregular and insecure)  
◆ Women’s changing roles (women have started working outside the homes however, they are still unequally treated and paid less than men therefore irregular and insecure jobs) | (Ruel & Garrett, 2004)                                                           |
| Africa                 | ◆ Poverty  
◆ Structural problems in the agricultural sector.  
◆ Growing urban population.  
◆ High food prices.                                                                                                                                                                                                                   | (Gaus, 2012)                                                                     |
<p>| Urban Africa           | ◆ The biggest reason for food insecurity is the low food production levels. This study reveals that the cause for food insecurity is;                                                                                                      | (Crush &amp; Frayne)                                                                 |</p>
<table>
<thead>
<tr>
<th>Region</th>
<th>Factors</th>
</tr>
</thead>
</table>
| Africa and Asia | - The Inability to access sufficient food.  
- Unequal distribution of food.  
| Increase in prices of domestically demanded foods due to the increase in world food prices. | (Allison, 2011) |
| EU | - Upward pressure on prices.  
- Climate change | (Dijk, 2012) |
| US | - Sudden spikes in prices of food items. | (Webwire, 2012) |
| US | - Increasing population levels  
- Urbanization | (Agriculture, 2012) |
| Global study | - Rapid human population increase  
- Maintaining efficient agricultural lands while ensuring biodiversity. | (Tscharntke, et al., 2012) |
| UK | - High energy prices  
- Poor harvests  
- Rising demand from a growing population  
- Use of biofuels and export bans  
- Climate change | (Defra, 2008) |
| UK | - Poverty  
- Irregular subsistence agriculture  
- Climate change (Disruption to food chains in the world)  
- International energy concerns)  
- International terrorism. | (Defra, 2006) |
| China | - High food prices | (Fortune, 2013) |
| Australia | - Low income levels  
- Disadvantaged people or people with special needs | (NSW Centre for Public Health Nutrition, 2003) |
| Australia | - Increasing population  
- Increasing food prices. | (Prasad & Langridge, 2012) |
<p>| Geneva | - Natural disasters | (Societies, 2006) |
| Global | - Higher energy costs. | (Mittal A., 2009) |</p>
<table>
<thead>
<tr>
<th>Scenario</th>
<th>Event(s)</th>
<th>Reference(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decline in agricultural production. Increased food demand.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Global Scenario</td>
<td>Climate change Water scarcity Energy crisis Credit crisis</td>
<td>(Hanjra &amp; Qureshi, 2010)</td>
</tr>
<tr>
<td>Rapid population growth Increasing demand for food, energy, water and land for housing. Climate change.</td>
<td>(Clark, Patti Kristjanson, Holbrook, Nelson, &amp; Dickson, 2010)</td>
<td></td>
</tr>
<tr>
<td>Drought Land degradation Global changes (water scarcity, loss of farm land to non-food producing uses and diminishing oil resources)</td>
<td>(Caldwell, Collett, Ludlow, Sinclair, &amp; Whitehead, 2011)</td>
<td></td>
</tr>
<tr>
<td>Increasing in overall food prices</td>
<td></td>
<td>(Mehra &amp; Rojas, 2008)</td>
</tr>
<tr>
<td>Food price formulation Environmental stress Financial market dynamics Energy production dynamics</td>
<td></td>
<td>(Caputi, 2013)</td>
</tr>
<tr>
<td>Agriculture Climate change (pollution, environmental damage)</td>
<td></td>
<td>(Nærstad, 2012)</td>
</tr>
<tr>
<td>Population increases Rising food demands</td>
<td></td>
<td>(Cirera &amp; Masset, 2010)</td>
</tr>
<tr>
<td>Population growth Consumption growth Competition for land, water and other resources</td>
<td></td>
<td>(Godfray, et al., 2010)</td>
</tr>
<tr>
<td>Climate variability and change</td>
<td></td>
<td>(Dobermann &amp;</td>
</tr>
</tbody>
</table>
Rising energy prices
Conflicts over land and water
Soil degradation
Out-migration of labor from rural areas.

On the Pacific and regional level, it is important to note UNICEF and Secretariat of the Pacific Community’s (SPC) role in addressing food security for Pacific island countries. UNICEF in its study on Pacific food security and corresponding nutrition and health concerns stated that Food security in the Pacific island territories is due to the ever increasing food prices, macroeconomic shocks and the effects of climate change caused by global warming (UNICEF, 2010). Similarly, SPC clearly argued that global increase in food prices, fuel price upheavals, economic conditions and climate change affects the availability and access to safe, sufficient and nutritious food (SPC, 2013). Another study on food security in South West Pacific Island reveals that the root cause of food insecurity is poverty, while poverty is a determinant of food security as well, therefore this is interlinked. Other contributing factors include; food productions risks from markets, uncertainties associate with food trade and availability, variability in food prices, variability in income and employment, health and environmental risks, political and policy failures like wars and socio-demographic risks all affect the food production chains leading to food insecurity (Simatupang & Fleming, 2000). Food security threats in the Pacific include rapid urban population growth in Melanesia, declining land productivity and land degradation in major parts of Pacific Island countries, climate change and natural disasters, breakdown in traditional coping mechanisms, the dependency on Polynesian countries on remittances for food security and limited opportunities for Polynesian countries and micro-states to expand their export earnings (McGregor, Bourke, Manley, Tubuna, & Deo, 2009).

In the local context, that is for the case of Fiji specifically there has been very limited number of researches carried out in the area of food security. Sharma (2006) recognized Fijis’ declining food security a problem due to the increase in the country’s population overtime and urbanization with corresponding levels of declining agricultural production
which has contributed to greater dependency on food imports. With booms in world food prices and corresponding high import bills, declining agricultural productions and low GDP growth rates, one only has to think carefully on how and for how long Fiji will be able to keep itself secured in terms of food.

2.2 Demand Estimation

As reviewed above there are many factors contributing to food insecurity in countries abroad, in the Pacific and locally. However, it is important to note that the best method to gauge the food insecurity issues is by firstly knowing the demand scenario for foods in the country which is by estimating demand elasticity as would be carried out in this work for Fiji. Therefore, the literature on demand estimations around the world and for the local context would be reviewed in this section.

The table 2.2.1 summarizes the results from studies on demand estimation conducted globally.

Table 2.2.1: Literature on Global Demand Estimation Results

<table>
<thead>
<tr>
<th>Country</th>
<th>Elasticity Results</th>
<th>Author/ Researcher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>Income elasticities are positive and low for all staple foods.</td>
<td>(Lema, Brascia, Berges, &amp; Casselas, 2007)</td>
</tr>
<tr>
<td>Bolivia</td>
<td>For Paraguay the own price elasticities for beef and chicken are inelastic and positive.</td>
<td></td>
</tr>
<tr>
<td>Paraguay</td>
<td>The income elasticities for all goods (maize, dairy products, beef, chicken, wheat, rice, sugar, apple, oil) are between 0 – 1 therefore these goods are normal goods.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Income elasticity is elastic in Argentina, particularly for beef, dairy products, chicken and oil.</td>
<td></td>
</tr>
<tr>
<td>Country</td>
<td>Findings</td>
<td>Source</td>
</tr>
<tr>
<td>--------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------</td>
</tr>
</tbody>
</table>
| Pakistan     | - Wheat has lowest income elasticity therefore demand is quite inelastic.  
              - Rice income elasticities are high and Rice own price elasticities are much higher.  
              - Fruits have much higher elasticities than vegetables.  
              - Meat and dairy products have the highest elasticities.                                                                                      | (Bouis, 1992)                               |
| UK           | - The own price elasticity is negative for all goods as expected.  
              - The income elasticities indicate that all foods are normal goods expect for prepared fish.                                             | (Lechene, n.d)                             |
| Australia    | - The highest expenditure elasticity is for meat and the lowest for margarine.  
              - The own price elasticities for all goods are negative as expected.  
              - Rice and bread appear to be substitute goods.  
              - Beef & Veal, Mutton & Lamb, Pork, Poultry, Other Meat are substitute goods.  
              - Interestingly, Fruits and vegetables appear to be complementary goods.  
              - Milk and bread have lowest expenditure elasticities whilst meat has highest expenditure elasticity. | (Ulubasoglu, Mallick, Wadud, Hone, & Haszler, 2010) |
| Indonesia    | - Maximum budget is allocated to rice and minimum on fish.                                                                                                                                             | (Surnayati, 2012)                          |
| India        | - In terms of the budget spending out of the 6 foods studied cereals have the highest budget share and pulses the lowest.  
              - The own price elasticity is negative for foods; cereals, pulses, salt, sugar, edible oil and spices.                                      | (Thanga, 2013)                             |
<p>| Bangladesh   | - Food security for the situation of Bangladesh had been evaluated with cereal demands in the country, rice to be more precise.                                                                         | (Begum &amp; D'Haese, 2010)                     |</p>
<table>
<thead>
<tr>
<th>Country</th>
<th>Observations</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pakistan</td>
<td>The countries own price elasticity for rice is -0.108 whilst the income elasticity is 0.199. This shows that the demand for rice is highly income elastic thus, consumers are highly likely to be affected by prices changes of rice.</td>
<td>(Haq, Gheblawi, Shah, Ali, &amp; Khan, 2009)</td>
</tr>
<tr>
<td>Pakistan</td>
<td>The own price elasticities for all goods are negative.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Demand for rice and meat are price elastic.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Demand for cooking oil is inelastic</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Expenditure elasticities suggest that all goods are normal goods.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rice, fruits, meat and other food products are luxury foods.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wheat, milk, vegetables and cooking oil are necessity goods.</td>
<td></td>
</tr>
<tr>
<td>U.S.A</td>
<td>The own price elasticities for all foods are negative as expected.</td>
<td>(Okrent &amp; Alston, 2011)</td>
</tr>
<tr>
<td></td>
<td>There is also some evidence of cross-price elasticities among foods.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The demand and expenditure elasticities for processed fruits and vegetables were more inelastic than elasticities for fresh fruits and vegetables.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The own price elasticity were negative for all fruits and vegetables apart from apples and processed fruits and vegetables.</td>
<td></td>
</tr>
<tr>
<td>UK</td>
<td>The foods studied include dairy and egg, fish, meat, fats and starches, fruits, vegetables and alcohol.</td>
<td>(Tiffin, Balcombe, Salois, &amp; Kehlbacher, 2011)</td>
</tr>
<tr>
<td></td>
<td>When food expenditure raises the demand for meat and alcohol rises most.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Households increase their consumption of fish and meat at the expense of their fruit consumption.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Household consumption of fruits and vegetables</td>
<td></td>
</tr>
</tbody>
</table>
Expenditure elasticities for meat in low income households are lower than in all population. Thus, low income households are less affected by changes in meat prices.

**Brazil**

- Expenditure elasticities for goods studied are positive.
- Indicating food products and tobacco are necessities whilst Housing, clothing, education, health and personal care are luxury.
- Fruits, sausage and hams have the highest expenditure elasticity whilst the smallest elasticities are for rice, beans and wheat.
- All own price elasticities are negative.

*(Menezes, Silveira, & Azzoni)*

**Africa Urban Mozambique**

- All foods studied have negative own price elasticities except for maize which is a giffen good. This could be due to large differences in the price of maize in the country.
- Vegetables meat and other staples are price inelastic.
- Fish, oil and fats, sugar and fruits are more price sensitive and price elastic.
- Vegetables, maize flour, oil and fats, fruits are necessary goods whilst fish, bread, rice, meat and sugar are luxury goods.

*(Barslund, 2011)*

**Slovenia**

- Sugar, lamb and apples have elastic demand whilst beans and pasta have inelastic demand. Watermelon and melons have close to unit price elasticities.
- The own price elasticities are negative and inelastic.
- Price elasticities of demand for bread and oil are found to be most inelastic.
- The most price elastic commodities are meat and

*(Genchev & Yarkova, 2010)*

*(Erjavec, Mergos, Mizzi, & Turk, 1998)*
fruits followed by milk and vegetables

- The most expenditure elastic is the demand for fruits and milk and least elastic are meats implying that more income to lead to greater spending on milk and fruits. Milk and fruits are luxury goods.
- Low and middle income households experienced decrease in meat demand followed by increase in demand for cereals and milk products.

<table>
<thead>
<tr>
<th>Vietnam</th>
<th>Expenditure elasticities are all positive implying the foods studied are normal goods.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Meat is the most expenditure elastic food group and rice least elastic.</td>
</tr>
<tr>
<td></td>
<td>Rice and vegetables are necessities whilst port, poultry, beef and fruits are luxury goods.</td>
</tr>
<tr>
<td></td>
<td>The expenditure elasticity of rice is lower than all other foods implying that with economic growth the demand for rice will gradually decrease.</td>
</tr>
<tr>
<td></td>
<td>Own price elasticities are negative. Poultry has a large negative own price elasticity implying that an increase in price across the board will cause households to cut their consumption of poultry most.</td>
</tr>
<tr>
<td></td>
<td>In terms of cross price elasticity, as rice is the most important food in the diet, expenditure on and consumption of all other foods is affected the price of rice. Except for vegetables all foods are considered complements to rice.</td>
</tr>
<tr>
<td></td>
<td>The poorest 20% of the population have high expenditure elasticities for fish, poultry, vegetables and fruit.</td>
</tr>
<tr>
<td></td>
<td>In terms of own price elasticities the rural demand is more price elastic for rice, poultry, meat, fruits and (Hoang, 2009)</td>
</tr>
</tbody>
</table>
When the price of rice, other staples and pork increases the poorest households cut consumption by most amounts and as these foods constitute the biggest part of the Vietnamese diet the food security of the poorest is highly affected.

**Canada**
- Urban households allocate more of their food budget to fish and fruits and less no others meats than rural h/holds.
- Fish, dairy and fruits have an income elastic demand whilst pork, other meat, egg, cereal, fats and oil have a inelastic income demand.
- Own and cross price elasticities are negative and less than 1.
- The own price elasticity of fruit is more elastic than vegetables.
- Fish in treated as a complementary food to other meats.
- Expenditure elasticities are positive and less than 1 for all foods except for fruits and vegetables which are luxury goods.

(Pomboza & Mbaga, 2007)

**USA**
- As expenditure on food decreases the expenditure on beef, meat, egg, cereals and bread also decreases. Whilst shares on poultry, fruits, vegetables and juice increases.
- The demand for dairy, fruits and vegetables are more price elastic than other goods.
- The own price elasticities are negative.

(Huang & Lin, 2000)

**Ethiopia**
- Cereal was found to be an inferior good.
- Pulses have higher expenditure elasticities in rural areas whilst oil, seeds, sugar and salt have

(Tafere, Taffesse, Tamru, Tefera, &
<table>
<thead>
<tr>
<th>Country</th>
<th>Findings</th>
<th>References</th>
</tr>
</thead>
</table>
| India     | Expenditure elasticities in urban areas.  
- Own price elasticities were negative as expected and cross price elasticities were varied among goods.  
- Price elasticity for demand of cereals in rural and urban is the same. | Paulos, 2010                                                               |
|           | Meat products were more sensitive to own price changes compared to vegetables. Due to the nature of the Indian economy where majority of the consumers are vegetarians and because India is a low income country where meat is a luxury good. Thus, as income increases more meat is substituted for vegetables. | (Lind & Frandsen, 2000)                                                  |
| Switzerland | Demand for meat and fresh fruits and vegetables is likely to increase with an increase in income as the own price and expenditure elasticity was high for low income groups. | Abdulai, 2002                                                             |
|           | Sensitivity of fresh fruit to price changes is considerably large thus, in order to maintain the accurate 5 servings of fresh fruit consumption per household the government would likely be required to subsidize the production of fresh fruits | (Durham & Eales, 2006)                                                  |
| India     | Urbanization increases the consumption of fruits and vegetables, milk and edible oil while it has a negative impact on the consumption of cereal pulses and sugar.  
- The low expenditure elasticity of food in urban consumers revealed that urban households have higher expenditure budget than rural households.  
- Expenditure elasticity for milk, meat, fish and eggs was greater than one, reaching the conclusion that as the share of expenditure on food increases the | (Mittal S., 2010) and (Kumar, Kumar, Parappurathu, & Raju, 2011) |
The proportion of expenditure on these food groups is much higher than on other food groups.

- On the contrary, Kumar further states that if food price inflation continues to increase the demand for staple food will not be affected adversely but instead the demand for high value products will be affected negatively and people may opt to go back to consuming cereals due to the continuous increase in prices of high value costly foods.

Virginia

- Of the 49 processed foods studied expenditure elasticities for whole milk, condensed milk, cheese, frozen fruits and vegetables and baked beans are less than or equal to zero. These are considered basic foods. Thus, as income increases consumers substitute.

- The most inelastic own price elasticities tend to be of items that are used to prepare meals like syrups and condiments. Processed food products that had many available substitutes like regular cheese for shredded cheese, refrigerated juices for frozen juices and canned soup for dry soup etc.

- In comparison with other studies over 40% of own price elasticities were larger than 1 and 60% of expenditure elasticities were less than or equal to 0 lower than other estimates of other studies.

East Africa

- The income elasticity or total cereal is 0.114. This implies that the demand for cereals is responsive to income changes and is a necessity good.

(Bergtold, Akobundu, & Peterson, 2004)

(Mkumbwa, 2011)

Sola (2013), Coelho, Aguiar, & Eales (2010), Pangaribowo (2010) and Ecker & Qaim (2008) respectively conducted studies on demand estimation for Ondo state Nigeria,
Brazil, Indonesia and Malawi. The authors unanimously concluded that households with greater income purchase more luxury goods and high value items like meat and milk. Interestingly, it was also noted that for the case of Brazil an increase in income led to a decline in the consumption of staple foods whilst for Nigeria the same increase in income had no impact on the consumption of staple foods and it remained at levels similar to before. Sola, (2013) also highlighted that expenditure share for food increases with household size and decreases with age. Ecker and Qaim (2008) further present that food security remains a problem in Malawi and consumption is highly dominated by low calorie and starchy staple food. The consumption of fruits and vegetables and animal meat and fats are often short of required levels thus, contributing to nutrient deficiency levels. Pangaribowo (2010), concluded that the larger the household the more the consumption of cheaper calorie staples foods and the smaller the household size the more the consumption of nutrient foods like milk, meat, eggs and other proteins. The education level of the head of the household also played a significant role in what the household consumes. The households consumed more nutritious protein based meals as opposed to households where the household head has low education levels.

In the Pacific context, a study on demand estimation was conducted in Samoa. The expenditure elasticities in Samoan urban households for all food is higher except for energy foods. Implying that energy foods are necessity foods and will demanded even on higher prices and irrespective of the consumer income levels. Protein foods have high elasticities thus, are highly responsive to the price. As expected own price elasticities are negative and in rural areas milk and dairy products are expensive thus, people end up finding substitutes (Jegasothy & Duval, 2003).

For the case of Fiji specifically, there have been three such studies of demand estimation; by Muhammad, James L. Seale, Meade, & Regmi (2011), James Seale, Regmi, & Bernstein (2003) and the other by Hone, Haszler, Natasiwai, Ratuvuki, & Waikere (2007). The major variances in these studies lie in the differences of the model and methodologies used for estimation. There have been very few studies that have used the Quadratic Almost Ideal Demand System (QUAIDS) model of estimation to generate
Mohammed et al (2011) and Seale et al (2007) studied consumption goods in a group of developing countries inclusive of Fiji. The Florida - Slutsky two-stage demand model was used to estimate demand elasticity’s in these two studies. The results suggested that low income countries were highly responsive to changes in prices of food and income thus, making outsized changes to their consumption patterns once changes occurred in their income or food prices. Foods own price elasticity’s tend to vary inversely with household incomes, implying that low income consumers spend a higher portion of their income on basic foods or staple foods than richer consumers. It was also noted that as countries prospered they spent more on luxury goods like recreation and consumption for high valued items like milk, meat and cheese. The findings further highlighted that when real changes occurred in prices and income (a change in prices accompanied by equivalent changes in income), the low and middle income countries made most adjustments to their food demands.

Similarly, demand elasticities were estimated for Fiji’s case using a stated non parametric preference approach (Bundell’s model of estimation). Demand elasticity’s were estimated for Bele, cassava, dalo, red meat and canned meat and fish. Similar to Mohammed et al (2011) and Seale et al (2007) the results from the analysis of urban consumers are very encouraging as the elasticity’s of all food items are 1 or more representing the disaggregated nature of food groups and implying the high responsiveness of consumers to a slight change in price or income. However, the findings could not be validated due to the lack of comparable data (Hone, Haszler, Natasiwai, Ratuvuki, & Waikere, 2007).

### 2.3 Demand Forecasting and Future Food production Gaps

Mittal., S (2008) and Nazli, Haider, & Tariq (2012) carried out demand and supply projection for cereals in India and Pakistan respectively in order to forecast the gap in cereal demand in future years. Whilst Mittal looked at items like rice, wheat, total cereal and pulses, Nazli, Haider and Tariq studied rice and wheat only. The findings of both the
authors slightly vary however both suggest similar policy option of improving technology for productivity enhancement if the country has to meet demand for these commodities in future. Mittal states that from 1983 to the 2004-05 period consumption of edible oil almost doubled and on the contrary consumption of cereals declined, she attributes this to the Engels law. This change was demonstrating an improvement in welfare of the people. Mittal concluded for India that demand for oil, edible seeds and cereals will have to be met through imports as domestic production will not be sufficient.

Mittal (2008) and Kumar et al. (2012) both forecast production gaps for wheat and rice in 2026 and 2025 respectively. While Mittal concludes that a production gap of 9.13 million tonnes in rice and 32.04 million tonnes in wheat would be expected in 2026, conversely Kumar, et al. reveals that there would be a surplus of rice production in 2025 and some but very little deficit in wheast production may be experienced in future. Whilst Mittal is concerned about overcoming food security in 2026, Kumar et al. (2012) is more concerned about how to manage India’s food production surplus come 2025. Parvathi & Arulselvam (2013) have also validated in their recent study that the demand for cereals in India is expected to steadily increase through 2025 to 2050. India has made tremendous progress in increasing it agricultural yields however, the high population growth in the country has nullified the increase in produce.

Similarly, Nazli, Haider, & Tariq (2012) revealed that the demand for rice and wheat will be more than doubled by 2030. The projections of supply also show an increase in the production of rice and wheat. The demand for wheat alone increases from 19 – 30 million tonnes from 2008 to 2030 respectively. The projected supply shows that by 2030 wheat production will be 28 million tones thus a shortage in meeting demand. However, the production of rice is expected to be greater than demand. Likewise, another study reveals that on an average consumption of 150kg/capita of wheat per annum, the 2013 production gap for wheat in Pakistan was -5.0 million tonnes and the gap would further widen -7.0 million tones come 2025 (Zulfiqar & Hussain, 2014).

For the case of Bangladesh it has been noted that from the 1971-72 to the 2008-09 period Bangladesh was fully sufficient with its grain production in terms of its
population however, in a recent study it was highlighted that up to 2021 the demand for foods would be greater than the domestic supply. The gap in rice production has been identified to be -0.28% whilst wheat is expected to have a gap of -1.76%. The demand for dairy products and meat is also expected to experience a shortage. Bangladesh has been meeting this shortage through, imports, food aids and its safety net program however; the most ideal solution to the problem is increase in yield production (Begum & D’Haese, 2010). Another study on Bangladesh reveals that after 2020 the country will experience continuous decline in the surplus or rice and wheat production that it had been accumulating in the before the 2020 period. This is due to the increase in population and land constraints that will affect grain production levels (Kumar, Prasad, & Pullabotla, 2012).

Masuda & Goldsmith (2012) estimates for the case of China, the demand for soybean meals is anticipated to increase by 30% in 2030 from the 2010 figure thus, similar to that suggested by Begum & D’Haese (2010) this gap in production needs to be filled in through imports or by increasing the yield for soybeans on the current lands. Contrary to the findings of Begum & D’Haese (2010) above, Zhou, Tian, Wang, Liu, & Cao (2012) reveal in their food study for China that by 2020 China will be largely self-sufficient in wheat and rice demand and supply. However, similar to Masuda & Goldsmith (2012) who also conducted a study on China, Zhou, Tian, Wang, Liu, & Cao (2012) also conclude that the future demand for soybeans may have to be met by imports as demand will be more than supply. The demands for high quality meats like beef, mutton and lamb is expected to increase more than supply thus a gap would be experienced by 2020. China is expected to be self sufficient in egg supply but will not be able to meet its dairy needs.

Hondurous in Latin America has its grain import levels increasing equal to and even more than domestic production levels clearly establishing its insufficiency levels. Similarly, by 2022 Tunisia, Algeria, Egypt and Morocco are anticipated to increase their grain imports to 77%, 74%, 40% and 50% respectively. This demonstrates the level of food insecurity that may be encountered by the North African countries come 2022 (Rosen, Meade, Shapouri, Souza, & Rada, 2012). On a global front for agriculture, today
the world demand for cereals stands at a 2.1 billion tonnes and this is expected to reach a demand of 3.0 billion tonnes by 2050. The population is expected to be 9 billion people in 2050 and an increase of 70% in the current cereal production levels would be expected to meet the 2050 demand of food. More importantly, the demand for foods like meat, dairy products and oils would grow at an even faster pace than cereals thus, a shortage in supply would be expected in 2050 (FAO, 2009). On the contrary Kruse (2010) reviews from his study of world food demand that there needs to be an increase of 86% in crop production to meet the increased food demand in 2050. The global demand for crops is expected to increase by 84% from 2000 – 2050 and to meet this ever increasing demand the world crop production needs to increase by 86%. A strong increase in the demand for poultry, egg and vegetable oil is expected in future as well. The expectation for strong meat, poultry and fruits and vegetables demand in future of the world is something that will have agricultural developments at its core. Primarily driven because the staple foods; maize and corn have to be accommodated to be used as food and as animal feed thus, the growing demand. There has also been an increase in the usage of maize for bio-fuels keeping in mind environmental protection and climate change mitigation (Gençkol & Fidan, nd).

In East Africa the Supply-Demand gap for maize, rice and wheat in 2020 is expected to experience a shortage in cereal supply to be domestically sufficient at a constant area harvested as now however, by increasing the yeilds in production and harvesting an area increasing at a rate of 1.67% East Africa will maintain sufficiency in cereal production (Mkumbwa, 2011).

2.4 The Method of Demand Analysis: The Quadratic Almost Ideal Demand Systems

Looking, internationally at demand estimation research it can be noted that a lot of authors have used the QUAIDS methodology for demand estimation. Some of the researchers that have recently used QUAIDS for their studies include; Sola (2013), (Masuda & Goldsmith, 2012) Kumar et al (2011), Dey, Alam, & Paraguas (2011), Tafere et al (2010), Coelho et al (2010), Pangaribowo, (2010), Mittal (2010), Ecker and
Qaim, (2008), Xi, Mittelhammer, & Heckelei (2004), Abdulai (2002). Observing the years in which the above studies had been undertaken it is noted that the QUAIDS methodology is a fairly new one. The QUAIDS is an extension of the Deaton & Muellbauer (1980), Almost Ideal Demand System (AIDS).

Banks, Blundell, & Lewbel (1997) have worked to extend the almost ideal demand system adding to it the quadratic term to incorporate the observed consumer behavior which is consistent with consumer theory and allows for the examination of welfare analysis. This welfare analysis can be measured through the Engels law and in the model this is captured by the log income and quadratic term. The QUAIDS has an additional higher order of income term and the log income is the leading term in the expenditure share model. This new model will allow the effects on the relative price to be flexible and at the same time allows it being consistent with the AIDS utility theory assumption. One of the key differences between AIDS and QUAIDS is that whilst AIDs assumes a linear Engel curve the QUAIDS assumes a non-linear curve which is preferable as it produces unbiased welfare estimates (Gahvari & Tsang, 2011). QUAIDS allows for expenditure shares to rise and decline with increasing incomes properly accounting for welfare effects (Kumar, Mehta, Pullabholta, Prasad, Ganguly, & Gulati, 2012). The quadratic term in the model allows for it to be flexible and unbiased through permitting the goods to be luxuries and necessities at different expenditure levels (Kratena & Wüger, 2010).

Flores & Kumar (2004) and Blow, Lechene, & Levell (2011) sate that QUAIDS was introduced for the purpose of allowing flexibility in the Engel curves through properly approximating the non-linear Engel curves in empirical analysis however, on the contrary the authors state that their findings of rural areas revel that the QUAIDS model does not fit well as households consumption behaviour is not well captured and the marginal income effect is posititve for food and cloting and negative for all other goods. The QUAIDS allows more curvature in the Engel path. The other important advantage of the QUAIDs is that the model provides the best fit and according to some discussion results it has been highlighted that aligned to the Theil’s average information inaccuracy the QUAIDS has the least information inaccuracy for the entire sample period.
However, AIDS results are also very close to fitting the data. The proper goodness of fit of the QUAIDS model reflects the dominance of this model over AIDS and Rotterdam (Decoster & Vermulen, nd). On the contrary, Gahvari & Tsang (2011) state that instead of having different results both the estimation models highlight the importance of specifying a demand model that does not enforce separability. Together with the many advantages listed above QUAIDS is simpler and easier to estimate and properly accounts for dynamic effects of falling marginal budget shares (Cicera, 2010).

The extension to the AIDS came after much interpretation and thought by Banks, Blundell and Lewbel (1997) and it has been gaining popularity since then. Many studies and authors have validated the results and estimations produced by QUAIDS model. Mittal S., (2010) generates results from the QUAIDS model which are very close to actual numbers; this comment justifies the precision of the model to an extent. Together with that this model assists in obtaining very accurate coefficients for elasticity determination and thus demand projections made on the most realistic assumptions support in making agricultural policies in an effective way. Masuda & Goldsmith (2012) further back-up the positive spillovers of the QUAIDS by stating that together with carrying forward the desirable properties of AIDS like exact non-linear aggregation and second order flexibility, the QUAIDS is more flexible in allowing for scenarios in which a change in expenditure changes the nature of the goods from being a luxury to a necessity good. The high Engel flexibility allows the goods to be luxury at low income levels and and norman at high income levels (Cicera, 2010). The interactions of price and expenditures in demand relationships is flexible and there is flexibility in the model for incorporating non-linear effects (Alviola, Capps, & Wu, 2010.).

The performance of the Almost Ideal Demand system and Linear Expenditure System was compared with the Quadratic Almost Ideal Demand System, Quadratic Expenditure System and AIDAD (Addictive Demand system) in predicting food demands based on estimations. It was noted that all these systems out-performed the AIDs and LES models using both in sample and out sample criteria in food demand prediction. QUAIDS are more suited to scenarios where price variations are paramount. (Cranfiled, Eales, Hertel, & Preckel, 2003). Similarly, Jithitikulchai (2010) reveals from his study that in
comparison to the OLS, 2SLS, FE and RE linear estimation models, the QUAIDS model provides more meaningful income elasticities for interpretation for both pooled and clustered dataset thus, more desirable in growing research areas. Liu, 2003 found that QUAIDS is more superior to the AIDS particularly because it has properties of both the flexible form (Fisher, Fleissig, & Serletis, 2001) and a non-linear Engel function which is more appropriate to household data (Banks, Blundell, & Lewbel, 1997).

This study using the QUAIDS methodology fills the gap in current literature as this method has not been applied to the South Pacific and Fijian context for the analysis of consumer demand and as proven by many researchers that have used this method the results are very close to depicting the real scenario thus, results will provide a good platform for policy makers to provide good advice.

2.5 Conclusion and Gap of Research

A thorough evaluation of literature, has been undertaken on Demand estimation, Food security and the QUAIDS methodology in the above section. The lack of literature on demand estimation for Pacific Island countries and specifically for Fiji clearly reveals that not many studies have been undertaken in this area in Fiji. There has been no study undertaken using the QUAIDS methodology thus, this work is the first to apply QUAIDS methodology to Fiji’s food demand context. The literature reveals the limitation on the application of this methodology on the issue of food security. This work is also provided to determine the extent of food security problem in Fiji.
Chapter 3  Methodology

3.1  The Data

The investigation and analysis in this paper is primarily based on the data collected by the Fiji Islands Bureau of Statistics (FIBOS) through its Household Income and Expenditure Survey (HIES) during 2008-09. The HIES data covers four divisions of the country namely Central, Eastern, Western and the Northern divisions. The rural and urban areas of these four (4) divisions are also covered by this HIES. The HIES data is collected based on the expenditure approach, implying that the data was collected in terms of the expenditure that each households has for each food and non-food item.

The HIES collects data on total households income, total household expenditure and expenditure on the goods and services that a household uses and consumes based on household size, ethnicity (Fijian, Indian and others), Division and area as mentioned above. The only limitation of the HIES for the purpose of this paper was that of the quantity and price data, both of which is not included in the HIES Publication. The price data is very important in demand estimation and the variation in prices should also be present to fully capture the correct impacts on households demand for instance, the prices of the same good varies in different division and areas; rural and urban as transport and other cartage costs are added into the price and passed onto consumers. Thus, the price data was separately collated from the Fiji island bureau of statistics for the 2008-09 period and variation in price was also noted. For the case of Fiji, the 2008-09 is the second round of HIES data collection, the first was for the period 2002-03 and the third is currently being carried out for the period 2013-14.

The 2008-09 HIES data is a representation of 3573 households across the country. However; for the purpose of demand estimation in this study only 3561 households are being considered. This is because 12 households had zero expenditure levels on foods which may be due to non-consumption by households of the foods being studied or due to error during HIES collation, thus had to be eliminated. There are many food items that a household consumes in a given period of time however; for the purpose of this study we have restricted this to a concentration of only four (4) broad food categories. These
categories include; total bread and cereals, total meat and seafood, total milk, cheese and eggs, total rice and fruits and vegetables.

The figure 3.1.1 shows further the breakdown of foods in each of the four major food groups being considered in this research.

**Figure 3.1.1: A breakdown of the foods considered in this study under each of the four broad food categories**

The rationale behind choosing these food categories is purely based on the view that Fiji is a multiracial country and people consume different combination of goods. It was traditionally comprehended that the I-Taukei people mostly consume root crops and seafood whilst the Indian population chooses to take rice with other meat and vegetables. Many times the religious limitations of the Indian population restrict it from consuming meat and seafood whereas the I-Taukei does not have any similar guiding principles or restrictions, thus, the differences in consumption patterns. However, over
the years, consumption patterns have changed and merged thus, evolved into an entirely blended combination of food that the people of Fiji eat today. No diet is now seen to be consumed by any particular ethnicity but households consume similar meals and food.

Data on non-food items was also collated from the HIES in order to properly capture the households behavior as all household income is not spent on food but on other goods as well. Hence, data on non-food items was also utilized for items including; clothing & footwear, housing, water, electricity & fuel, furnishing household equipment & maintenance, health, transport, communication, recreation & culture, education, restaurants and miscellaneous goods & services.

The capturing of household data on ethnicity is a significant component of the Fiji HIES. It enables proper analysis to establish which ethnicity is actually reacting more and changing their consumption patterns given a change in their income or prices of the goods that they are consuming. Such findings would enable more appropriate and direct policy recommendations.

**Table 3.1.1: Summary of the raw data used for estimation**

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Households</th>
<th>Divisions</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fijian (I-Taukei)</td>
<td>2029</td>
<td>Central - 864</td>
<td>Rural – 470</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Eastern – 286</td>
<td>Urban – 394</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Northern – 317</td>
<td>Urban – 255</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Western - 562</td>
<td>Urban – 273</td>
</tr>
<tr>
<td>Indians (Fijians)</td>
<td>1318</td>
<td>Central - 479</td>
<td>Rural – 403</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Eastern – 5</td>
<td>Urban – 76</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Northern – 240</td>
<td>Urban – 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Western - 594</td>
<td>Urban – 140</td>
</tr>
<tr>
<td>Others</td>
<td>214</td>
<td>Central - 119</td>
<td>Rural – 109</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Eastern – 34</td>
<td>Urban – 10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Northern – 39</td>
<td>Urban – 14</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Western - 22</td>
<td>Urban – 25</td>
</tr>
<tr>
<td>Total</td>
<td>3561</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Source:** Fiji HIES, (2008-09)

The table 3.1.1 shows a summary of the household data set (Fiji HIES 2008-09) utilized in this study. A total of 3561 households are considered of which 2029 households are
Fijians, 1318 are Indians and 214 households are Others that is Rotuman’s’, Chinese and other pacific islanders.

The figure 3.1.2 shows the number of households that fall in each of the income groups based on Ethnicity. It is observed that all the income groups have the highest number Fijian households; this is due to the fact that there is a greater representation of Fijian households in the dataset that is being considered in this study as they form a greater part of the Fiji population.

**Figure 3.1.2: Distribution of households into Income Quartiles**

Considering each of the separate ethnicities and their division in each income groups it is highlighted that for the Fijians, the largest number of households fall in the second income quartile followed by the forth income quartile, then the third and the lowest number of Fijian households fall in the first income quartile. As for the Indians, the largest number of Indian households falls in the first income quartile and the lowest fall in the fourth income quartile. As for the Others ethnicity most households fall in the fourth income quartile, followed by the third income quartile and lowest fall in the 2nd income quartile. This goes on to prove that majority of the Indians can afford a higher standard of living in relation to the ethnicities being considered whilst the “Others” ethnicity comprises mainly of poor families.
3.2 The Database

A brief discussion has been undertaken above in section 3.1 regarding the data that is being used to carry out the study.

Now further a database was compiled in Microsoft (MS) Excel to be recognized by the STATA software for the model to calculate demand elasticities. The database was constructed based on the four broad food groups and prices for the HIES foods were accessed from the FIBOS. The database also had the expenditure by each household on the ten (10) non-food items and due to the lack of prices of these items the price indices provided by the FIBOS was used. The total group price indices for food and non-food was calculated on the method as it was done in the paper by Dey, Alam, & Paraguas, 2011 based on shares and individual prices of foods in each group.

The collated database was run in the STATA software to estimate the parameters for demand elasticities for each broad food group using the Quadratic Almost Ideal Demand System (QUAIDS). The method and the model are clearly explained below.

The demand estimation under the QUAIDS methodology would establish how different households dispersed in the two different areas; rural and urban, located in different locations of the country and constraint by specific budget limitations with an urge to attain maximum satisfaction react to a change in the price of one good with respect to maintaining its normal basket of goods or reacting to a change in income.

3.3 The Model

3.3.1 Demand Estimation

The methodology used for the estimation of the demand elasticity is the Quadratic Almost Ideal Demand system (QUAIDS) model. It computes the parameters to calculate demand elasticities using the STATA software as is undertaken in this study.

The QUAIDS model which was derived by Banks et al. (1997) from utility maximization is an extension of the Deaton and Muellbauer (1980), Almost Ideal
Demand System (AIDS). The basis for which the extension is reasonable is the fact that the relationship between budget shares and income is not always direct and this is captured by the QUAIDS model. The AIDS model is the most popular approach of doing this type of demand estimations as it is easy to estimate and permits accurate aggregation over households (Poi, 2002). Under the QUAIDS method as opposed to the AIDS method the assumption of linearity in the expenditure function is given away. The QUAIDS differs from AIDS in that the QUAIDS assumes that there is a nonlinear relationship between income and expenditure model and thus, the expenditure is treated as a quadratic term for expenditure in the extended model. It includes a higher order of expenditure term to capture the non-linearity of the Engel term (Pangaribowo, 2010). The QUAIDS model has gained its fair share of admiration as not only does it have the properties of the AIDS model but it has added characteristics like flexibility in modeling consumer expenditure patterns which make it more influential and dominating.

The STATA software system would estimate results on two stages to capture accurately the consumer behavior therefore, correctly predicting the required parameters for demand estimation.

**Figure 3.3.1.1: The two Stage budgeting framework for estimation of food demand**
The first stage regression was carried out capturing the consumer expenditure on both food and non-food groups. The non-food items were considered as household’s expenditure on food highly depends on expenditure of households on non-food items. The non-food items that were considered include,

1. Clothing and Footwear
2. Housing, Water, Electricity and fuel
3. Health
4. Travel
5. Furnishing, Households Equipment and Maintenance
6. Communication
7. Recreation and Culture
8. Education
9. Restaurants
10. Miscellaneous Goods and Services

The second stage was carried out in detail for the four (4) food groups to see the parameters predicted for these items in order to estimate the elasticities. As mentioned earlier, the categories have been designed keeping in mind the food consumption patterns of the Fijian and I-Taukei population which would depict a true picture of the demand of different ethnicities and allow accurate policy advice.

The QUAIDS model of estimation is highly accepted in research due to its comprehensiveness and simplicity. Mittal (2010), had carried out a small validation exercise to justify the importance of the results outputted by QUAIDS. She concluded that the results from the QUAIDS model are much closer to the actual numbers. Masuda & Goldsmith (2012) stated that under AIDs model results the expenditure elasticities are independent of expenditure levels however, under QUAIDs, the quadratic term in the logarithm of total expenditure allows for situations where increase in expenditure would turn a luxury good to a necessity good thus, capturing very significant conditions.

In comparison with other demand estimation models the QUAIDS model is more appropriate for the analysis of food demand behavior as it has diverse advantages over
other models. Firstly, the model is able to capture own and cross price elasticity very efficiently. The model takes care of the correlation in the error term and the real income effect is properly captured in the system. Most specifically the QUAIDS model is able to capture the curvature of Engel’s Law (Pangaribowo and Tsegai, 2011) which states that as income increases the proportion of income spent on food decreases. The QUAIDS model automatically corrects a lot of shortcoming that are present in the other models of estimation therefore, mostly desirable for use in such estimation areas.

The benefit of the QUAIDS model is that the quadratic income specification does not have to be applied for all goods, Gahvari and Tsang (2011).

The model that will be specifically used in this case is as follows;

**Stage 1:**

The model used for the Stage 1 regression was also carried out using the STATA software. The software was used to predict the expenditure values and these predicted values were used for the stage 1 and stage 2 regressions. The reason for using the predicted the value is to get accurate values once demand is estimated.

The model used for stage 1 regression is as follows;

**Food Expenditure Function**

\[ \ln(M) = \alpha + \gamma_1 \ln(P_f) + \gamma_2 \ln(P_{nf}) + \beta \ln(Y) \]  
3.3.1(a)

**Restriction at sample mean of Ln(Y)**

\[ \gamma_1 + \gamma_2 + \beta = 0 \]  
3.3.1(b)

*Where;*

\( m = \text{per capita food expenditure} \)

\( P_f = \text{price index of food} \)

\( y = \text{per capita total expenditure} \)

\( P_{nf} = \text{price index of nonfood} \)
Stage 2:

*Establishing the demand system*

For the demand system to properly function, they are specified with expenditure shares as the dependent variables. Suppose the households expenditure shares are given by:

\[ w_i = \frac{p_i q_i}{m} \]

Where:

\( p_i = \text{price of good } i \)

\( q_i = \text{quantity of good } i \)

\( m = \text{households total expenditure on all goods in the demand system} \)

As there are a number of goods in the typical consumer basket, and there are different coefficients to be estimated, if the number of goods in the system is \( N \), the total expenditure share is further simplified as:

\[ \sum_{i=1}^{N} w_i = 1 \]

Price of \( i \)-th food group items is derived by weighted average of all \( j \)-items within the group.

\[ \ln p_i = \sum_{j=1}^{n} w_{ij} \ln p_{ij} \]

where \( \ln p_{ij} \) is the log price of \( j \)-th item within \( i \)-th food group.

In the QUAIDS model each expenditure share can be estimated as:

\[ w_i = \alpha_i + \sum_{j=1}^{N} \gamma_{ij} \ln p_j + \beta_i \ln \frac{m}{a(p)} + \frac{\lambda_i}{b(p)} \left[ \ln \frac{m}{a(p)} \right]^2 + \varepsilon_i \]

Where:

\( p = \text{the vector of all prices.} \)

\( \varepsilon_i = \text{the error term} \)
\[ b(p) = \prod_{i=1}^{N} p_i^{\beta_i} \]  

3.3.1(e)

- The price index is defined by;

\[ \ln a(p) = \alpha_0 + \sum_{i=1}^{N} \alpha_i \ln p_i + \frac{1}{2} \sum_{i=1}^{N} \sum_{j=1}^{N} \gamma_{ij} \ln p_i \ln p_j \]

By the adding up condition (1), the parameters have to fulfill the following conditions;

\[ \Sigma_{i=1}^{K} \alpha_i = 1, \Sigma_{i=1}^{K} \beta_i = 0, \Sigma_{i=1}^{K} \lambda_{ij}, \text{ and } \Sigma_{i=1}^{K} \gamma_{ij} = 0 \text{ for all } j \]  

3.3.1(f)

While by homogeneity of degree zero in prices and spending, and by slutsky symmetry,

\[ \gamma_{ij} = \gamma_{ji} \text{ and } \sum_{j=1}^{N} \gamma_{ij} = 0 \text{ for all } i \]

\[ \gamma_{ij} = \gamma_{ji} \]

- Given those restrictions, we drop one of the \( N \) equations when estimating the system and recover its parameters using (3) and (4).

**Note:**

Once that once we have estimated the system we can estimate the following elasticities as follows by differentiating equation (3) with respect to \( ln m \) and \( ln p_j \) respectively;

\[ \mu_i = \frac{\partial w_i}{\partial lnm} = \beta + \frac{2\lambda}{b(p)} \left\{ \ln \left[ \frac{m}{a(p)} \right] \right\} \]

\[ \mu_{ij} = \frac{\partial w_i}{\partial ln p_j} = \gamma_{ij} - \mu_i(\alpha_j + \sum_k \gamma_{jk} ln P_k) - \frac{\lambda i \beta j}{b(p)} \left\{ \ln \left[ \frac{m}{a(p)} \right]^2 \right\} \]

Income elasticity can then be found as;

\[ \psi_i = \frac{\mu_i}{w_i} + 1 \]
Whereas price elasticities are given by;

\[ \varepsilon_{ij} = \frac{\mu_{ij}}{w_i} - \delta_{ij} \]

The above methodology would form the basis for analysis and computations using the STATA software to determine the different elasticity’s for the distinguished commodities being studied in this paper.

**3.3.2 Demand Projection/ Demand Forecasting**

There is a set equation for demand forecasting using the demand elasticity estimates determined by the above methodology, this is described below;

3.3.2(a)

\[ D_t = d_0 \times N_t \times \left(1 + y \times e\right)^t \]

Where;

\[ D_t = \text{household demand of a commodity in year } t \]
\[ D_0 = \text{per capita demand of the commodities in the base year} \]
\[ y = \text{growth in per capita income} \]
\[ e = \text{the expenditure elasticity’s of demand for the commodity} \]
\[ N_t = \text{the projected population in year } t. \]

In order for the above formula to be effectively carried out and to establish accurate demands for Fiji the population and growth in income per capita were calculated based on the equation below.

**Population Projection**

Population in Future = base year population \( \times (1 + g)^t \)  

3.3.2(b)
Where:

g = 11 year average population growth rate

t = number of years between the base year and the year projected.

3.3.3 The Gap in future Supply and Demand

\[
Production \ Gap = D_t - S_t
\]

Where;

\[D_t = the \ household \ demand \ of \ a \ commodity \ in \ year \ t\]

\[S_t = the \ supply \ of \ the \ commodity \ in \ year \ t.\]

The continuous decline in the Fiji economy’s Agricultural sector has prompted the interest and need to study household demand. The application of the model of food demand in Fiji is interesting because not very much is known about the food demand in this country. This study enables the interpretation of results to determine the future food demand with the use of demand elasticity’s calculated.

Supply Projection

\[
Projected \ Supply = base \ year \ supply \times (1 + g)^t
\]

Where;

\[g = the \ 15 \ year \ average \ supply \ growth \ rates\]

\[t = number \ of \ years \ between \ the \ base \ year \ and \ the \ year \ projected.\]

With the availability and use of the Supply side data on these same food commodities production gaps such as shortages or surpluses in food production that we would encounter in future would be known and enable us to judge the food security situation of Fiji and allow us to take proactive decisions for what the country may encounter in future.
3.3.4 Multivariate Regression

The multivariate regression was undertaken to further validate the results demonstrated by the income and own price elasticities. Placing it formally, a multivariate model is one in which multiple variables are found on the right hand side of the model equation. This statistical model is used to attempt to assess the relationship between a numbers of variables (Hidalgo & Goodman, 2012).

A multivariate or multivariable model is of the form described below;

\[ y = \alpha + x_1\beta_1 + x_2\beta_2 + \cdots + x_k\beta_k + \epsilon \quad 3.3.4(a) \]

**Where**

\( y \)  = a continuous dependent variable
\( x_1, x_2 \ldots x_k \) = predictors in the multivariate model

Conclusively, the formulas described in section 3.3 above will form the basis of calculation for appropriate results of demand estimation and projection in this study. For the case, of Fiji as a developing island nation, there is still room for improvements in terms of data collection and availability. Issues of food security are becoming increasingly important especially when the impacts of climate change are increasingly affecting the Pacific. As such the HIES data had to be utilized to determine the production gaps in order to come up with policy advice and evidence that Fiji is facing a shortage of food and agricultural output and this gap will widen if the agriculture sector is not addressed immediately. However, further to this, with the release of the HIES 2013/14 demand estimation and projection can be undertaken based on new data to see if there are changes to the resulting production gaps for Fiji. This would allow comparisons in this area of study.
Chapter 4  Demand Estimation and Production Gaps

4.1  Consumption pattern and household budgets for food: Overview

The consumption patterns in Fiji are distinct based on the fact that it is a multi-racial society with diverse cultural and religious backgrounds. The consumption patterns are dependent on two factors, firstly, the amount and type of food consumed due to the income levels and secondly, due to the different consumption preferences and habits aligned to the culture and religion. Traditionally, there was major difference in the diet patterns of the people, mostly among the country’s two largest population groups the Fijians and the Indians. The two ethnicities had their strict separate standard food choices. For instance, to name a few the Fijian families’ main dishes are fish proteins, dalo, cassava and other root crops as carbohydrates. For the Indian households the main carbohydrates are rice and roti with vegetable curries, chicken and occasionally fish and other seafood. However, the closeness of the community over the last century has taught the people to cook, consume and enjoy the foods of different communities in the country leading to a more shared diet but still the noticeable difference is evident. Thus, in view of this unique habit of the Fijian society it is important to note, the expenditure that the households being considered in this study allocate from their total budget to these four (4) groups of food being studied. However, firstly an evaluation is made into how much consumers allocated from their budget to food and non-food items.

Table 4.1.1: Expenditure Shares on Food and Non-Food Items by households

<table>
<thead>
<tr>
<th>% Expenditure on total foods considered</th>
<th>Average % Expenditure on each Item</th>
<th>Average Per Capita Expenditure on Each Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Expenditure on total foods</td>
<td>18.79%</td>
<td>$538.18</td>
</tr>
<tr>
<td>and alcoholic and non-alcoholic drinks not considered</td>
<td>6.29%</td>
<td>$193.01</td>
</tr>
<tr>
<td>% Expenditure on total non-food items</td>
<td>45.76%</td>
<td>$2,104.35</td>
</tr>
<tr>
<td>% Expenditure on total Other Expenses</td>
<td>29.16%</td>
<td>$896.84</td>
</tr>
</tbody>
</table>

Note: Calculation by Author from HIES (2008-09) data
The table 4.1.1 shows the average percentage expenditure by households on food and non-foods items. As expected the highest expenditure is allocated to the non-food (entertainment, travel, health, education and others) category where a household allocates an average of 45% of income on non-food items. Around 25% is spent on food, non-alcoholic and alcoholic beverages. Similar, to the results of Fiji, on average the Malaysian household spends around 20.4% of their income on food (Tey, 2009). Other global findings reveal that on average an American allocates 13.1% of his income to food expenditures (Goldstein & Vo, 2012). However, for Vietnam it is observed that 53% of households’ expenditure is allocated to food (Hoang, 2009) and similarly Ghana households also devote half of their expenditure (50%) to food (Donkoh, Alhassan, & Nkegbe, 2014).

**Figure 4.1.1: Expenditure Shares on food groups by households**

![Expenditure Shares on each food group by Households](image)

Figure 4.1.1, shows on average how much of their income, households spend on each of the four food groups. The expenditure shares have been calculated by dividing the households’ expenditure on each food group by the overall total households’ expenditure. Observed from the graph above the highest expenditure is allocated to Meat, Fish and Seafood whilst the lowest on milk, cheese and eggs. It is evident from the income elasticity results in figure 4.2.1, that in Fiji, Meat, Fish and Seafood is a normal good and Milk, Cheese and Eggs is a luxury food group. Therefore, the
expenditure on food as mentioned above is due to this fact to an extent. Fiji is an agricultural economy and many people are surviving at subsistence levels where fishing and hunting for family enables them to consume more meat and fish. Households find that meat, fish and seafood group is cheaper as its available domestically but milk and cheese are mostly imported and affected by world food prices and translating into high domestic retail prices the high prices are out of the of affordability households, hence low expenditure. The expenditure on fruits and vegetables is also quite high in comparison to the other foods. This is because many of the Indian households are vegetarians therefore; they consume fruits and vegetables as a substitute to meat, fish, seafood and eggs.

**Figure 4.1.2: Expenditure on Food Groups by Households based on Ethnicity**

The figure 4.1.2 shows the percentage of total budget that the different Ethnicities allocate to and spend on the four groups of food being considered in this case. This is a good demonstration of determining which food groups are more important for which groups of people. Looking at the first food group that is “Bread and Cereals” it is clearly evident that all households spend nearly the same amount on this food category particularly because it is cheap source of carbohydrates which keeps individuals fuller for long. It is also important to note that the Indo-Fijians (Indians) spend the highest on this group in comparison with other ethnicities. A very simple explanation for this can
be the fact that Fijians and Others population depend more on root crops as a source of their carbohydrates which does not constitute part of this food group therefore their spending is lower in comparison to the Indians (Country and their Cultures, 2014). For the “Meat, Fish and Seafood” category the Indians spend the lowest of all groups on this category. This is mostly because most of the Indians (Hindus) are bound by religious restrictions on consuming meat and thus, are vegetarians most of the time or avoid taking beef, the Muslims on the other hand cannot consume pork thus, justifying the low expenditure (Country and their Cultures, 2014). However, the Indo-Fijians have the highest spending on “Milk, Cheese and Eggs” and on “Fruits and Vegetables”. As the Indians are vegetarians or consume only a few selected meats, they use Milk, Cheese, Fruits and Vegetables as their substitute foods.

**Figure 4.1.3: Expenditure on Food Groups by Households based on Income Quartiles**

The figure 4.1.3 clearly demonstrates that the richer the households the more their expenditure on foods in each of the food group. For the case of Fiji; Milk, Cheese & Eggs and Fruits & Vegetables are luxury goods as depicted in Figure 4.2.1 below. Therefore, similar to the observation of Muhammad, James L. Seale, Meade, & Regmi,
(2011) it is evident for Fiji as well that as households get richer they allocate more of their budget to luxury foods as opposed to middle income and poor households.

**Figure 4.1.4: Expenditure by Households on Food in the Rural and Urban Areas**

The figure 4.1.4 shows the percentage of the total budget expenditure spent on each food group by the rural and urban households. The urban households spend more on bread and cereals; milk, cheese and eggs and fruits and vegetables in relation to rural households particularly because life in the urban areas is fast, competitive and demanding therefore, households depend on more on ready to eat foods like bread and cereals and milk, cheese and eggs. Also urban consumers are more informed and educated they focus on eating healthy thus, spending more on fruits and vegetables. Another reason for the rural households spending less on the three food groups in relation to the urban households is the fact that poverty in the rural areas is high. Data for Fiji shows that in 2008-09 period poverty in the rural areas was 43% whilst it was 19% for the urban areas (Fiji HIES, 2008-09). Therefore, it can be generalized that more poverty in the rural areas is one of the reasons for rural households spending less on the mentioned food groups. The high expenditure by rural households on meat, fish and seafood is because for Fiji, this falls in the “normal food” category and many rural households depend on subsistence farming for their consumption of fruits and vegetables therefore spend majority of their income on meat, fish and seafood.
### Table 4.1.2: Multivariate Regressions Observations on Expenditure Shares

<table>
<thead>
<tr>
<th>Expenditure Share</th>
<th>Food group 1 (Bread &amp; Cereal)</th>
<th>Food group 2 (Meat, Fish &amp; Seafood)</th>
<th>Food group 3 (Milk, Cheese &amp; Eggs)</th>
<th>Food group 4 (Fruits &amp; Vegetables)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity 2 (Indian)</td>
<td>-.115 (0.00)</td>
<td>-.059 (0.00)</td>
<td>.0253 (0.00)</td>
<td>.148 (0.00)</td>
</tr>
<tr>
<td>Ethnicity 3 (Others)</td>
<td>-.065 (0.00)</td>
<td>.011 (0.387)</td>
<td>.0232 (0.00)</td>
<td>.030 (0.013)</td>
</tr>
<tr>
<td>Division 2 (Eastern)</td>
<td>095 (0.00)</td>
<td>-.050 (0.00)</td>
<td>.000 (0.864)</td>
<td>-.046 (0.00)</td>
</tr>
<tr>
<td>Division 3 (Northern)</td>
<td>.051 (0.00)</td>
<td>-.062 (0.00)</td>
<td>-.002 (0.519)</td>
<td>.012 (0.130)</td>
</tr>
<tr>
<td>Division 4 (Western)</td>
<td>-.016 (0.02)</td>
<td>-.0299 (0.00)</td>
<td>.026 (0.000)</td>
<td>.019 (0.06)</td>
</tr>
<tr>
<td>Area 2 (Urban)</td>
<td>.0822 (0.00)</td>
<td>-.0219 (0.001)</td>
<td>-.023 (0.00)</td>
<td>.036 (0.00)</td>
</tr>
</tbody>
</table>

**Note:** Figures in parenthesis represent level of significance

The table 4.1.2 further confirms the results that have been demonstrated in figures 4.1.1 to 4.1.4 in regards to the expenditure shares by households based on ethnicity, division and area. The multivariate results prove with regression that in Fiji, Indians spend more on fruits and vegetables and less on meat, fish and seafood in comparison to the other two ethnicities. The spending on different food groups by households in different locations is also demonstrated confirming the finding of the data analysis in sections 4.1.1 to 4.1.4.
4.2 Demand Estimation Results

The food security issues are best evaluated by studying demand estimation which can be established by estimating income, cross and own price elasticities.

**Figure 4.2.1: Income Elasticities of Food in Fiji**

The figure 4.2.1 summarizes the results for the income elasticities of the four food groups studied in this research. The income elasticity of demand is used to measure how sensitive the demand of a good is to a change in income. The income elasticities of Bread and Cereal and Meat, Fish and Seafood are 0.744 and 0.771 for Fiji respectively. This implies that for Fiji these two food groups are a necessity and normal good. The income elasticity for Milk, Cheese & Eggs and Fruits and vegetables is greater than one and is 1.906 and 1.770 respectively. The elasticity estimates prove that these two goods have *elastic demand and are luxury goods*. In comparison, to the results of Muhammad, Seale, Meade, & Regmi, (2011) their study revealed that the income elasticity for food, beverage and tabacco in Fiji is 0.735 which is quiet close to the finding on this research.

The figure 4.2.2 summarizes the income elasticities of the four food groups based on the three major ethnicities in the country. The income elasticity of “Bread and Cereal” and “Meat, Fish and Seafood” is estimated and is around 0.74 to 0.77 for the three Ethnicities. It is important to note that the Fijians, Indians and Others all have similar
income elasticities for these two food groups. The elasticities imply that these two goods are income inelastic and are normal goods which are necessary and normal foods for the population.

**Figure 4.2.2: Income Elasticity for Food based on Ethnicity**

It is highlighted that in comparison to all ethnicities the “Others” ethnicity is most likely to change their demand for foods come a change in their income. This is observed that the “others” ethnicity has the highest income elasticities on all food though only a slight increase in seen. One of the likely reasons for this inferred from the data used in this study is that of the total others households majority fall in the lowest income quartile, qualifying as poor hence responsive to income changes.

The figure 4.2.3 shows the income elasticity of food from the four foods groups based on the four Divisions in Fiji. It is interesting to note that out of the four divisions the consumers in the Northern Division are most responsive to change their quantity of “Bread and Cereals” consumption come a change income. Whilst the Central Division is most responsive to the “Fish, Meat and Seafood” and “Milk, Cheese and Eggs” come a change in income. One the reasons for the Central Division leading the income responsiveness of these two food groups is due to the fact that Central Division has the lowest level of poverty in comparison to other divisions and milk, cheese and eggs is a luxury food thus, households make most adjustment to their quantity demanded.
Similarly, the Northern Division is most responsive to the prices of “Fruits and vegetables”. This is attributed to that fact that poverty in the Northern Division is 48% (Fiji HIES, 2008-09) and households are poor thus, are very reactive to income changes. Fruits and vegetables are luxury goods and households change their consumption most come a change in income. The Central Division is least responsive to the prices of Bread and Cereals whilst the Northern Division is least responsive to the price of “Fish, Meat and Seafood” and “Milk, Cheese and Eggs”. The consumers in the Central Division are least responsive to the prices of fruits and vegetables due to the assumption that majority consumers in the Central Division have white collar jobs thus, more income and greater ability to purchase luxury goods like Fruits and Vegetables.

The figure 4.2.4 shows the average income elasticity based on the locality in Fiji. It is clearly evident from the graph above and the income elasticities that for all the food groups, the rural households and consumers are more responsive to income changes when compared to the urban households therefore making outsized changes in their consumption of food.
This is due to the fact that majority of the households in the rural areas are poor as the poverty rate in the rural area is 43% (Fiji, HIES 2008-09) thus, households are more reactive to changing their food demand with a change in income.

The figure 4.2.5 shows the income elasticity based on income quartiles. These quartiles relate to the income groups that the households in the study correspond to with Quartile
1 being the lowest income group and quartile 4 consisting of the highest income group. Looking at the elasticities for total Bread and Cereals and total meat and seafood it is noted that this good is income inelastic and is a normal good. Thus, suggesting that a change in income will not cause demand for these foods to change drastically as consumers are not sensitive to its demand. On the contrary looking at the income elasticities for Milk, Cheese & Eggs and Fruits & Vegetables, the elasticities show that for the case of Fiji both these groups of foods are highly income elastic and are luxury goods. An increase in income causes the spending on these food groups to increase the most. Therefore, it is noted that the income elasticities and the income quartiles are positively correlated this situation. For Milk, Cheese & Eggs it is clearly seen that as we go up in terms of the income (income quartiles) the income elasticities are increasing. Interestingly, for the two luxury foods that is Milk, Cheese & Eggs and Fruits & Vegetables, as the income classes go up further from the 3rd to the 4th quartile it is noted that the expenditure elasticity goes down. The rate of growth of the expenditure elasticity shows that as in income increases, the consumer expenditure on these goods increase but only up to a certain point after which expenditure declines. This is consistent with the Engels law which states that as income increases the proportion of that income spent on food declines (Web Finance, 2014). However, just to be precise the law does not state that money spent on food falls with increase in income but just the percentage of income spent on food rises slower than percentage increase in income as rich households are more inclined to spend on other luxury goods apart from food.

Table 4.2.1: Multivariate Regressions Observations on Income Elasticity

<table>
<thead>
<tr>
<th>Income Elasticity</th>
<th>Food group 1 (Bread &amp; Cereal)</th>
<th>Food group 2 (Meat, Fish &amp; Seafood)</th>
<th>Food group 3 (Milk, Cheese &amp; Eggs)</th>
<th>Food group 4 (Fruits &amp; Vegetables)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity 2 (Indian)</td>
<td>-.138 (0.00)</td>
<td>-.036 (0.001)</td>
<td>-.318 (0.00)</td>
<td>-.475 (0.00)</td>
</tr>
<tr>
<td>Ethnicity 3 (Others)</td>
<td>.014 (0.627)</td>
<td>.045 (0.040)</td>
<td>-.419 (0.00)</td>
<td>-.418 (0.007)</td>
</tr>
<tr>
<td>Division 2 (Eastern)</td>
<td>.095 (0.00)</td>
<td>-.008 (0.704)</td>
<td>-.443 (0.00)</td>
<td>.232 (0.107)</td>
</tr>
<tr>
<td>Division 3 (Northern)</td>
<td>.044 (0.040)</td>
<td>.067 (0.00)</td>
<td>-.377 (0.00)</td>
<td>.072 (0.505)</td>
</tr>
<tr>
<td>Division 4 (Western)</td>
<td>.079 (0.00)</td>
<td>.015 (0.211)</td>
<td>-.332 (0.00)</td>
<td>-.322 (0.00)</td>
</tr>
</tbody>
</table>
The table 4.2.1 further confirms the results of income elasticity findings in Fiji’s case as demonstrated in figures 4.2.1 to 4.2. For instance the multivariate regression result further confirm that in comparison to the “others” population the Indian population is less responsive to income change in terms of demand for fruits and vegetables. Similarly, the “Others” population is more responsive to changing their demand for milk, cheese and egg with a corresponding change in income.

**Figure 4.2.6: Own price elasticity for the four food groups in Fiji**

![Own Price Elasticity of the four food groups in Fiji](image)

The figure 4.2.6 shows the own price elasticity of the four food groups in Fiji covered in this study. The Own Price Elasticity of demand measures the responsiveness of changes in quantity associated with a change in the goods own price. As expected the own price elasticities for Bread and cereals, meat fish and seafood and fruits and vegetables is negative depicting the negative relationship between the price of food and quantity.
demanded. The own price elasticity for bread and cereals and meat, fish and seafood is inelastic but ordinary foods. The elasticities for these two foods depict that a 1% increase in price bread and cereals will lead the households to decrease consumption by 0.427% and a 1% increase in price of meat, fish and seafood will lead to the decline of 0.467% consumption. The inelasticity of the food groups’ state that the percentage change in quantity demanded is less than percentage change in price. The own price elasticity of fruits and vegetables is -1.161 implying that this food has elastic demand and percentage change in quantity demanded is greater than percentage change in price. However, the own price elasticity of milk, cheese and eggs is positive, depicting that this portrays the “Snob effect” where an increase in price lead to an increase in quantity demanded of food. The increase in price is mostly considered a signal of good quality. Comparing the results to a similar study undertaken by Seale, Regmi, & Bernstein, (2003), the study revealed that the Frisch own price elasticity for food, beverages and tabacco is -0.495, whereas another study revels the Frisch own price elasticity for food in Fiji to be -0.539 (Muhammad, James L. Seale, Meade, & Regmi, 2011).

Table 4.2.3: The own price elasticity based on ethnicity

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Bread &amp; Cereal</th>
<th>Meat, Fish &amp; Seafood</th>
<th>Milk Cheese &amp; Egg</th>
<th>Fruits n Vegetables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fijian</td>
<td>-0.42517</td>
<td>-0.46682</td>
<td>0.20317</td>
<td>-1.16125</td>
</tr>
<tr>
<td>Indian</td>
<td>-0.42352</td>
<td>-0.46680</td>
<td>0.20522</td>
<td>-1.15958</td>
</tr>
<tr>
<td>Others</td>
<td>-0.42953</td>
<td>-0.47194</td>
<td>0.23313</td>
<td>-1.16436</td>
</tr>
</tbody>
</table>

The table 4.2.3 shows that the own price elasticity based on ethnicity. It is important to note that the own price elasticity among ethnicity is mostly similar however it is observed that the “Others” population is more responsive to own price changes of all four groups of food. A 1% increase in price of any of the above food groups leads the others population to make most changes to their quantity demanded and consumed of these foods. One of the reasons for this may be the fact that majority of the “Others” population fall in Fiji’s lowest income quartile therefore most responsive to price changes. The Indians and the Fijians react slightly to the own price changes of the above
mentioned foods as the elasticities are very close and similar. However, Indians are seen to make least changes to their demand for fruits and vegetables as they rigidly consume this food as substitute for meat due to their cultural restriction.

**Figure 4.2.7: Own Price elasticity of food based on division**

The figure 4.2.7 shows the own price elasticity based on the four major Divisions in Fiji. Looking at the food Group 1 which is “Bread & Cereals” the households in the Northern Division is most responsive to own price changes and the Central Division households is least responsive to own price changes. As mentioned earlier life in the urban centers are fast and households depend on these ready to eat meal thus come a positive or negative change in income household still consume this foods. The households in the Central Division make least changes to their quantity demand of “Meat, Fish and Seafood” come a 1% change in price of meat, fish and seafood whilst the Northern Division households makes the most changes to their quantity demand corresponding to the same increase in price. The Milk, Cheese and Eggs Category 3 of food are considered a Veblen good for the case of Fiji. With a 1% increase in price of this category of food the northern households make least change to their demand of these goods and the Central
households makes outsized changes to their demands. This demonstrates the “snob effect” where the demand for a product by a high income segment varies inversely with its demand by the low income households (Business dictionary, 2014). The Central division makes greater changes to their demand for milk, cheese and eggs as poverty in the central division is 36% compared to 41% in the Northern (Fiji, HIES 2008-09). Thus, it can be assumed that high income households reside in the urban centers and with an increase in income they spend more on luxury foods as the high price of milk, cheese and eggs signal better quality of the product which the rich urban households wish to consume. On the contrary, a 1% increase in the price of fruits and vegetables leads the central households to makes least changes in their demand whilst the northern households make most changes. As mentioned earlier the households in the urban areas are more health conscious and informed therefore they are rigid in their consumption of fruits and vegetables.

The figure 4.2.8 shows the Own Price Elasticity based on the two localities in Fiji that is Rural and Urban. It is evident from the graph above that the own price elasticity for all the four food groups is lower in the urban areas compared to the rural areas. Thus, these investigation results reveal that for Bread and Cereals a 1% increase in price leads to a 0.425% decrease in quantity demanded in the urban areas whilst the same 1% increase in price leads to a 0.424% decrease in quantity demanded in the rural areas. The results reveal that urban consumers are more sensitive to the own price changes of this good in comparison with the Rural consumers. For Fish, Meat and Seafood a 1% increase in price leads to a 0.468% decrease in quantity demanded in the urban areas and 0.470% decrease in the rural areas.
Figure 4.2.8: Own Price Elasticity of food based on area

This implies that consumers in the rural areas are more responsive to the price change of this good than the consumers in the urban areas. The Milk, Cheese and Eggs are considered the results of the “snob effect” in both urban areas. The results for urban households reveal that a 1% increase in the price milk, cheese and eggs will lead to an increase in demand by 0.2% for urban households and 0.22% for rural households. The fruits and vegetables have an elastic demand which can be interpreted as a 1% increase in price of fruits and vegetables will lead to a decline in quantity demanded of that good by 1.20% in the urban areas and 1.22% in the rural areas. All consumers are highly responsive to the fruits and vegetables of this good however, the rural consumers are slightly more responsive than the urban consumers.

Figure 4.2.9: Cross price elasticity of food in Fiji
The figure 4.2.9 demonstrates the cross price elasticity among the four food groups. The cross price elasticity of demand shows the responsiveness of changes in quantity associated with a change in price of another good. The two foods are either substitute or complement foods. For the ease of reference for each food group, group 1 is Bread and Cereals, Group 2 is Meat, Fish and Seafood, Group 3 is Milk, Cheese and Eggs and Group 4 is Fruits and Vegetables. Thus, judging from the above, food groups 1 and 2, 1 and 3, 2 and 3 and 3 and 4 have negative cross price elasticities implying that these food groups are complementary to each other. That is are consumed together. This means a 1% increase in price of bread and cereals leads to a 0.274% decrease in the quantity demanded of meat, fish and seafood. Similarly, if a 1% increase in price is experienced for milk, cheese and eggs, the households decrease their consumption of fruits and vegetables by 0.033% as these foods are consumed hand in hand by the households as depicted by the elasticity results. The results show that there is a strong relationship between bread and cereals and meat, fish and seafood as well as between bread and cereal and milk, cheese and eggs. The complementary nature of the foods makes sense and bread and cereals and milk, cheese and eggs are mostly consumed for breakfast thus satisfying the complementary criteria. Similar to bread and cereals and meat, fish and seafood which are used in main meals with food made of wheat like pasta. The elasticity results for bread and cereals and fruits and vegetables and milk, cheese and eggs and fruits and vegetables are positive justifying that these foods are substitute foods. Bread and cereals and fruits and vegetables are substitute foods as they are mostly either is consumed by households and for meat, fish and seafood and fruits and vegetables, this significantly applies to the Indian households who due to their vegetarian nature consume fruits and vegetables in substitute to meat and seafood.

**Table 4.2.2: Multivariate Regression Observations on Cross Price Elasticity**

<table>
<thead>
<tr>
<th>Own price Elasticity</th>
<th>Food group 1 (Bread &amp; Cereal)</th>
<th>Food group 2 (Meat, Fish &amp; Seafood)</th>
<th>Food group 3 (Milk, Cheese &amp; Eggs)</th>
<th>Food group 4 (Fruits &amp; Vegetables)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ethnicity 2</strong> (Indian)</td>
<td>.299 (0.00)</td>
<td>.120 (0.00)</td>
<td>-.421 (0.00)</td>
<td>.121 (0.00)</td>
</tr>
<tr>
<td><strong>Ethnicity 3</strong> (Others)</td>
<td>.135 (0.007)</td>
<td>.001 (0.976)</td>
<td>-.453 (0.001)</td>
<td>.113 (0.004)</td>
</tr>
<tr>
<td><strong>Division 2</strong></td>
<td>-.135 (0.003)</td>
<td>.013 (0.765)</td>
<td>-.435 (0.006)</td>
<td>-.062 (0.087)</td>
</tr>
</tbody>
</table>
The table 4.2.2 further confirms the results of own price elasticities that have been demonstrated in figure 4.2.9 in terms of Division, Area and Ethnicity.

### 4.3 Domestic Demand, Supply and Production Gaps

This sub chapter attempts to further forecast the production gaps for some of the food items, based on the demand elasticity estimated in the above section. The current situation of Fiji’s food demand and supply in 2009 as the base year will form the basis for discussions here. At this juncture it is important to note Fiji’s data limitation related to two points. Firstly, Fiji is a small developing island economy and though the most developed in the South Pacific island group, data compilation on food production and consumption is still pre-mature. Secondly, the data on food demand is difficult to establish based on the information taken from the Household Income and Expenditure survey (HIES) even though this is the only means of capturing this data. However, the HIES in Fiji uses an expenditure approach of compilation and data on food expenditure is collated not the actual or real consumption quantities. These issues pose restrictions on the projection of demand. Hence, this study confines into a few food items out of all the foods in the food groups considered when estimating elasticities. In this section, Fiji’s food production gap will be identified to see if Fiji is progressing towards a sufficiency, surplus or shortage of food in future. The production gaps will be projected...
for eight (8) foods namely; pork meat, chicken, egg, fish, fruits, root crops, milk and paddy rice.

4.3.1 The Past Trends, current situation and projected domestic food supply for Fiji

**Figure 4.3.1: Average Annual Domestic Supply Growth Rate**

Looking at the domestic average food supply growth rates for the past 30 years it is noted that the supply growth rates for the production of pork meat and eggs has been increasing over the years. On the contrary it is observed that the supply growth rate of fruits has been fluctuating over the last thirty years with an increase in supply in the 2000s from the 1990s. However, even with this slight increase the full potential that Fiji has in its fruits production is not expedited as in the 1980’s the fruit production was 3.46% depicting a very good fruit produce back in the years. However, it is still good to note an improvement in production in the 2000’s after a very large decline in supply growth from the 1980’s to the 1990’s. The supply growth rate and production has been declining for chicken, fish, root crops and paddy rice. The supply growth rate of fish and
roots crops have declined by more than half since the 1990’s and these are some of the most important foods in the Fijian diet, thus Fijian consumption patterns would be greatly affected if this decline continues. The supply growth of paddy rice is the most affected and very recently it has started to run into a negative growth rate which is not only bad for our agricultural sector as Fiji had potential to be at least 66% sufficient in rice production, Sen, Roy, & Tisdell, (1997) but will also place immense pressure on the imports as rice is one of the core items used in Fiji’s diet hence, highly demanded.

Table 4.3.1: Ten (10) year Average domestic supply of food in Fiji 1979-2000

<table>
<thead>
<tr>
<th>Foods</th>
<th>Average Domestic Supply (metric tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pork Meat</td>
<td>628.73</td>
</tr>
<tr>
<td>Chicken</td>
<td>3,622.09</td>
</tr>
<tr>
<td>Eggs</td>
<td>1,850.73</td>
</tr>
<tr>
<td>Fish</td>
<td>10,691.36</td>
</tr>
<tr>
<td>Root Crops</td>
<td>38,929.00</td>
</tr>
<tr>
<td>Fruits</td>
<td>4,481.00</td>
</tr>
<tr>
<td>Milk</td>
<td>-</td>
</tr>
<tr>
<td>Paddy Rice</td>
<td>22,896.64</td>
</tr>
</tbody>
</table>

Source: Ministry of Agriculture, (2013)

Table 4.3.1 illustrates what the food supply levels were for Fiji for the past thirty (30) years. The food supply is being investigated as it is an important player in the prediction of the future production gap. The food supply will be compared to demand in order to establish the future gap in production thus, it is important at this point to note the determinants of supply. The determinants of supply include; changes in the costs of production (that is changes in wages and raw material prices, changes in technology, incentives provided like subsidies and taxes charged), the profitability in producing other goods, natural and random shocks (cyclone, hurricane, dispute) and expectations of future prices (Beggs, The Determinants of Supply, 2014). Similar to the figure 4.3.1, the above table shows the actual supply of foods in Fiji in metric tonnes. It is depicted that the supply of paddy rice has been declining over the last 30 years whereas the
supply fruits has been fluctuating with an increase in production in the 2000’s. The supply of all other foods being estimated that is pork meat, poultry, eggs and fish is increasing gradually over the ten year intervals.

Table 4.3.2: Annual Base Year Supply growth rate

<table>
<thead>
<tr>
<th>Food Items</th>
<th>2009 Base year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pork Meat</td>
<td>0.055</td>
</tr>
<tr>
<td>Poultry</td>
<td>0.044</td>
</tr>
<tr>
<td>Fish</td>
<td>0.012</td>
</tr>
<tr>
<td>Eggs</td>
<td>0.016</td>
</tr>
<tr>
<td>Milk</td>
<td>0.009</td>
</tr>
<tr>
<td>Fruits</td>
<td>0.203</td>
</tr>
<tr>
<td>Root crops</td>
<td>0.097</td>
</tr>
<tr>
<td>Rice</td>
<td>-0.027</td>
</tr>
</tbody>
</table>

Source: Ministry of Agriculture, (2014)

The table 4.3.2 shows the base year, 2009 supply growth rates for the eight food items for which production gaps have been projected. These supply growth rates have been inflated at appropriate time periods to enable the projecting of demand for these foods in 2020, 2025 and 2030.

The table 4.3.3 shows the total projected supply and the per capita projected supply for foods in Fiji. In order to accurately project the per capita gap in agricultural production, the population was also projected at appropriate rates. The formula used to calculate the population growth rates for years 2020, 2025 and 2030 is as follows and is also mentioned as Equation 3.3.2(b) earlier.

\[
\text{Population in Future} = \text{base year population} \times (1 + g)^t.
\]

Hence, the above formula has been used to project future population. Therefore, consistent with the 2009, base year supply or production situation and assuming no other shocks on the supply of food in Fiji, the above table shows that the supply for all foods will increase over the projected years except for rice.
Table 4.3.3: Fiji’s Projected Total and Per Capita domestic Food Supply

<table>
<thead>
<tr>
<th>Food Items</th>
<th>Total Projected Domestic Supply of Food in Fiji (Metric tonnes)</th>
<th>Per Capita Projected Domestic Supply of Food in Fiji (metric tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2009 - Base year</td>
<td>2020</td>
</tr>
<tr>
<td>Pork Meat</td>
<td>1,128.00</td>
<td>2,029.89</td>
</tr>
<tr>
<td>Poultry</td>
<td>11,866.00</td>
<td>19,013.68</td>
</tr>
<tr>
<td>Fish</td>
<td>13,252.00</td>
<td>15,099.34</td>
</tr>
<tr>
<td>Eggs</td>
<td>3,471.00</td>
<td>4,133.18</td>
</tr>
<tr>
<td>Milk</td>
<td>1,009.77</td>
<td>1,114.36</td>
</tr>
<tr>
<td>Fruits</td>
<td>6,079.00</td>
<td>47,494.45</td>
</tr>
<tr>
<td>Root crops</td>
<td>118,311.00</td>
<td>328,129.39</td>
</tr>
<tr>
<td>Rice</td>
<td>11,637</td>
<td>8,612.75</td>
</tr>
</tbody>
</table>

Note: Calculations by the Author

Even though rice production increases in 2020 it is seen to decline in 2025 and further decline in 2030 this is attributed to the fact that rice has a negative growth rate in 2009, the base year. The agricultural foods that have been forecasted to have the most increase in supply over the next couple of years are fruits and root crops.

The table 4.3.4 shows the domestic consumption patterns of pork, poultry, fish, eggs, milk, fruits, root crops and rice in Fiji with 2009 as the base year. It is important that the demand for food in a country depends on many factors. Some of the determinants of demand include; changes in tastes and fashions which is impacted by advertising and health consideration, prices of related goods that is prices of substitutes and complementary goods prices, the income of people, population levels and expectations of future prices will impact the demand of foods (Beggs, 2014).
The projected domestic demand for 2020, 2025 and 2030 has been estimated at appropriate income growth rates, population and time periods. Based on the base year, 2009 data when ranked in order of the most demanded foods out of the eight (8) foods above, the root crops is most demanded followed by milk, rice, poultry, eggs, fish, fruits and pork is the least demanded.

**Table 4.3.4: Projected Domestic Demand for Food in Fiji**

<table>
<thead>
<tr>
<th>Food Items</th>
<th>Projected Domestic Demand per capita of Food in Fiji (metric tonnes)</th>
<th>Projected Domestic total Demand of Food in Fiji (million metric tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2009 - Base year</td>
<td>2020</td>
</tr>
<tr>
<td>Pork Meat</td>
<td>0.39</td>
<td>0.42</td>
</tr>
<tr>
<td>Poultry</td>
<td>26.99</td>
<td>29.31</td>
</tr>
<tr>
<td>Fish</td>
<td>7.47</td>
<td>8.11</td>
</tr>
<tr>
<td>Eggs</td>
<td>32.64</td>
<td>39.98</td>
</tr>
<tr>
<td>Milk</td>
<td>95.42</td>
<td>116.87</td>
</tr>
<tr>
<td>Fruits</td>
<td>7.54</td>
<td>9.10</td>
</tr>
<tr>
<td>Root crops</td>
<td>250.74</td>
<td>302.70</td>
</tr>
<tr>
<td>Rice</td>
<td>45.51</td>
<td>54.94</td>
</tr>
</tbody>
</table>

**Note:** Calculations by the Author

The root crops is the most demanded as a bigger section of the population is Fijian and over the years due to the multiracial nature of the country whole of the population has developed a taste for this food item. Pork meat is the least demanded food out of the eight foods based on the fact that the Muslim population is culturally restricted to consume pork meat and majority of the Hindu population is vegetarian thus, such a low demand for the meat is seen. It is essential to note that the demand data above reveals root crops, milk and paddy rice to be the most demanded foods. However, when compared to the supply data on table 4.2.2, the growth rate for supply for roots crops in 2009 is 9.6% but the supply growth rates for milk and paddy rice is still very low. This is a matter of great concern as the projections show that the demand for these foods will
continue to increase and if supply is growing a constant rate there will be serious food shortage issues in the coming years which may put even more pressure on the import bills and balance of trade.

The table 4.3.5 shows the production gap that existed in Fiji in 2009 and the gaps that will be experienced by the country in the coming years at intervals of 5 years; 2020, 2025 and 2030. The table depicts both the total gap that currently exists and will exist and for Fiji at large as a whole and the gap that exists and will exist per capita for food in each year as mentioned.

**Table 4.3.5: Trends of Total Projected & Per Capita Food Production Gaps in Fiji**

<table>
<thead>
<tr>
<th>Food</th>
<th>Projected Annual Total Production Gap in Fiji (Million metric tonnes)</th>
<th>Projected Annual Production Gap Per Capita (Metric Tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2009 - Base year</td>
<td>2020</td>
</tr>
<tr>
<td>Pork Meat</td>
<td>(0.330)</td>
<td>(0.381)</td>
</tr>
<tr>
<td>Eggs</td>
<td>(27.824)</td>
<td>(36.269)</td>
</tr>
<tr>
<td>Milk</td>
<td>(81.346)</td>
<td>(106.036)</td>
</tr>
<tr>
<td>Paddy Rice</td>
<td>(38.786)</td>
<td>(49.843)</td>
</tr>
</tbody>
</table>

**Note:** Calculations by the Author and parenthesis indicates negative value.

The foods are projected at 5 year intervals as a lot of policies and performance of the country is due for transformation every 5 years, there is a change of government with election very 4 years and the important strategic plans and frameworks in Fiji also cover 5 year periods thus, predictions at 5 year intervals are viable. Together with that a lot of literature is available where studies have been undertaken to predict production gaps over five year periods like Mittal (2008), Kumar, et al. (2012) and Kumar, Prasad, & Pullabotla (2012) to name a few. Therefore, assuming the determinants of demand and
supply to be constant to the 2009 situation the result above shows the gap in supply and demand that will be experienced in the future. The predictions for the year 2009 show that there was a shortage of all the 8 foods mentioned above, there was more demand than supply. Similar patterns are observed for the other three (3) years.

It is important to note that the largest production gap is observed for root crops, followed by milk, rice, poultry, eggs, fish, fruits and pork meat with the lowest gap in food demand. Fiji is a small developing economy with agriculture as one of its major sectors especially for the rural population as a means of livelihood. However, over the years with issues like expiry of land leases and natural disasters the farmers have lost confidence on the sector thus, a greater production gap being seen which will further widen in future. Hence, policy makers have to be proactive to devise policies and strengthen existing means of increasing production to meet the ever increasing food demand so this projected gap can narrow down a little. The Government should allocate more resources and invest towards the farming of roots crops and milk. In fact Fiji has a lot of potential in the farming of all these products especially fruits and root crops as it is a tropical country however, more should be done so existing farmers and potential farmers are more confident in the industry and increase their produce so the country benefits as a whole.

Looking at the production gap for rice; the base year gap in rice production is 38.79 million tons and these further increases over the years which is similar to the case of India where Mittal S. , 2008 concludes that the production gap in rice will be 9 million tonnes in 2026 increasing further. However, on the contrary for China, self-sufficiency in rice will be experienced come 2020 (Zhou, Tian, Wang, Liu, & Cao, 2012) and Pakistan is predicted to to have a surplus in rice production come 2030 (Nazli, Haider, & Tariq, 2012). Similar to the situation of Bangaldesh and China, Fiji is also projected to experience a shortage in meat and milk supply in comparision to the level of demand for these foods (Begum & D'Haese, 2010 and Zhou, Tian, Wang, Liu, & Cao, 2012).

According to the Food Agricultural Organisation (FAO, 2009) it is expected that the demand for meat and milk will grow at higher rate than for all the food groups and thus, the production gap will these foods are the widest. However, interpreting the results on
production gaps for Fiji’s case and looking at the gaps for milk and few meat products that have been projected it is noted that the production gap for milk is quite large, consistent to the perception of FAO. However, the production gap for meat though positive but is still quite low compared to the gap that exists for root crops. In real terms the production gap for root crops is even larger than the gap for meat in Fiji, this view is contrasting to assumption of the FAO.

As highlighted before it is projected that Fiji has a steady negative production gap of pork, eggs, poultry, fruits and root crops. This is similar to the findings of Kruse, 2010, Kruse predicted that on a global level the production gap of pork, eggs, poultry and fruits and vegetables will further increase as demand for these foods will be increasing on a faster rate than then the supply growth rate. The production gap of fish, rice and milk will also widen in the future similar to the other five foods mentioned above therefore providing evidence for taking immediate policy actions to improve productivity of the agricultural sector.

4.4 Conclusion

The result findings suggest that for Fiji; “milk, cheese and eggs” and “fruits and vegetables” are luxury goods whilst “bread and cereals” and “Meat, Fish and Seafood” are normal goods. The income elasticity for bread and cereal is 0.744 and 0.771 for “meat, fish and seafood”. The elasticity for “milk, cheese and eggs” and “fruits and vegetables” is 1.906 and 1.770 respectively. This clearly depicts Fiji’s condition as imported items like milk, cheese and fruits are expensive and do fall in the luxury category while households’ find meat, and fish to be normal goods as it’s available locally.

Secondly, the growth of supply of agricultural foods is projected to decline into the coming years and demand is increasing, this is going to cause food security problem for Fiji. The highest production gap is highlighted for root crops. Production gaps for milk, rice, eggs and fish will also continue to widen. It is interesting to note that Fiji once having a comparative advantage in its agriculture sector is now having huge production gaps.
Chapter 5  Conclusion & Policy Recommendations

As highlighted by Barnett (2007), traditionally the Pacific Island countries have been achieving food security through diverse means that include, subsistence economy, fishing, gardening, hunting and through selling of excess production for cash. Fiji was no exception to this, food was always abundant and people of different ethnicities and backgrounds had unique eating habits which was well accomodated by its agricultural sector. This view changed over the last two decades and agricultural output declined significantly, increasing imports and putting immerse pressure on Fiji’s security for food. The current study attempts to investigate whether this trend might bring any threat to the food security in near future. In order to investigate this, the study has estimated demand elasticities of major food items and then forecasted demand and supply to see the gap.

5.1  Summary of Observations

The 2008-09 HIES data was used to achieve the ultimate objective of the paper which was to establish the gap in agricultural output that Fiji is likely to face in future. The research results are based on a total of 3561 households spread over Fiji’s four major Divisions which were further divided into rural and urban locations. The research findings included results on breakdown of households into income quartiles, households expenditure allocated to food, elasticity estimations and forecasting of production gaps. The analysis results and observations from the research are further summarised below.

Firstly, an evaluation was made into how much households in Fiji allocated to each of the four food groups analysed in this study. The results revealed that out of their total expenditure households allocated 11% to food group 1 - Bread and Cereals, 15% to food group 2 – Meat, Fish and Seafood, 3% to food group 3 – Milk, Cheese and Eggs and 14% to food group 4 – fruits and vegetables. Looking at the expenditure on food based on ethnicity, it is evident that the highest consumers of bread and cereal; milk, cheese and eggs and fruits and vegetables are the Indo Fijians whereas the Fijians are the highest consumers of meat, fish and seafood. Looking at the same results based on
locally it is noted that the urban households consume more of all food groups in comparison to rural households except for meat, fish and seafood. The expenditure on food was also evaluated in terms of households in different income quartiles and it was evident that the households in high income quartiles spend more on all food groups in contrast poor households.

Secondly, an estimation of demand for food was undertaken and income, own price and cross price elasticities for the four food groups were predicted. The income elasticity for bread and cereal is 0.744 and 0.771 for meat, fish and seafood. The elasticity for milk, cheese and eggs and fruits and vegetables is 1.906 and 1.770 respectively. The income elasticity was further divided based on ethnicities and revealed that the “Others” population in Fiji have the highest income elasticity on all food groups. The income elasticities based on the four Division shows that the Northern Division has the highest elasticity in terms of bread and cereal and fruits and vegetables whilst the Central Division has the lowest. For meat, fish and seafood and milk, cheese and eggs the Northern division has the lowest income elasticity and the Central division the highest. The income elasticities distributed by area reveals that the income elasticities for all foods in the rural areas are higher than for that in the urban areas.

The own price elasticity for bread and cereals; meat, fish and seafood and fruits and vegetables are negative and range from -0.472 to -1.161. However, the cross price elasticity for milk, cheese and eggs is 0.02. In terms of Ethnicity the “Others” population households have the highest own price elasticities. Similar to the income elasticities the own price elasticities for bread and cereal and fruits and vegetables are the highest in the Central Division and the lowest in the Northern Division whilst the own price elasticities for the meat, fish and seafood and milk, cheese and eggs is the lowest in the Central Division and highest in the Northern division. In terms of the area, the own price elasticity for meat, fish and seafood; milk, cheese and eggs and fruits and vegetables is higher in the rural areas except for bread and cereals where own price elasticity is higher in the urban centres.

The cross price elasticities reveal that for the case of Fiji “Bread and Cereals” and “Meat, Fish and Seafood”, “Bread and Cereals” and “Milk, Cheese and Eggs”, “Meat,
Thirdly, based on the income elasticity mentioned above, the domestic demand was calculated based on the method used by Mittal (2008). The year 2009 is considered the base year for demand projections. Demand was projected at appropriate population and income growth rates at respective time periods. The demand was projected at years 2020, 2025 and 2030. Demand for seven individual foods was projected, these included pork meat, poultry, fish, eggs, milk, fruits, root crops and paddy rice. Out of these foods the base year demand was the highest for root crops, followed by milk, rice, poultry, eggs, fish, fruits and pork which is the least demanded in the group.

Next the domestic supply for the above seven mentioned foods was collated and forecasted to appropriate years based on 10 year supply growth rates averages. The supply growth rate revealed that the production growth rates for chicken, fish, root crops, milk and rice has been declining steadily over the years and rice even has a negative growth rate. The supply was also projected for the years 2020, 2025 and 2030. Out of the foods being considered in this section root crops has the highest supply in the base years followed by fish, poultry, rice, fruits, eggs, pork and milk.

Lastly, using the projected demand and supply, the future production gaps were identified for three years into the future. Due to the demand for these seven goods increasing steadily into the future and the supply growing at very low rates, assuming that the condition of the future remain as in the base year that is food production techniques and tools are the same, a large gap in food production may be experienced in future. The results indicate that the gaps will just widen at predicted demand and supply growth rates. Over the years the maximum gap is expected to be for root crops based on the base year gaps of (214mmt), followed by milk (81mmt), paddy rice (39mmt), eggs (28mmt), poultry (23mmt), fruits (6.4mmt), fish (6.3mmt), and pork (0.33mmt). It is evident that the current gap in production is already quite high. Thus, if production levels remain the same, income levels improve further and population steadily increases the demand for food would definitely increase placing greater burden on the poor, as if
domestic supply will not be able to meet the growing demand more will have to be imported and looking at the global trends the world food price inflation will be passed onto consumers domestically and affecting the poor the most.

5.2 Implications of the Study

The findings of this research illustrates numerous details about Fiji’s consumption patterns and food security situation. The expenditure shares on food show that the Fijian households spend most on meat, fish and seafood and fruits and vegetables. Looking at the division by ethnicity it can be established that due to religious restrictions of being vegetarians the Indian households spend the highest on fruits and vegetables and the Fijians the lowest. It is also inferred that the income elasticities in the rural areas are higher for all foods in comparison to urban households. This may be due to majority households in rural areas involved in informal sectors for employment therefore, are highly responsive to income changes.

It is noted that the own price elasticity of milk, cheese and eggs is positive violating the negative correlation between own price and quantity that is normally expected. However, as this food group falls in the luxury food group for Fiji, such a result for own price elasticity may be due to the “snob effect”. The cross price elasticities as mentioned above also demonstrate the different combination of foods that are complementatry for Fiji and those that are substitutes. Interestingly, “Others” households have the highest income and own price elasticities which may be because of majority of this population fell in the income quartile four which is the poorest group which makes them more sensitive to income and price changes.

The results ultimately enabled the projection of production gap for seven foods in Fiji. It clearly demonstrate Fiji’s food security situation and the production gap is expected to widen even further. If this scenario continues there is a likely chance that Fiji will have to highly depend on its food imports which would be be bad for the economy overall.

It is an indisputed fact that Fiji’s agricultural production and contribution to GDP has declined substantially over the years. This has been due to the impacts of climate change
as change in weather patterns such as excessive rainfall and prolonged dry conditions, hurricanes and droughts have all affected Fiji’s fertile land. This has simply led to damaged crops, lower yields and overall lesser agricultural productivity, for farmers. This has simply caused farmers to leave their farms and move away to urban areas. The low productivity and the volatily of the industry has made farmers lose confidence in the sector and opt for other means of income and survival for their families.

In view of the above Fiji is expected to be negatively affected in terms of its commercial agricultural output, export earnings as well as the tourism industry which is also closely linked Fiji’s agricultural sector. Thus, it is important to take a proactive approach now and this research has been undertaken to quantify the agriculture scenario that is expected for Fiji. Demand elasticities have been estimated, demand projections for food have been undertaken, food supply has been projected for future and food production gaps likely to occur in future has been identified.

This research has now made it clearer with evidence that food insecurity exists in Fiji and this will further widen if the supply for these projected foods remain at current levels and appropriate policies are not developed to cushion the effects of climate change or restore farmer confidence in the sector. It is important to bring to the attention of the policies makers that the production of agricultural food like Root crops, Milk, Rice needs to increase among the other foods like poultry, eggs, fruits and pork meat. Root Crops are one the basic foods for native Fijians and demand is expected to continue increasing. Thus, more effort should be placed on increasing supply. Similarly, for the case of rice, Fiji is a small economy with abundant fertile land therefore rice production should increase substantially. According to a study undertaken by Sen, Roy, & Tisdell, (1997) in 1989 Fiji was at least 66% self-sufficient in rice production and this would have further increased but the imports of rice into the country lowered the domestic rice price and productivity as farmers realised that they were not getting appropriate returns for their rice production and moved to producing other cash crops. It is important to highlight that all foods for which production gap was forecasted has a negative gap meaning that demand is greater than the supply of the country.
**Therefore, some policies and activities that can be undertaken and implemented to assist in overcoming the food insecurity issues include the following.**

Firstly, as we assume that one of the major reasons for the decline in the industry may be climate change or increase in trade which has caused farmers move away from farms it is important that policies are designed to counter effect these. Thus, it is important for Fiji to explore the option of Crop Insurance to restore farmer confidence. This insurance is especially important for Fiji’s case where the cyclone seasons are for 5 months and there is a great chance of output, crops being damaged. Thus, if such an insurance is available farmers would still remain in production as they know their crops are secured and will remain in the industry instead of moving out completely.

Other improvements that can take place is reviving the rice industry. Allocating land to rice industry, providing incentives like subsidies, minimum domestic rate for rice to be established domestically with appropriate consultations with relevant stakeholders. Subsidies should also be provided for cash crop farming.

Fiji should also involve more in innovation in the agriculture sector and look towards technical improvements, observe from what other countries are doing as best practices and apply it to Fiji’s context. There should be more infrastructure support provided to farmers for the production, marketing and distribution of agricultural produce. Irrigation support by Government would also assist to a great deal.

Another issue that requires urgent attention is the land reforms. Policy makers should efficiently and effectively undertake land reforms so farmers do not have to move out of their farms and relocate their families come an expiry of their land leases etc. There should also be proper monitoring and evaluation to ensure that all lands allocated to agriculture are farmed and more lands are allotted to cash crops like fruits, poultry and eggs. This will ensure that farmers achieve fast returns and will strengthen Fiji’s food supply as well.

Fiji has an advantage in the agricultural sector due to its fertile lands and tropical climate. Therefore, more needs to be done so Fiji can effectively realise and take advantage of its full potential in the sector. More trainings should be organised by the
Ministry of Agriculture for farmers to learn new farming techniques. The Ministry should also encourage farmers to undertake crop diversification so more variety of crops are produced and the risks in producing only one crop is lessened.

More research should be undertaken in the producing of agricultural crops so more can be exported. Fiji also has an advantage of the knowledge in farming traditional, root crops (Dalo, cassava and kumala) therefore this should be expedited. More efforts should be put in by the policy makers to ensure that facilities are available for the packaging of these foods locally and marketing of these foods both locally and in overseas markets. New efforts of processing the root crops into new snacks can be discovered. Similarly, Fiji has the gain in owning so much of marine resources therefore to assist in the declining production of fish and seafood more training and new production methods should be explored.

The Ministry of Agriculture has also developed Fiji’s National Agriculture Policy 2013-2030 which has import substitution efforts as one of its key priority areas. It is important for Fiji to be secure in terms of food domestically and this can be achieved by increasing domestic agricultural output and reducing food imports. Therefore, the approach of undertaking rigorous import substitution is indeed very important.

The above are some policy suggestions for the improvement of Fiji’s agriculture sector.

5.3 **Limitations & Future Scope of the Study**

There had been a few studies undertaken in Fiji’s situation estimating demand elasticity’s for food demand. This allowed room for this current research and study to be validated to certain extend. However, one of the major limitations remained that the results of the production gaps established in this study could not be validated due to the lack of any similar study in relation to Fiji.

Another limitation that existed was that of the data used in this study. The HIES is compiled on the basis of expenditure approach therefore the actual quantity that a households actually consumes is captured in monetary value not in real terms that was one of the limitations experienced whilst projecting the production gap. However, due to
the availability of the price data of food for that year, this issue was well covered to a magnitude. There was also unavailability of supply data for all foods produced in Fiji and for some foods where supply data was available could not be used with accuracy as different institutions from which data was requested provided different data for the same foods, the production gaps for those foods could not be determined.

Demand projection is a very important topic especially with the ever increasing impacts of climate change and its direct influence on agriculture. There is scope of further works to be undertaken in this area. Firstly, production gaps for other foods for which have not been forecasted in this study can be forecasted as an extension. On the contrary, research can still be undertaken to determine production gaps for same foods which have been projected in this study but by use of another methodology to estimate demand elasticities so that the results can be compared and validated for accuracy.

The study can be extended further by applying the same methodology to any one of the other Pacific island countries and studying the consumption patterns, demand elasticities and production gaps in comparison to Fiji’s results.

The above are some of the extensions that can be applied to this current research.
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Appendix - Multivariate Results

Table A1: Income Elasticity of Food Group 1 – Bread & Cereals

```
mvreg inelasfg1 = i.eth i.div i.area
Equation ObsParms RMSE "R-sq" F P
inelasfg1 3478 7 .4112237 0.9325 19.44495 0.0000

| inelasfg1 | Coef. Std. Err. t P>|t| [95% Conf. Interval] |
|-----------|-----------------|----------|--------|------------------------|
| eth       |                 |          |        |                        |
| 2         | -.1384899 .0156058 -8.87 0.000 -.1690873 -.1078925 |
| 3         | .0146661 .0302598 0.49 0.627 -.0446427 .0740148 |
| div       |                 |          |        |                        |
| 2         | .0945152 .0270955 3.49 0.000 .0433906 .1476399 |
| 3         | .0400007 .0213835 2.06 0.040 .0020753 .0859262 |
| 4         | .0786218 .0170625 4.62 0.000 .0454084 .2123153 |
| 2.area    | -.0031442 .0154698 -0.20 0.839 -.0334751 .0271866 |
| _cons     | .7527836 .0139047 54.14 0.000 .7254884 .7800128 |
```

A.1.1 - Abbreviation

Inelasfg1 – income elasticity food group 1
Eth – Ethnicity
Div – Division
Area – Rural/Urban
Mvreg – multivariate regression

Table A2: Income Elasticity of Food Group 2 – Meat, Fish & Seafood

```
mvreg inelasfg2 = i.eth i.div i.area
Equation ObsParms RMSE "R-sq" F P
inelasfg2 3314 7 .2974174 0.0320 18.20519 0.0000

| inelasfg2 | Coef. Std. Err. t P>|t| [95% Conf. Interval] |
|-----------|-----------------|----------|--------|------------------------|
| eth       |                 |          |        |                        |
| 2         | -.0361064 .0113199 -3.19 0.001 -.0583012 -.0139116 |
| 3         | .0446311 .0217716 2.05 0.040 .0019444 .0873182 |
| div       |                 |          |        |                        |
| 2         | -.0076134 .0200234 -.38 0.704 -.0468731 .0316442 |
| 3         | -.067042 .0156058 -4.27 0.000 -.0978129 -.0362712 |
| 4         | .0134176 .0123211 1.25 0.211 -.00874 .0395753 |
| 2.area    | -.075634 .0112052 -6.75 0.000 -.0976079 -.0536681 |
| _cons     | .826584 .009976 82.86 0.000 .8070242 .8461438 |
```
Inelasfg2 – income elasticity food group 2; Other abbreviations same as A.1.1

Table A3: Income Elasticity of Food Group 3 – Milk, Cheese & Eggs

```
.mvreg inelasfg3 = i.eth i.div i.area
Equation     Obs Parms      RMSE    "R-sq"      F        P
inelasfg3   1996  7  1.10181  0.0469  16.32125  0.0000

|     | Coef.  | Std. Err. | t    | P>|t|   | [95% Conf. Interval] |
|-----|--------|-----------|------|-------|---------------------|
| eth |        |           |      |       |                     |
| 2   | -.2177359 | .0526438 | -6.04| 0.000 | -.4209787  -.2144932 |
| 3   | -.4189526 | .1046145 | -4.00| 0.000 | -.6241181  -.2137871 |
| div |        |           |      |       |                     |
| 2   | -.4429444 | .1260359 | -3.51| 0.000 | -.6901207  -.1957681 |
| 3   | -.3771026 | .0880523 | -4.28| 0.000 | -.549787   -.2044182 |
| 4   | -.3320236 | .0567988 | -5.85| 0.000 | -.443415   -.2206321 |
| area| .0463272 | .0536637 | .83  | 0.409 | -.0609158  .1495702 |
| _cons| 2.25901 | .0469944 | 48.07| 0.000 | 2.166847   2.351174  
```

Inelasfg3 – income elasticity food group 3
Other abbreviations same as A.1.1

Table A4: Income Elasticity of Food Group 4 – Fruits, Vegetables & Root Crops

```
.mvreg inelasfg4 = i.eth i.div i.area
Equation     Obs Parms      RMSE    "R-sq"      F        P
inelasfg4   3378  7  2.049373  0.0441  25.91767  0.0000

|     | Coef.  | Std. Err. | t    | P>|t|   | [95% Conf. Interval] |
|-----|--------|-----------|------|-------|---------------------|
| eth |        |           |      |       |                     |
| 2   | -.475142 | .0777214 | -6.11| 0.000 | -.6275281  -.3227564 |
| 3   | -.4175676 | .1553935 | -2.69| 0.007 | -.7222427  -.1129825 |
| div |        |           |      |       |                     |
| 2   | .2324591 | .1440147 | 1.61 | 0.107 | -.0499058  .5148241 |
| 3   | .0724397 | .1085395 | 0.67 | 0.505 | -.1403702  .2852496 |
| 4   | -.3215926 | .0857305 | -3.75| 0.000 | -.4896817  -.1535035 |
| area| .5140281 | .0778854 | 6.60 | 0.000 | .3613207   .6667354 |
| _cons| 1.792857 | .0690091 | 25.68| 0.000 | 1.655984   1.929729  
```

101
Inelasfg4 – income elasticity food group 4

Other abbreviations same as A.1.1

**Table A5: Cross Price Elasticity of Food Group 1 – Bread & Cereals**

<table>
<thead>
<tr>
<th>Equation</th>
<th>Obs</th>
<th>Parms</th>
<th>RMSE</th>
<th>&quot;R-sq&quot;</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
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<td>crspelasfg1</td>
<td>3478</td>
<td>7</td>
<td>.6793278</td>
<td>0.0700</td>
<td>43.54849</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

| crspelasfg1 | Coef. | Std. Err. | t  | P>|t|  [95% Conf. Interval] |
|-------------|-------|-----------|----|------|----------------------|
| eth         |       |           |    |      |                      |
| firm 2      | .2992871 | .0257802 | 11.61 | 0.000 | .2487411 - .349833 |
| firm 3      | .134556  | .0499881  | 2.69  | 0.007 | .0365469 - .2325651 |
| div         |       |           |    |      |                      |
| firm 2      | -.1351325 | .0447608 | -3.02 | 0.003 | -.2228926 - -.0473724 |
| firm 3      | -.0991802 | .0353248 | -2.81 | 0.005 | -.1684396 - -.0299208 |
| firm 4      | .0112236  | .0281866  | 0.40  | 0.691 | -0.0440404 - .0664876 |

| 2.area | -.1288919  | .0255556  | -5.04 | 0.000 | -.1789975 - -.0787863 |
| _cons   | -.4488745  | .0229701  | -19.54 | 0.000 | -.4939108 - -.4038383 |

| 2.area | -.1288919  | .0255556  | -5.04 | 0.000 | -.1789975 - -.0787863 |
| _cons   | -.4488745  | .0229701  | -19.54 | 0.000 | -.4939108 - -.4038383 |

Crspelasfg2 – income elasticity food group 2

Other abbreviations same as A.1.1

**Table A6: Cross Price Elasticity of Food Group 2 – Meat, Fish & Seafood**

```
mvreg crspelasfg2 = i.eth i.div i.area
```

<table>
<thead>
<tr>
<th>Equation</th>
<th>Obs</th>
<th>Parms</th>
<th>RMSE</th>
<th>&quot;R-sq&quot;</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
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<td>.6401285</td>
<td>0.0249</td>
<td>14.05011</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

| crspelasfg2 | Coef. | Std. Err. | t  | P>|t|  [95% Conf. Interval] |
|-------------|-------|-----------|----|------|----------------------|
| eth         |       |           |    |      |                      |
| firm 2      | .1202168  | .0248033  | 4.85  | 0.000 | .0715855 - .1688481 |
| firm 3      | .0014305  | .047704    | 0.03  | 0.976 | -.0921018 - .0949628 |
| div         |       |           |    |      |                      |
| firm 2      | .0131253  | .0436714  | 0.30  | 0.765 | -.0928926 - .0991433 |
| firm 3      | .1424399  | .0343873  | 4.14  | 0.000 | .0750174 - .2098625 |
| firm 4      | .0648916  | .0299968  | 2.40  | 0.016 | .0119595 - .1178238 |

| 2.area | .1162797  | .024552  | 4.74  | 0.000 | .0683141 - .1644184 |
| _cons   | -.6165859 | .0218586 | -28.21 | 0.000 | -.6594437 - -.5737281 |

Crspelasfg2 – income elasticity food group 2

Other abbreviations same as A.1.1
Table A7: Cross Price Elasticity of Food Group 3 – Milk, Cheese & Eggs

```
mvreg crspelasfg3 = i.eth i.div i.area
```

<table>
<thead>
<tr>
<th>Equation</th>
<th>Obs</th>
<th>Parms</th>
<th>RMSE</th>
<th>&quot;R-sq&quot;</th>
<th>F</th>
<th>P</th>
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<td>1.370046</td>
<td>0.0392</td>
<td>13.54123</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

| crspelasfg3 | Coef. | Std. Err. | t    | P>|t| | [95% Conf. Interval] |
|-------------|-------|-----------|------|------|----------------------|------------------------|
| eth         |       |           |      |      |                      |                        |
| 2           | -.4208316 | .0654599 | -6.43 | 0.000 | -.5492088           | -.2924544             |
| 3           | -.4528131 | .1300829 | -3.48 | 0.001 | -.7079261           | -.1977                |
| div         |       |           |      |      |                      |                        |
| 2           | -.4349885 | .1567194 | -2.78 | 0.006 | -.7423399           | -.127637              |
| 3           | -.3775982 | .1094886 | -3.45 | 0.001 | -.5919227           | -.1624738             |
| 4           | -.2867689 | .0706265 | -4.06 | 0.000 | -.4252786           | -.1482591             |
| 2.area      | -.0538116 | .0667282 | -0.81 | 0.420 | -.184676            | .0770528              |
| _cons       | .6245316  | .0584352 | 10.69 | 0.000 | .509931             | .7391323              |

crspelasfg3 – income elasticity food group 3

Other abbreviations same as A.1.1

Table A8: Cross Price Elasticity of Food Group 4 – Fruits & Vegetables

```
mvreg crspelasfg4 = i.eth i.div i.area
```

<table>
<thead>
<tr>
<th>Equation</th>
<th>Obs</th>
<th>Parms</th>
<th>RMSE</th>
<th>&quot;R-sq&quot;</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>crspelasfg4</td>
<td>3378</td>
<td>7</td>
<td>.5187591</td>
<td>0.0496</td>
<td>29.32132</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

| crspelasfg4 | Coef. | Std. Err. | t    | P>|t| | [95% Conf. Interval] |
|-------------|-------|-----------|------|------|----------------------|------------------------|
| eth         |       |           |      |      |                      |                        |
| 2           | .1224774 | .0196737 | 6.17 | 0.000 | .0829039            | .1600509              |
| 3           | .1129204 | .0393349 | 2.87 | 0.004 | .0357978            | .190043               |
| div         |       |           |      |      |                      |                        |
| 2           | -.0634199 | .0364545 | -1.71 | 0.087 | -.1338951           | .0090553              |
| 3           | -.0374472 | .0274747 | -1.36 | 0.173 | -.0913159           | .0164216              |
| 4           | .0851632  | .021701  | 3.92 | 0.000 | .0426147            | .1277117              |
| 2.area      | -.1399696 | .0197152 | -7.10 | 0.000 | -.1786245           | -.1013147             |
| _cons       | -.116095  | .0176708 | -65.70 | 0.000 | -.195596            | -.126303              |

crspelasfg4 – income elasticity food group 4

Other abbreviations same as A.1.1

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Table A9: Expenditure Shares on Food Group 1-Bread & Cereals

\[ \text{. mvreg } w1 = i.eth \ i.div \ i.area \]

<table>
<thead>
<tr>
<th>Equation</th>
<th>Obs</th>
<th>Parms</th>
<th>RMSE</th>
<th>&quot;R-sq&quot;</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>w1</td>
<td>3560</td>
<td>7</td>
<td>.1623516</td>
<td>0.2371</td>
<td>184.0887</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

| Coef. | Std. Err. | t | P>|t| | [95% Conf. Interval] |
|-------|-----------|---|--------|-------------------|
| eth   |           |   |        |                   |
| 2     | -.1145481 | .0060716 | -18.87 | 0.000 | -.1264522 | -.1026439 |
| 3     | -.0650596 | .0118325 | -5.50  | 0.000 | -.0882589 | -.0418604 |
| div   |           |   |        |                   |
| 2     | .0952206  | .0105564 | 9.02   | 0.000 | .0745234  | .1159178  |
| 3     | .0512684  | .0066842 | 7.18   | 0.000 | .0350055  | .0675313  |
| 4     | -.0155636 | .0082947 | -2.33  | 0.020 | -.0286688 | -.0024584 |
| 2.area| .0821571  | .0060441 | 13.59  | 0.000 | .0703068  | .0940075  |
| _cons | .2921748  | .0054444 | 53.67  | 0.000 | .2815004  | .3028492  |

w1 - expenditure share on food group 1.
Other abbreviations same as A.1.1

Table A10: Expenditure Shares on Food Group 2-Meat, Fish & Seafood

\[ \text{. mvreg } w2 = i.eth \ i.div \ i.area \]

<table>
<thead>
<tr>
<th>Equation</th>
<th>Obs</th>
<th>Parms</th>
<th>RMSE</th>
<th>&quot;R-sq&quot;</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>w2</td>
<td>3560</td>
<td>7</td>
<td>.1799474</td>
<td>0.0476</td>
<td>29.55668</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

| Coef. | Std. Err. | t | P>|t| | [95% Conf. Interval] |
|-------|-----------|---|--------|-------------------|
| eth   |           |   |        |                   |
| 2     | -.059123  | .0067296 | -8.79  | 0.000 | -.0723173 | -.0459287 |
| 3     | .0113458  | .0131149 | 0.86   | 0.387 | .0143697  | .0170574  |
| div   |           |   |        |                   |
| 2     | -.050097  | .0117005 | -4.28  | 0.000 | -.0730373 | -.0271566 |
| 3     | -.0615329 | .0091937 | -6.69  | 0.000 | -.0795584 | -.0435075 |
| 4     | -.0294502 | .0074086 | -4.04  | 0.000 | -.0444758 | -.0156246 |
| 2.area| -.0219712 | .0060441 | -3.28  | 0.001 | -.0351059 | -.0088365 |
| _cons | .374081   | .0060344 | 61.99  | 0.000 | .3622497  | .3859123  |

w2 - expenditure share on food group 2.
Other abbreviations same as A.1.1
Table A11: Expenditure Shares on Food Group 3-Milk, Cheese & Eggs

. mivreg w3 = i.eth.i.div.i.area

<table>
<thead>
<tr>
<th>Equation</th>
<th>Obs</th>
<th>Parms</th>
<th>RMSE</th>
<th>&quot;R-sq&quot;</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>w3</td>
<td>3560</td>
<td>7</td>
<td>.0812477</td>
<td>0.0750</td>
<td>48.03519</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

| w3 | Coef.   Std. Err. | t    | P>|t|  | [95% Conf. Interval] |
|----|-------------------|------|-----|----|----------------------|
| eth |                   |      |     |    |                      |
| 2  | 0.023589          | .0030385 | 8.36 | 0.000 | .0194416 | .0213563 |
| 3  | 0.0232756         | .0059215 | 3.93 | 0.000 | .0110657 | .0348854 |
| div |                   |      |     |    |                      |
| 2  | -.0009059         | .0052829 | 0.17 | 0.864 | -.0112837 | .0094821 |
| 3  | -.0026786         | .004151 | -.65 | 0.519 | -.0108172 | .00546 |
| 4  | .0264081          | .0033451 | 7.89 | 0.000 | .0198497 | .0329665 |
| area |                 |      |     |    |                      |
| 2  | -.0234516         | .0030247 | -.75 | 0.000 | -.0293821 | -.0175212 |
| _cons |               |      |     |    |                      |
| 3  | .053382           | .0027246 | 19.59 | 0.000 | .0480401 | .0587239 |

w3 - expenditure share on food group.

Other abbreviations same as A.1.1

Table A12: Expenditure Shares on Food Group 4-Fruits & Vegetables

. mivreg w4 = i.eth.i.div.i.area

<table>
<thead>
<tr>
<th>Equation</th>
<th>Obs</th>
<th>Parms</th>
<th>RMSE</th>
<th>&quot;R-sq&quot;</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>w4</td>
<td>3560</td>
<td>7</td>
<td>.1671652</td>
<td>0.1968</td>
<td>145.1265</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

| w4 | Coef.   Std. Err. | t    | P>|t|  | [95% Conf. Interval] |
|----|-------------------|------|-----|----|----------------------|
| eth |                   |      |     |    |                      |
| 2  | .1482722          | .0062516 | 23.72 | 0.000 | .1360151 | .1605292 |
| 3  | .0304402          | .0121833 | 2.50  | 0.013 | .006332 | .0543273 |
| div |                   |      |     |    |                      |
| 2  | -.0460295         | .0108694 | -4.23 | 0.000 | -.0673404 | -.0247187 |
| 3  | .0129431          | .0085407 | 1.52  | 0.130 | -.003802 | .0296882 |
| 4  | .0191057          | .0068824 | 2.78  | 0.006 | .0096119 | .0325995 |
| area |                 |      |     |    |                      |
| 2  | -.0367363         | .0062233 | -5.90 | 0.000 | -.048936 | -.0245326 |
| _cons |               |      |     |    |                      |
| 3  | .2803622          | .0056058 | 50.01 | 0.000 | .2693713 | .2913531 |

w3 - expenditure share on food group.

Other abbreviations same as A.1.1

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