HOUSEHOLD DEMAND FOR FRUITS AND VEGETABLES IN MALAYSIA

MANGALESWARI A/P K SUBRAMANIAM

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HOUSEHOLD DEMAND FOR FRUITS AND VEGETABLES IN MALAYSIA

by

MANGALESWARI A/P K SUBRAMANIAM

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LIST OF ABBREVIATIONS

AIDS   Almost Ideal Demand System

CAGR   Compounded Annual Growth Rate

CDF   Cumulative Distribution Function

CPI   Consumer Price Index

F.T   Federal Territory

FAMA   Federal Agriculture Marketing Authority

FOA   Farmer's Organisation Authority

FV   Fruits and vegetables

GDP   Gross Domestic Products

IMR   Inverse Mills Ratio

LA/AIDS   Linear Approximate Almost Ideal Demand System

LES   Linear Expenditure System

MANS   Malaysia Adult Nutrition Survey

MARDI   Malaysian Agricultural Research and Development Institute

MHES   Malaysian Household Expenditure Survey

MOA   Ministry of Agriculture and Agro-based Industry Malaysia

MOH   Ministry of Health Malaysia

MP   Malaysia Plan

NGO   Non-governmental Organisation

NHMS   National Health and Morbidity Survey

NW   North Western

PDF   Probability Density Function

QUAIDS   Quadratic Almost Ideal Demand System

US   United States

USDA	United States Department of Agriculture
USM	Universiti Sains Malaysia
WHO	World Health Organisation

PERMINTAAN ISIRUMAH UNTUK BUAH-BUAHAN DAN SAYUR-SAYURAN DI MALAYSIA

ABSTRAK

Di Malaysia, proses globalisasi telah mendorong perubahan dalam corak pengambilan makanan. Di tengah perubahan kepelbagaian corak pengambilan makanan, beberapa cabaran juga timbul dalam industri buah-buahan dan sayur-sayuran (FV) di Malaysia. Kajian ini menganggarkan keanjalan permintaan pendapatan harga sendiri, harga silang, permintaan pendapatan dan menilai keanjalan permintaan nutrien menggunakan data Penyiasatan Perbelanjaan Isirumah Malaysia, 2014. Seterusnya, unjuran permintaan diramalkan untuk menentukan keperluan FV dari 2025–2040. Untuk mencapai objektif ini, model *Quadratic Almost Ideal Demand System* (QUAIDS) digunakan. Kajian ini melibatkan dua kategori buah-buahan iaitu buah-buahan tidak bermusim dan bermusim, serta tiga kategori sayur-sayuran, iaitu sayuran jenis berakar, berdaun dan berbuah. Penggabungan dua kategori buah adalah mengikut musim, sementara ketiga-tiga kategori sayur-sayuran adalah berdasarkan sifat hasil pengeluaran. Dengan ini, ciri-ciri komoditi telah dikenal pasti sebelum digabungkan. Keanjalan permintaan harga sendiri tanpa kompensasi adalah negatif di kalangan isirumah bandar dan luar bandar. Di kawasan bandar dan luar bandar, keanjalan permintaan harga sendiri untuk buah-buahan bermusim dan sayur-sayuran berbuah adalah lebih daripada satu. Keanjalan permintaan harga silang tanpa kompensasi menunjukkan bahawa sebahagian besar komoditi FV mempunyai permintaan yang tidak elastik. Keputusan menunjukkan bahawa komoditi buah-buahan saling melengkapi sementara majoriti komoditi sayuran dikenal pasti sebagai pengganti. Hasil kajian keanjalan permintaan harga sendiri dan keanjalan permintaan

harga silang berkompensasi menggambarkan arah aliran yang sama dengan keanjalan permintaan harga sendiri tanpa kompensasi. Keputusan analisis keanjalan permintaan pendapatan menyimpulkan bahawa komoditi FV di Malaysia ialah barang normal. Keanjalan nutrien permintaan pendapatan adalah positif bagi semua komoditi FV. Keputusan juga menunjukkan bahawa kebanyakan keanjalan nutrien permintaan harga adalah negatif. Keanjalan nutrien permintaan harga dianggarkan tidak elastik di kalangan isirumah bandar dan luar bandar, dan bagi kumpulan pendapatan yang berbeza, sekali gus menunjukkan bahawa perubahan harga tidak banyak mempengaruhi permintaan nutrien. Secara umumnya, kajian ini menunjukkan bahawa kebanyakan pemboleh ubah sosiodemografi seperti ukuran isirumah, pendapatan, jantina ketua isirumah, etnik, usia, pendidikan, pekerjaan, status perkahwinan ketua isirumah dan kedudukan serantau isirumah adalah dikaitkan secara signifikan mengikut statistik dengan permintaan FV dan nutrien. Anggaran permintaan masa depan menunjukkan peningkatan permintaan bagi kesemua komoditi FV di bawah tiga senario pertumbuhan ekonomi yang berbeza. Komoditi buah-buahan tidak bermusim, buah-buahan bermusim, dan sayur-sayuran berbuah ialah komoditi yang mempunyai permintaan paling tinggi. Oleh yang demikian, kajian ini mengesyorkan beberapa dasar yang menumpukan pada kawalan harga dan peningkatan pendapatan isirumah untuk menggalakkan permintaan terhadap FV dan nutrien. Sokongan teknikal disyorkan untuk ditawarkan kepada penanam bagi meningkatkan hasil FV mengikut jadual pengeluaran yang sesuai untuk memenuhi permintaan FV yang semakin meningkat.

HOUSEHOLD DEMAND FOR FRUITS AND VEGETABLES IN MALAYSIA

ABSTRACT

In Malaysia, the globalisation process has driven the country to experience changes in food consumption patterns. Amidst the changing diversification of food consumption patterns, several challenges also arise in the Malaysian Fruits and Vegetables (FV) industries. This study estimates FV's own-price, cross-price, income demand elasticity and evaluates nutrient demand elasticities using Malaysia Household Expenditure Survey (MHES) data set 2014. Demand is forecasted to predetermine the FV demand from 2025–2040. To achieve these objectives, the Quadratic Almost Ideal Demand System (QUAIDS) model is used. This study involved two categories of fruits: non-seasonal and seasonal, and three categories of vegetables: root, leafy and fruity vegetables. The aggregation of the two categories of fruits are according to seasonality, while the three categories of vegetables are based on the nature of the produce. With these, the characteristics of the commodities have been identified before it is being aggregated. The uncompensated own-price demand elasticity is negative among urban and rural households. In both areas, the own-price demand elasticity for seasonal fruits and fruity vegetables is greater than one. The uncompensated cross-price demand elasticity revealed that most FV commodities have inelastic demand. The results reveal that fruit commodities complement each other while vegetable commodities are primarily substitutes. The result of compensated own-price and cross-price demand elasticities, depict the same trend as the uncompensated own-price demand elasticity. The income demand elasticity show that FV commodities in Malaysia is normal commodities. The income nutrient demand elasticity is positive across all the FV commodities. Most price nutrient demand

elasticity is negative. Price nutrient demand elasticity is inelastic among urban and rural households and across different income groups, indicating that price changes have little effect on the nutrient demand. In general, the study reveals that most sociodemographic variables such as household size, income, gender of household heads, ethnicity, age, education, occupation, marital status of household heads and region of households are significantly associated with FV and nutrient demand. Future demand estimate shows an increase in demand for all FV commodities under three different economic growth scenarios. Non-seasonal fruits, seasonal fruits, and fruity vegetables appears to be the most demanded commodities. Therefore, the study recommended a few policies that focus on price regulation and household income improvement to enhance the demand for FV and nutrients. In addition, it is recommended to provide technical support to the growers to enhance FV produce according to proper production schedules to meet the growing FV demand.

CHAPTER 1

INTRODUCTION

The phenomena of globalisation have a significant impact on food demand worldwide (Vorley & Lançon, 2016). Such changes in the food system have resulted in higher food availability and diversity (Kennedy et al., 2004). In Malaysia, the globalisation process has also driven the country to experience changes in food consumption patterns. The changes in food expenditure structure and diversification have improved Malaysians' quality of life (Ishida et al., 2003; Rao, 2000).

A steady economic growth rate is augmented by significant progress in food consumption trends among Malaysian households. Over the past decades (1970–2018), the nation has successfully maintained an average annual growth rate of 6.1% in real gross domestic products (GDP) (Organisation for Economic Co-operation and Development, 2019). Per capita income has also increased during the same period and reached RM 42,937 in 2018 (Ministry of Finance Malaysia, 2019). Such changes empower lifestyle changes towards a better quality of life for Malaysians and provide a new perspective on Malaysia's food consumption outlook.

1.1 Malaysian Demographic Background

1.1.1 Household Income Classification

The Department of Statistics Malaysia refers to household income as a total income emolument received by the household members either in cash or in kinds during the survey period (Department of Statistics Malaysia, 2014a). In 2010, the Malaysian government initiated a new approach to income distribution, and it was actualised in the Tenth Malaysia Plan 2011–2015 (10th MP). The 10th MP has given a

new perspective for the household income classification: (i) Bottom 40 (B40), (ii) Middle 40 (M40), and (iii) Top 20 (T20) (Economic Planning Unit Malaysia, 2010).

Table 1.1 shows that in 2009, the Bottom 40 (B40) comprised 40.0% of the households with a total income of less than RM 2,300 per month. The Middle 40 (M40) comprised another 40.0% of households, which earned between RM 2,300–RM 5,599 per month. The top income group (T20) consists of 20.0% of households in the income bar, more than RM 5,600 per month. Over the years, each group's income level has increased.

Table 1.1 Income range for B40, M40, and T20 households in 2009, 2012, 2014, 2016 and 2019

	B40 (RM)	M40 (RM)	T20 (RM)
2009	<2,300	2,300 – 5,599	>5,599
2012	<3,050	3,050 – 5,960	>6,950
2014	<3,855	3,856 – 8,135	>8,135
2016	<4,360	4,360 – 9,619	>9,619
2019	<4,850	4,850 – 10,959	>10,959

(Source: Department of Statistics Malaysia, 2010, 2014b, 2017b; Economic Planning Unit Malaysia, 2019; Rashid et al., 2018)

In 2014, the B40 income group grew at the highest rate, about 26.4%, from RM 3,050 in 2012 to RM 3,855 in 2014, followed by 13.0% in 2016 and 11.2% in 2019. One of the possible reasons for the rise in 2014 could be the implementation of minimum wages in 2013 by the Malaysian government (Department of Statistics Malaysia, 2014b).

The revised income range in 2019 showed that the B40 income group was scaled less than RM 4,850 while the M40 income group was scaled between RM 4,850–RM 10,959, and T20, the income range recorded at RM 10,960 and above.

1.1.2   Urban-Rural Poverty

One of Malaysia's primary economic objectives is to eradicate poverty and restructure societal imbalances (Economic Planning Unit Malaysia, 2017). Therefore, the nation has successfully reduced the overall poverty rate[1] from 49.3% in 1970 to 0.4% in 2019, as shown in Figure 1.1. Meanwhile, the poverty rate for urban and rural also exhibited a declining trend over the same period.
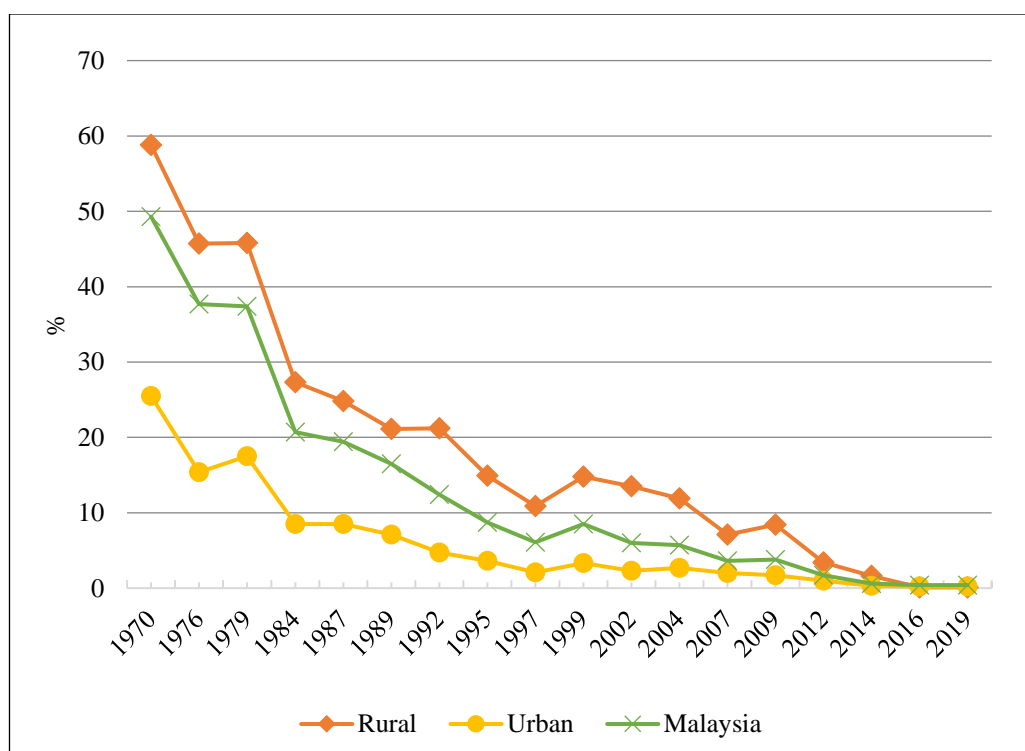
Figure 1.1 Poverty rate urban-rural, Malaysia 1970–2019

(Source: Economic Planning Unit Malaysia, 2016; Ministry of Women Family and Community Development Malaysia, 2019)

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[1] Malaysia's National Poverty Line Income (PLI) for the poor is a monthly household income of RM 2,2800 (Department of Statistics Malaysia, 2017b).

Despite the remarkable drop in the poverty rate over the years, poverty still exists at roughly 0.2% in urban areas and 0.1% in rural areas in 2019. The low poverty rate showed that the nation experienced significant progress successfully in reducing the poverty rate. This is very important to the nation in restructuring the societal imbalance, regardless of its locality differences.

1.1.3 Gap Between Average Households Income Groups and Urban-Rural Households

In Malaysia, the overall household income groups have registered an increase in its annual growth rate over the years, as shown in Figure 1.2. Household income group B40 reported a yearly growth rate of 6.6% in 2014–2016, where the median income rose from RM 2,629 to RM 3,000 in 2016. However, the growth decelerated sharply at 1.8% in 2016–2019. This annual growth rate appeared to be the lowest rate, which indicates that the B40 households are experiencing the slowest annual income growth.

Household income group M40 posted the highest annual growth in 2014–2016 with 6.9%; the median income rose from RM 5,465 in 2014 to RM 6,275 in 2016. Subsequently, household income group M40 reported a yearly growth rate of 4.1% in 2016–2019. In contrast, household income group T20 registered the highest annual growth rate of 4.8% in 2019, where the median income rose from RM 13,148 in 2016 to RM 15,301 in 2019.
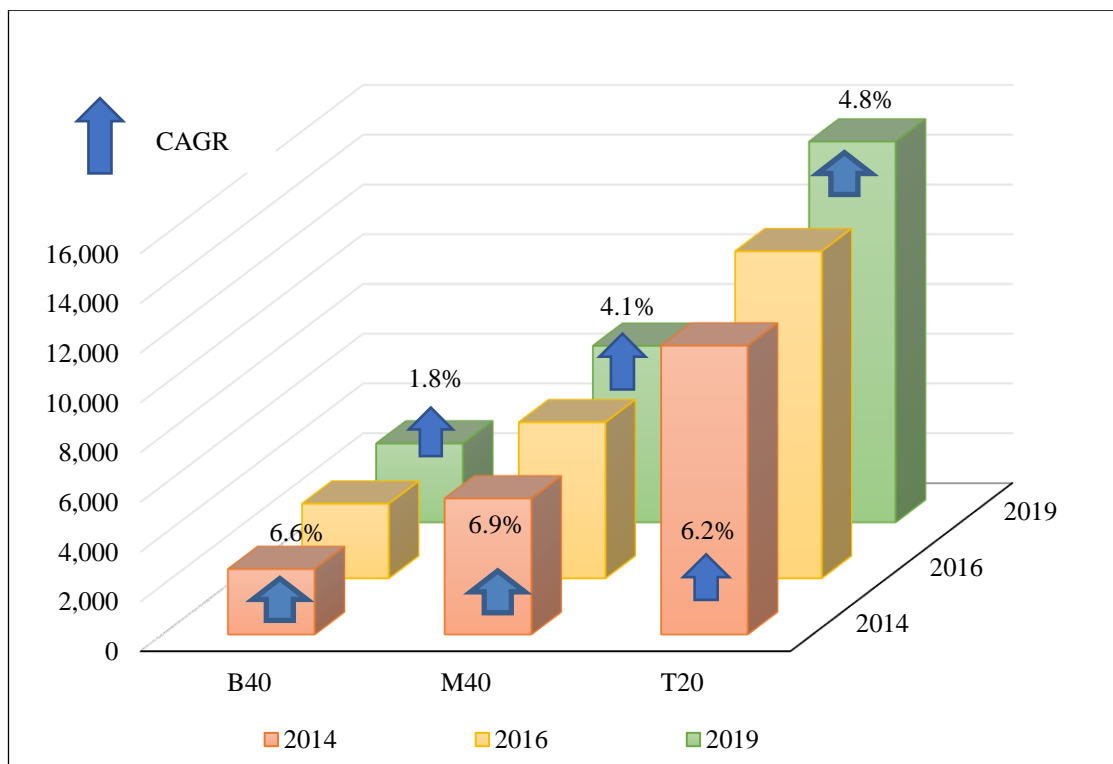
Figure 1.2 Compounded Annual Growth Rate (CAGR) by income groups, 2014–2019

(Source: Department of Statistics Malaysia, 2014a, 2020)

Although income growth among the T20 households continued to grow steadily, growth among the B40 group had not been occurring at a similar rate. This happened as the income gap between the T20 and B40 groups showed an unequal distribution pattern among Malaysian households. Nevertheless, it is also crucial to understand the urban-rural household income distribution to understand the equitable distribution between urban and rural households. Figure 1.3 depicts the average household gross income between urban-rural and its disparate income gap.
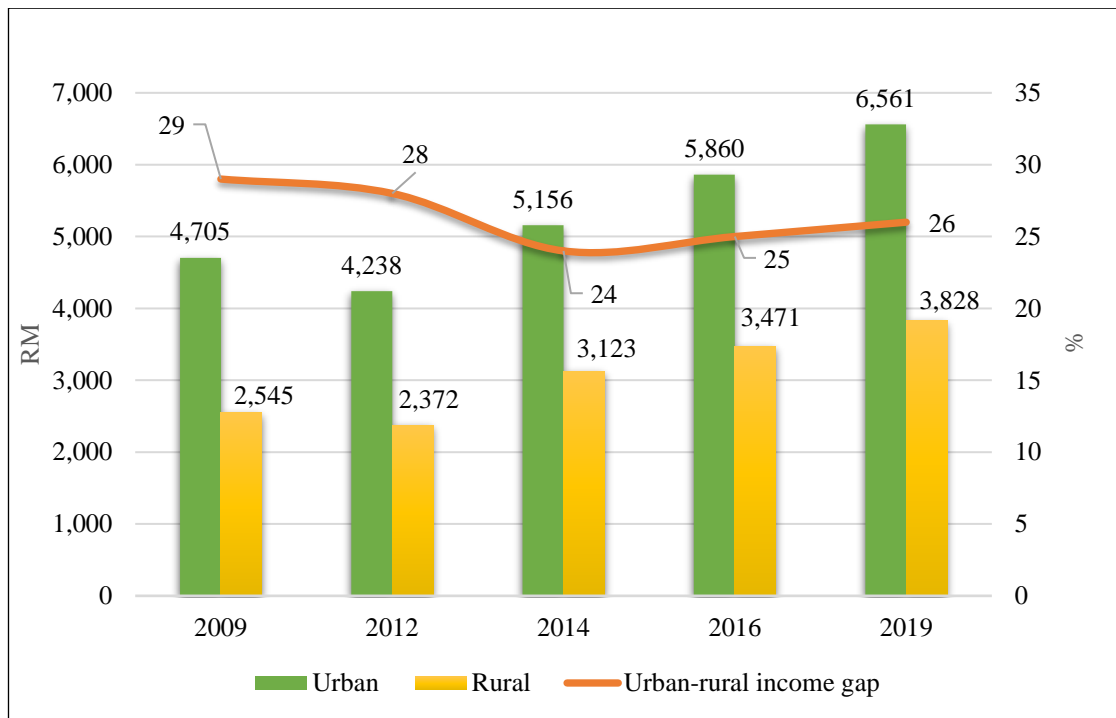
Figure 1.3 Average household gross income of urban, rural, and urban-rural income gap, 2009–2019

(Source: Department of Statistics Malaysia, 2011, 2014a, 2020; Ministry of Rural and Regional Development Malaysia, 2015)

In 1999, monthly household gross incomes were RM 4,705 for urban and RM 2,545 for rural households. Meanwhile, in 2014 the monthly household gross incomes in urban and rural households averaged RM 5,156 and RM 3,123, respectively. The differences in income between the urban-rural households over the periods were noticeable as the average monthly household gross income among urbanities are roughly double than those of rural households. At the same time, there was a slight increase in the income gap by 0.1%, from 25.0% in 2016 to 26.0% in the year 2019. In general, the gap has been narrowing in recent years. The narrowing disparity in urban-rural income suggests that economic welfare in rural households is on the rise.

1.2 Food Consumption Patterns

The rising trends in economic growth and per capita income have contributed to diversifications in the food consumption patterns of various food groups among Malaysians. For example, fish and seafood saw steady increases in per capita household consumption, with a rise of nearly 218% between 1993 and 2019 (Table 1.2). Meanwhile, rice, bread, and cereal exhibited an almost 167% increase in per capita household consumption over the same period. Both outcomes are expected given the availability of fish and seafood products in a country such as Malaysia, with vast coastal shorelines and rice being a staple food item in the local diet. As for other main commodity groups, household expenditures for meats also registered a steady increase by 167% over the same period, thus suggesting a preference and consumption of meat among Malaysians.

Meanwhile, despite a modest increase of only 17%, the combination of Fruits and Vegetables (FV) has consistently ranked in the top three highest commodity food groups in terms of per capita consumed in Malaysia.

Table 1.2 shows the per capita consumption of FV showed an increasing trend of 132% from 1993–2019, suggesting the potential for FV to be further ingrained into the Malaysian diet.

Table 1.2 Per capita household consumption of food, Malaysia, 1993–2019
(RM/Month)

Commodity Group	1993/ 94	1998/ 99	2004/ 05	2009/ 10	2014	2016	2019
Rice, bread and cereal	56	81	80	97	131	141	150
Meat	41	50	54	64	101	104	109
Fish and seafood	53	74	82	98	150	158	169
Milk, cheese and eggs	24	30	31	38	56	59	64
Fruits	25	30	27	26	39	48	53
Vegetables	35	45	44	47	80	84	86
Total FV	60	75	71	73	119	132	139
Coffee, tea, and non-alcoholic beverages	13	19	25	29	43	43	48
Other foods	31	40	50	46	56	69	80

(Source: Department of Statistics Malaysia, 2011, 2014a, 2017b, 2019)

1.3 Fruits and Vegetables Consumption by Urban-Rural Households

Studies have shown significant differences between FV diets in urban versus rural households (Chan et al., 2014; Cheung et al., 2021; Chong et al., 2017; Izzah et al., 2012). One possible reason for this outcome is that FV is typically home-grown in rural areas, while the availability of fresh produce is more limited in urban areas. FV prices could also be higher in urban than rural areas due to transportation and distribution costs (Cheung et al., 2021). In contrast, studies have also argued that the higher socioeconomic statuses (e.g. education, income) of urban households may be the primary factors driving FV intake (Izzah et al., 2012). Advertisements and awareness campaigns promoting FV's health benefits are also more prevalent in urban

areas, contributing to its increased consumption among urbanites (Cheung et al., 2021).

In Malaysia, food insecurity is more prevalent among rural households, of which 85.2% are facing this problem, while 40.8% involve child hunger (Mohamadpour et al., 2012). Studies have also pointed out that calorie consumption is considerably lower among rural compared to urban households. This occurs as urban households generally possess higher income, and have better access and supplies of a wider range of foods enabling them to consume more FV than rural households (Shariff et al., 2015).

Ooi (2016) also suggested that urban households in Malaysia consume a more diverse and nutritious diet than those in rural areas. For example, urban households spent 8.3% (10.6%) of their monthly expenditure allocation on fruits (vegetables) compared to only 5.1% (10.5%) by rural households (Department of Statistics Malaysia, 2011). This showed that while the proportion consumption of vegetables may not differ between urban and rural households, urbanites appear to be spending relatively more on fruits than rural dwellers. Figure 1.4 shows monthly household consumption expenditure on FV by urban-rural households in Malaysia from 2014–2019.
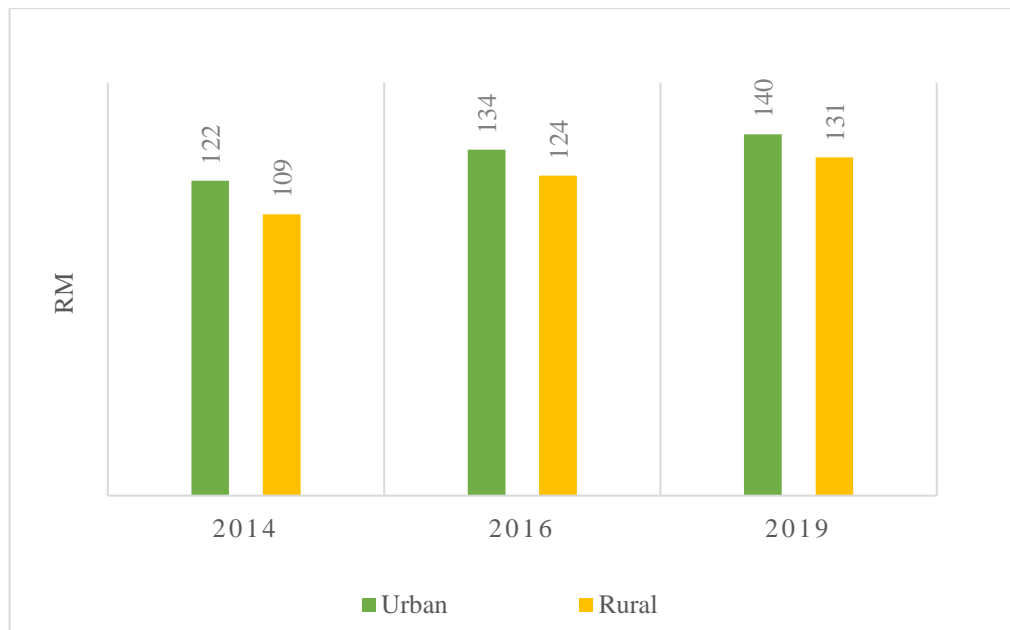
Figure 1.4 Monthly household consumption expenditure of fruits and vegetables by urban-rural Malaysia, 2014–2019

(Source: Department of Statistics Malaysia, 2014a, 2019; Khazanah Research Institute Malaysia, 2018)

Figure 1.4 depict the total consumption expenditure of FV which shows an increasing trend for both urban and rural households. The urban household expenditure increased around 9.9% in 2016, from RM 122/month in 2014 to RM 134/month in 2016 and increased to RM140/month in 2019. Meanwhile, rural households FV expenditure also shows a steady increasing trend from RM 109/month in 2014 to RM 124/month in 2016 and RM 131/month in 2019. Even though the urban and rural households showed an ascending path, the urban households appeared to spend more on FV.

1.4 Fruits and Vegetables Consumption by Income Groups

Studies have shown significant variances between FV expenditure among different income groups (Khaliukova, 2013; Ruel & Alderman, 2013; Tey, 2008a). Figure 1.5 depicts the monthly household FV consumption expenditure by income groups, 2014–2019.
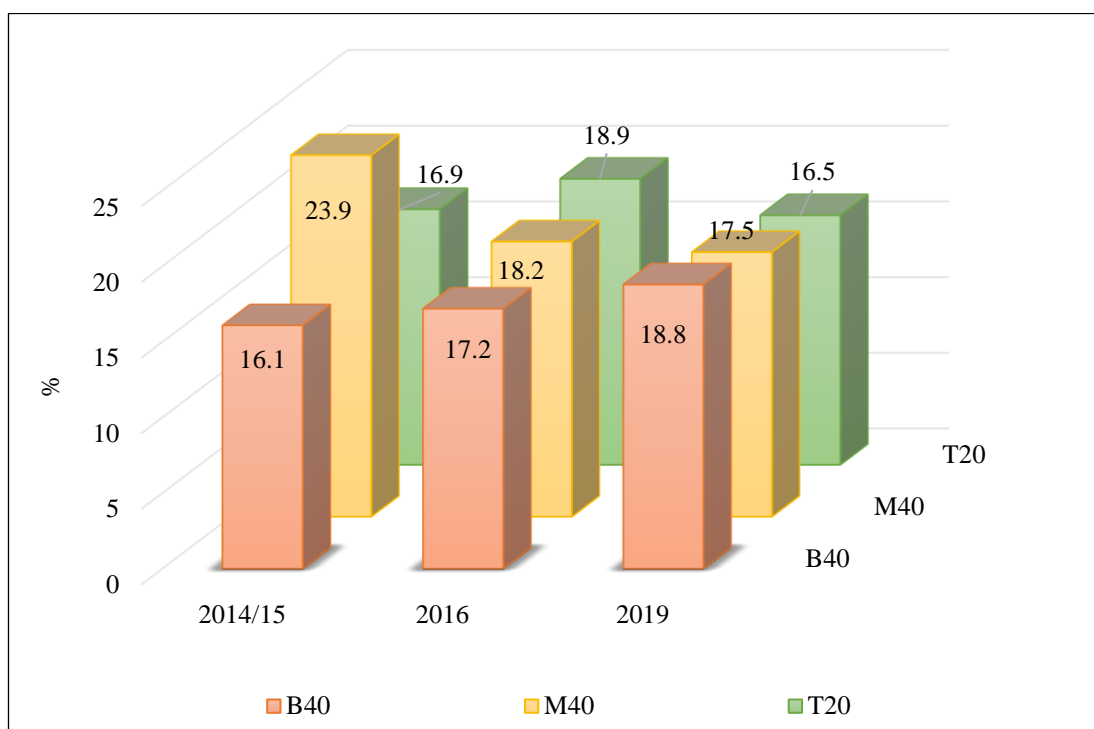
Figure 1.5 Proportion of monthly household consumption expenditure of FV by income groups, Malaysia, 2014–2019

(Source: Department of Statistics Malaysia, 2010, 2014b, 2017b)

Figure 1.5 shows the monthly household consumption expenditure trend by income group classifications; B40, M40 and T20. In 2014, M40 households registered the highest consumption of FV with 23.9%. However, the expenditure continued to drop in 2016 and 2019, with the percentage allocated for FV being 18.2% and 17.5%, respectively. Among T20 households, the proportion of monthly FV dropped from 18.9% in 2016 to 16.5% in 2019. This complied with "Engel's law", the food share

of the total budget was expected to decline as income increased. In line with this, an increase in income level among T20 households reflected the declining proportion of FV consumption expenditure in 2019.

On the other hand, B40 households showed continuous growth in FV consumption expenditure from 16.1% in 2014 to 17.2% in 2016 and 18.8% in 2019. This portrays the preferences of the B40 households on FV consumption as B40 have a less diverse option on food intake compared to more affluent income groups. Besides that, M40 and T20 also have different preferences in their budget allocation. Subsequently, the Department of Statistics Malaysia (2019) reported that B40 allocated 24.2% on food expenditure compared to only 18.0% by M40 and 12.6% by T20.

1.5   Issues Arising

Amidst the changing diversification of food consumption patterns of various food groups and differences in consumption patterns between the urban-rural and income divides, several challenges arises in the Malaysian FV industry (Lipoeto et al., 2013; Othman et al., 2013). First, growers facing a lack of understanding of consumer demand often encounter scheduling and planning issues throughout the year. World Bank Group (2019) also reported that lack of information on consumer preferences regarding volume, varieties and grades are some of the agro production weaknesses. Therefore, an imbalanced market setting resulted as production did not meet consumer demands. This scenario was highlighted by the Federal Agriculture Marketing Authority (FAMA) that due to the low production of certain types of home-grown FV, its prices were often higher than imported products (Ruban, 2015). Prices of locally grown FV were also commonly hiked up by several stages from wholesale to retail

markets (Khazanah Research Institute Malaysia, 2019; Man et al., 2009). To meet this excess demand, the government of Malaysia had to rely on approximately RM 3.2 billion worth of imported vegetables in 2014 (Carvalho, 2015).

On the other hand, insufficient and inconsistent production is one of the major problem (Man et al., 2009). Thus, the misguidance of consumer demand in the FV market is one reason this issue arises. This situation transpired during the seasonal fruits season in 2015, when the prices of seasonal fruits dropped drastically. For example, in Malaysia's Northern Region, a glut in 'durian kampung' caused its market price to decrease as low as RM0.50/kg. As a result, the Ministry of Agriculture and Agro-based Industry Malaysia (MOA) had to step in to set minimum floor prices to assist growers who were facing financial losses due to overproduction and prevailing low market prices (Berita Harian Malaysia, 2015).

Secondly, the prevailing FV consumption patterns among Malaysians is a concern. According to the World Health Organisation (WHO), a daily intake of five servings (approximately 400 grams) of FV, consisting of two servings of fruits and three servings of vegetables, is recommended for optimal health (Food and Agriculture Organisation of the United Nations and World Health Organisation, 2003). In Malaysia, Ghazali et al. (2015) revealed that one of the major lifestyle risk factors is inadequate FV intake, accounting for 72.8% compared to other factors. This can be seen in the World Health Organization (2013) report that showed a large portion of Malaysian adults, approximately 84.9%, failed to meet the recommended FV intake. Supported with this, the Malaysian Adult Nutrition Survey 2014 (MANS) data also revealed that Malaysian adults consumed only 1.4 servings of fruits and 1.5 servings of vegetables daily (Ministry of Health Malaysia, 2014b). This indicates that

Malaysian adults do not eat enough FV and failed to meet the WHO total recommendation of five servings per day for ideal health.

Low consumption of FV would increase the risk of obesity, diabetes, diverticulosis, and hypertension. It can also lead to death caused by ischaemic heart disease and stroke at the risk rate of about 11% and 9%, respectively (Hall et al., 2009; World Health Organization, 2017). Thus, despite knowing the importance of FV, the low intake of FV in Malaysia is an issue that needs to be addressed.

Thirdly, Malaysia's evolving economic and population growth rate have significantly created uncertainty in food demand (World Bank Group, 2019). Consequently, it disturbed the pattern of FV demand. Ministry of International Trade and Industry Malaysia (2019) reported that these issues need to be addressed in facilitating the FV industry to meet the demands.

1.6   Problem Statement

Given the challenges faced by the FV industry in Malaysia, several issues have arisen. First, growers in Malaysia are often caught unaware of consumer demand, thus causing an imbalanced market structure in the FV industry. This is manifested by production shortages of certain FV, leading to an over-reliance on imported products. Inappropriate scheduling and planning problems also occur in the FV industry resulting in overproduction and wastage. Secondly, despite the known importance of FV to individual health, Malaysians still did not eat enough FV as the amount consumed are far lower than the total recommended by WHO for optimal health. These unmet nutritional needs pose a potential major health problem to Malaysians and may exacerbate the future health costs of the nation. Third, evolving economic scenarios

(e.g. GDP growth and projected population increases) created market uncertainties in the FV industry. This resulted in indiscriminate planning of the types and quantities of FV to be produced locally or imported from abroad.

1.7 Research Questions

This study poses the following research questions:

(i) What are the FV demand elasticities ((uncompensated and compensated) own-price, cross-price, income) and how are sociodemographic factors associated with FV demand among Malaysian households according to urban-rural and income groups settings?

(ii) What are the FV nutrient elasticities (uncompensated price, income) and how are sociodemographic factors associated with FV nutrient intake among Malaysian households according to urban-rural and income groups settings?

(iii) How does economic growth affect the future FV demand among Malaysian households?

1.8 Research Objectives

The primary objective of this study is to examine the household demand for FV in Malaysia. Specific objectives are:

i. To estimate the demand elasticities ((uncompensated and compensated) own-price, cross-price, income) and examine the role of

sociodemographic factors on FV demand among Malaysian households according to urban-rural and income groups classifications.

ii.   To estimate the nutrient elasticities (uncompensated price, income) and examine the role of sociodemographic characteristics on FV nutrient intake among Malaysian households according to urban-rural and income groups classifications.

iii.   To project future FV demand of Malaysian households under different economic growth scenarios.

1.9   Data

Data from this study were obtained from the Malaysian Household Expenditure Survey (MHES) conducted by the Department of Statistics Malaysia in 2014. The survey covered cross-sectional households in urban and rural areas in Malaysia. The primary purpose of the MHES survey was to collect information on the levels and patterns of consumption expenditure by Malaysian households on a comprehensive range of goods and services. It is also used to update the consumer price index (CPI) weights. This inflationary indicator measures the average rate of change in prices of a fixed basket of goods and services, representing the expenditure patterns of households in Malaysia (Department of Statistics Malaysia, 2011).

In this study, data on household expenditures on FV was utilised. Specifically, expenditures on fruit commodities (i.e. guava, jackfruit, banana, papaya, ciku, pineapple, watermelon, duku, cempedak, duku, durian, and mangosteen) were used. Meanwhile, expenditures on vegetable commodities (i.e. ginger, pumpkin, cabbage, sawi, kailan tomato, cucumber, brinjal, okra, fresh chilli, fresh beans and long beans)

were used. The choice of selected FV crops is based on the varieties of items most commonly consumed in Malaysia (Federal Agriculture Marketing Authority, 2014). Besides, the selected crops are also among the FV highlighted in the Ninth Malaysia Plan 2006–2010 (9th MP), which was given a high priority of domestic and export markets (Salleh & Yusof, 2006).

Additional data sourced from the MHES are sociodemographic information, of the households, such as the household head's gender, age, education, occupation, and marital status. Other household information, including ethnicity, household size, state of household, urbanicity (urban/rural), regional and income level (Department of Statistics Malaysia, 2014a).

Since FV prices are unavailable from the MHES, this information was obtained from FAMA. FAMA is an authorised agency under the MOA to collect data on FV prices. FAMA compiles plantation and crop prices, including farm price, the wholesale price and retail price. For this study, FAMA's retail price of each FV commodity is according to the state for the same period as the MHES used. To calculate the nutrient volumes consumed, information on the nutrient content on the selected FV has been obtained from the United States Department of Agriculture (USDA) nutrient database (United States Department of Agriculture, 2014).

1.10   Scope of Study

Although the MHES consisted of specific information on various food items purchased by households in Malaysia, two (2) categories of fruits and three (3) categories of vegetables were examined. Aggregation of the two categories of fruits are according to seasonality (non-seasonal and seasonal), while the three categories of

vegetables are based on the nature of the produce (root, leafy, fruity). In this study, the aggregated analysis of the FV items are conducted for two reasons. First, the types of fruits considered may have different characteristics. Seasonality plays a significant role in supply as non-seasonal fruits (e.g. guava, jackfruit, banana, papaya, ciku, pineapple, watermelon) can be obtained throughout the year. In contrast, seasonal fruits (e.g. cempedak, duku, durian, mangosteen) are only available during specific periods of the year.

Secondly, the types of vegetables considered generally come from diverse environments. In particular, the lifespan of root and even fruity vegetables is usually longer than leafy vegetables. Further information on the breakdown of food categories is provided in Figure 1.6.

Therefore, the commodities were grouped according to the common classification, such as seasonal and non-seasonal for fruit commodities while root, leafy and fruity vegetables for vegetable commodities. With this, the characteristics of the commodities were identified before being grouped. Besides that, growers commonly have few commodities that grow together based on the similar pattern of farming. For instance, the cucumber growers may also grow long beans as it has the same growth pattern such as the time frame and farming facilities.

Nonetheless, it is acknowledged that the MHES data does not differentiate FV in terms of its domestic or imported nature, nor specify the organic or inorganic FV types. Therefore, the scope of the current study is limited to the expenditures on the specific type of FV consumed.
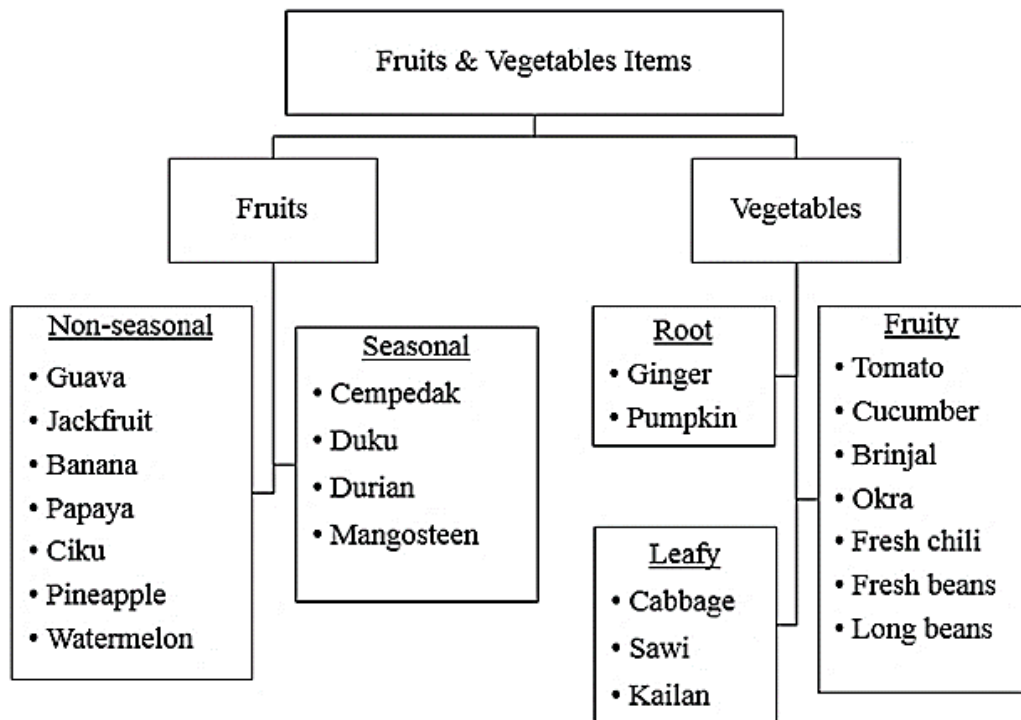
Figure 1.6 Breakdown of fruits and vegetables categories

1.11   Framework of Study

The study framework is provided in Figure 1.7. fruits were categorised according to seasonality (non-seasonal and seasonal), while vegetables were classified based on type (root, leafy, fruity). To fulfil the first objective of the study, analysis of (uncompensated and compensated) own-price, cross-price and income elasticities for the five (5) categories of FV was conducted using the Quadratic Almost Ideal Demand System (QUAIDS) model. The role of sociodemographic factors on FV demand will be further examined by urban-rural and income group settings.

The price demand elasticity and income demand elasticity were utilised to compute nutrient elasticities using the QUAIDS model to fulfil the second objective. The role of sociodemographic factors was examined based on nutrient demands, and analysis conducted according to urban-rural and income groups breakdowns.

The third objective is actualised as information on income demand elasticity obtained from the first objective will be combined with Malaysia's projected growth rate and population trend to compute the FV demand projection between the years 2025–2040.

Note: e* - elasticity

Figure 1.7 Framework of study

1.12   Significance of Study

This study is relevant as it provides essential information on the demand for FV in general and specific commodities in the industry. Knowledge of how changes in price and income as well as sociodemographic factors on demand for FV would enable growers to anticipate the responsiveness of Malaysian consumers to the product. Malaysian government agencies (e.g. MOA, FAMA, Malaysian Agricultural Research and Development Institute (MARDI), Farmer's Organisation Authority (FOA), and Ministry of Health Malaysia (MOH)) can also differentiate the trends and variations of the consumer needs based on the different urban-rural and income group settings. Comprehensive knowledge of the demand structure and consumer behaviour needs towards FV commodities will allow the government authorities, agribusinesses, food marketing agencies, and growers to tailor effective marketing programmes to specific segments of the communities based on their sociodemographic characteristics. As a result, the scheduling and planning issues and imbalanced market settings (under/overproduction) faced by growers would be solved.

Based on large sample nationwide data, information on the nutrient demand elasticities allows for a better understanding of the nutritional needs of Malaysians in response to price and income changes. Insights on nutrient demand elasticities would enable government policymakers to balance the variations in nutrient intake among Malaysian households. This includes designing effective nutrition-related policies for specific target groups (e.g. by ethnic backgrounds, gender, educational status, household size) in different urban-rural and income groups settings to balance the nutritional needs among Malaysians. Ruel and Alderman (2013) and Ecker and Qaim (2011) suggested understanding the food consumption patterns and nutrient elasticities

allows policymakers to design policies effectively and help obtain ideal nutrition information, ultimately leading to a healthier lifestyle among Malaysians.

The demand projections for various FV in Malaysia will enable the growers to estimate the future demand for FV among households in Malaysia. This future demand projection based on income demand elasticity found in this study and coupled with different economic scenarios (e.g. GDP growth and projected population) will allow growers and related government agencies to anticipate future demand and schedule proper production timetables in the FV industry from 2025–2040. In doing so, problems caused by indiscriminate planning of the types and quantities of FV to be produced or imported from abroad can be minimised.

1.13   Organisation of Study

The rest of this study is organised as follows. Chapter 2 provides insights from the literature. An overview and important concepts related to this study are put forth, followed by a discussion on nutrient demand elasticities. Next, description of the demand system's properties and choice of functional form and variables are discussed. Chapter 3 describes the methodology used in this study. Data sources and their transformation are explained in detail. Chapter 4 provides the estimation and interpretation of the results. Chapter 5 summarizes results, conclusions, and arising policy implications. Limitations of the study and recommendations for future studies are also provided in this concluding chapter.

CHAPTER 2

LITERATURE REVIEW

The following discussions provide an overview of the concepts and theoretical reviews related to this study. This is followed by discussions on the demand model consisting of the single demand model and the complete demand system. Next, insights from the literature on FV demand are discussed. The methodologies used in estimating demand systems are also reviewed.

2.1   Demand

Demand is the quantity of goods and services that consumers desire and are willing to purchase in a market at various prices during a specific period (Rehman et al., 2014). In short, demand describes a list of factors that justify the consumer's desire and the price that he or she is willing to pay for the goods and services.

$$D = f(P_x, P_y, M, T, Pop)$$
                                                                    2.1

Where

P_x	= price of commodity x
P_y	= price of commodity y
M	= income
T	= taste (age, gender, occupation, marital status)
Pop	= population

Equation 2.1 explains the demand for commodity x, an individual's willingness to purchase certain commodities during a certain time period. It is determined by the price of the commodity (x), price of other commodities (y), income (M), taste (T) (individual preferences), and population (Pop). As for taste, it is associated with