ASSESSING THE DEMAND FOR A HEALTHY DIET IN SRI LANKA: THE ALMOST IDEAL DEMAND SYSTEM WITH INFREQUENCY OF PURCHASE

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Abstract

Due to the high prevalence of diet related diseases and malnutrition, assessing dietary choices in terms of a healthy diet is essential in the Sri Lankan context. By utilizing the Household Income and Expenditure Survey, 2006/07, Linear Approximation of the Almost Ideal Demand System (LA/AIDS) was employed to estimate price and expenditure elasticities, while paying particular concern to the infrequency of purchase. The results revealed that own and relative prices, real expenditure, demographic and socio-economic characteristics will immensely affect the dietary choices and income related policies will have a more impact on promoting food consumption. Hence, the government should pay more attention to these aspects when establishing policies.

Keywords: AIDS model, censoring, demand, elasticity, healthy diet

JEL Codes: I12, I31, C22

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INTRODUCTION

Food demand patterns of a particular country play a vital role in developing policies. They assist to improve the nutritional status of individuals and households through identifying the most appropriate policy interventions. They help the government in which food subsidy strategies should be implemented. Moreover, the knowledge of the food consumption behaviour is essential for sectoral and macroeconomic policy analysis (Weliwita *et al.* 2003).

The estimation of price and income elasticities of food is the key to the analysis of food demand behaviour. According to the literature, primary attention has been paid in the past to the estimation of food demand elasticities in developed countries (Weliwita *et al.* 2003). Although a number of studies have been published on the subject in developing countries like South Africa (Agbola, 2003), Tanzania (Weliwita *et al.* 2003), India (Kumar *et al.* 2011), Pakistan (Mudassar, 2012), Nigeria (Fashogbon and Oni, 2013) etc., there is a paucity of studies on food demand behaviour of Sri Lankans in the published literature.

Conversely, consumption of plenty of foods may not provide all the essential nutrients that the body needs to be healthy and function efficiently whereas, a healthy diet does. According to the food based dietary guidelines for Sri Lankans, a healthy diet comprises of six food groups:

1. grains and tubers
2. fruits
3. vegetables
4. fish, pulses, meat and eggs
5. milk and/or milk products
6. nuts and oil seeds (Ministry of Health, 2011), which provide carbohydrates, proteins, fats, vitamins and minerals. These constituents of a healthy diet not only provide nutrients, but also, are responsible for serving numerous functions such as providing energy for bodily functions and daily activities, protecting body from diseases, assisting in growth and maintenance of the body, bones and teeth etc.

However, due to urbanization, economic growth and changes in lifestyle patterns, Sri Lanka is experiencing a nutritional transition, which leads to under-nutrition, overweight and obesity. A quarter of adults in Sri Lanka are suffering from metabolic syndrome, while one in every five adults is diagnosed with either diabetes or pre-diabetes. Recent studies signify that the prevalence of hypertension, obesity, dyslipidaemia in urban areas are reaching epidemic proportions. Further, 18.3% of total mortality and 16.7% of hospital expenditure in Sri Lanka account for diet-related chronic diseases (Jayawardena *et al.* 2012).

Moreover, child malnutrition is emphasized through prevalence of stunting, wasting and underweight among children 6 - 59 months of age, which the proportions are 13.1, 19.6 and 23.5 percent respectively (Jayatissa *et al.* 2012).

Despite all the evidences of diet related non-communicable diseases, studies on the subject of dietary choices are rather scarce in the Sri Lankan context (Jayawardena *et al.* 2012). Therefore, this study aims to determine the factors and what impacts do they have on consuming a healthy diet, by incorporating an economic framework to the households in Sri Lanka. Moreover, this intends to present price and expenditure elasticities of demand for different food groups which should be included in a Sri Lankan's healthy diet, in order to discover the most suitable policy interventions for the country.

METHODOLOGY AND DATA

Model Specification

Among the models which have been proposed to analyze consumption patterns, the Rotterdam model and the Translog model have been frequently used in past (Feng and Chern, 2000). Nevertheless, the Almost Ideal Demand System (AIDS) proposed by Deaton and Muellbauer, (1980) is widely used in recent years and has considerable advantages over both the Rotterdam and Translog models. It “gives an arbitrary first-order approximation to any demand system; satisfies the axioms of choice exactly; aggregates perfectly over consumers without invoking parallel linear Engel curves; has a functional form which is consistent with known household-budget data; simple to estimate, largely avoiding the need for non-linear estimation; and can be used to test the restrictions of homogeneity and symmetry through linear restrictions on fixed parameters” (Deaton and Muellbauer, 1980).

The AIDS was developed through the minimum cost or expenditure function, which is required to achieve a specific utility level at given prices. The AIDS model in budget share form can be expressed as:

$$W_i = \alpha_i + \beta_i \ln \left(\frac{x}{P} \right) + \sum_j \gamma_{ij} \ln (P_j) \quad (1)$$

Where, W_i = budget share of i^{th} food group; x = the total expenditure on all foods per household; P_j = prices of the j^{th} food items; P = price index defined as;

$$\ln P = \alpha_0 + \sum_k \alpha_k \ln P_k + \frac{1}{2} \sum_j \sum_k \gamma_{kj} \ln P_k \ln P_j \quad (2)$$

The α_i parameter is the average budget share when all prices and real expenditure are equal to one. The β_i and γ_{ij} parameters measure the change in the i^{th} budget share for a unit change in the real income and P_j respectively, ceteris paribus (Weliwita *et al.* 2003).

Although the true AIDS model possesses many desirable properties, its nonlinearity makes it difficult to estimate (Feng and Chern, 2000). To avoid nonlinearity, P in the equation (1) was estimated as the Stone price index:

$$\ln(P^*) = \sum_i \bar{W}_i \ln(P_i) \quad (3)$$

Where, $\bar{W}_i$ denotes the mean budget share of i^{th} food item (Bett *et al.* 2012).

Therefore, the Linear Approximation of the AIDS (LA/AIDS) was used in this study. Here, the budget shares of various commodities are linearly related to logarithms of real expenditure and relative prices (Deaton and Muellbauer, 1980). Hence, the LA/AIDS can be defined as;

$$W_i = \alpha_i + \beta_i \ln\left(\frac{x}{P^*}\right) + \sum_j \gamma_{ij} \ln(P_j) \quad (4)$$

Data and Estimation Procedure

Data for the analysis were taken from the Household Income and Expenditure Survey (HIES) 2006/07, conducted by the Department of Census and Statistics, Sri Lanka. It has been conducted over a period of 12 monthly rounds. HIES provided information on demographic and socio-economic characteristics, income and expenditure of households in Sri Lanka, excluding the Northern province and Trincomalee district in the Eastern province. The completed sample size was 18,544 households.

The weekly consumption of 148 food items was selected according to the six food groups which have been recommended by the Ministry of Health, (2011). As both fruits and vegetables facilitate a same function (protection of the body from diseases), all fruits and vegetable types were categorized under a single group (fruits and vegetables). Since, consumption has been measured by different units, food items were aggregated into n ($n=15$) groups, with respect to the units of measurements (Table 1).

As done in many demand studies (Bett *et al.* 2012; Heien and Wessells, 1990; Park *et al.* 1996; Tiffin and Arnoult, 2010), to capture the taste and preferences among households, demographic and socio economic characteristics were incorporated into the budget share Equation in Table 2.

Table 1: Classification of food groups

	Food groups	Description
1	Grains and tubers	1. Grains 2. Prepared foods 3. Tubers
2	Fruits and	4. Fruits
3	Vegetables	5. Fruit vegetables 6. Leafy vegetables
4	Fish, pulses, meat and eggs	7. Pulses 8. Meat 9. Fish 10. Eggs
5	Milk and/or milk products	11. Milk 12. Milk products
6	Nuts and oil seeds	13. Nuts 14. Fats and oils 15. Dried fruits

Because, the actual market prices of commodities have not been collected in the survey, the unit values (expenditure/quantity) were used as proxies for prices as it is the common practice in literature (Park *et al.* 1996; Weliwitaet *al.* 2003). For the households which had zero expenditure, the unit values were replaced by the average values of the nonzero unit values within the most ideal cluster (Weliwitaet *al.* 2003).

Due to the infrequent consumption, budget shares of all food groups were censored using the two-stage decision process. In the first stage, the decision to buy or not to buy was expressed as a dummy variable (1 if a household buys and 0 otherwise). Then, a probit regression was carried out for $(n-1)$ food groups and the Inverse Mills Ratios (IMRs) for each household for each food group were computed using θ (standard normal density) and Θ (cumulative probability function), where $IMR(\Phi_i = \theta/\Theta)$. Secondly, estimated IMRs were used in the AIDS as an instrumental variable (Weliwitaet *al.*, 2003). Hence, the estimating model is:

$$W_i = \alpha_i + \beta_i \ln \left(\frac{x}{P^*} \right) + \sum_j \gamma_{ij} \ln(P_j) + \sum_k \rho_{ik} Z_k + \omega_i \Phi_i + \varepsilon_i \quad (5)$$

Where, Z_k is the matrix of demographic or socio-economic variables and ρ_{ik} is the relevant vector of parameters; ω_i = coefficient of i^{th} IMR; ε_i = error term of i^{th} food equation (Bett *et al.* 2012).

Table 2: Socio-economic and demographic variables

Variable	Description
Sector	Two dummy variables urban = 1, otherwise = 0 estate = 1, otherwise = 0
Household size	
Gender of the household head	One dummy variable male = 1, female = 0
Education level of the head	
Education level of the spouse	
Employment status of the head	One dummy variable employed = 1, unemployed = 0
Employment status of the spouse	One dummy variable employed = 1, unemployed = 0
Presence of children up to three years of age	One dummy variable if present = 1, otherwise = 0
Presence of heart diseases	One dummy variable if present = 1, otherwise = 0
Presence of blood pressure	One dummy variable if present = 1, otherwise = 0
Presence of diabetes	One dummy variable if present = 1, otherwise = 0
Owned land extent (ha)	
Household income (SLR)	
(Income was divided into four equal groups using quartiles; group 1: 0 - 8422.916 group 2: 8423.33 – 15493.75 group 3: 15500 – 30330 group 4: 30333.33 – 1.80e+07)	Three dummy variables income group 2 = 1, otherwise = 0 income group 3 = 1, otherwise = 0 income group 4 = 1, otherwise = 0

To conform to the demand theory, adding up (6), homogeneity (7) and symmetry (8) restrictions were imposed on the equation (5):

$$\sum_i \alpha_i = 1, \sum_i \beta_i = 0, \sum_i \gamma_{ij} = 0, \sum_k \rho_{ik} = 0, \sum_i \omega_i = 0, j = 1, \dots, n. \quad (6)$$

$$\sum_j \gamma_{ij} = 0, i = 1, \dots, n. \quad (7)$$

$$\gamma_{ij} = \gamma_{ji}, i, j = 1, \dots, n. \quad (8)$$

Elasticities

Marshallian price elasticities [Equation (9)] and expenditure elasticity [Equation (10)] of i^{th} food group were calculated as;

$$\varepsilon_{ij} = -\delta_{ij} + \frac{\{\gamma_{ij} - \beta_i \overline{W_j}\}}{\overline{W_i}} \quad (9)$$

Where, δ_{ij} = Kronecker delta, which is equal to one for $i = j$ and zero for $i \neq j$ (Bettet *al.*, 2012).

$$\eta_i = 1 + \frac{\beta_i}{\overline{W_i}} \quad (10)$$

Since, adding up restrictions ensure $\sum W_i = 1$, one equation (dried fruits) was dropped from the system. A Seemingly Unrelated Regression (SUR) technique was employed to avoid possible correlation of errors of each equation. The estimation was carried out by the use of Stata 11.2, under the constrained Iterated SUR (ITSUR) procedure.

RESULTS AND DISCUSSION

Descriptive Statistics

Table 3 represents the details of socio-economic and demographic variables used in the study. Household size varies within 1 and 18, with an average of 5 members. Education level has been measured as an array of 0-16, where 0 stands for studying in grade 1 and 16 for passed post graduate degree/diploma. The results denoted that the average of education level of both head and spouse is the passed level of grade 9. The extent of owned land lies within 0-42 hectares, and has an average of 0.3 hectares.

Grains accountable for the highest expenditure, with a mean of 324.55, where people allocate a more proportion from their budgets on grains out of all food groups. Besides, fruit vegetables, fish, milk products and nuts have highest shares within each of their respective main food groups (Table 4).

Table 3: Descriptive statistics of socio-economic and demographic variables

Variable	Mean	Standard Deviation	Range
Urban sector	0.2498	0.4329	0-1
Estate sector	0.0929	0.2902	0-1
Household size	4.3861	1.8034	1-18
Gender of the head	0.7619	0.4260	0-1
Education level of the head	8.6418	4.3130	0-16
Employment status of the head	0.7146	0.4516	0-1
Education level of the spouse	9.1525	4.1073	0-16
Employment status of the spouse	0.3220	0.4673	0-1
Presence of children	0.2475	0.4316	0-1
Presence of heart diseases	0.0464	0.2103	0-1
Presence of blood pressure	0.1046	0.3060	0-1
Presence of diabetes	0.0776	0.2675	0-1
Income group 2	0.2484	0.4321	0-1
Income group 3	0.2516	0.4340	0-1
Income group 4	0.2500	0.4330	0-1
Owned land extent (ha)	0.2790	0.8459	0-42

Source : Authors' Estimations

Empirical Results

Usually, model significance in SUR models is checked through Chi-square tests. In the present model, Chi-squares for all equations were significant at 1% level (Table 5). In addition, most of the IMR coefficients were significant at 5% level, implying ignorance of zero budget shares when estimating the system, would generate biased and inconsistent parameter estimates (Table 6).

Socio-economic and Demographic Effects

Results in the table 7 indicated that prepared foods have the highest demand while having the lowest demand for grains in the urban sector, with compared to the rural sector. This may be due to the fact that most of the people in urban areas are engaged with tight daily routines and thus, they will tend more to consume prepared foods. Estate sector covers plantation areas, which are more than 20 acres of extent and having

not less than 10 residential labourers. Majority of estate community is Tamils and therefore, cereals are well-liked components in their diets because, most of their food items are prepared using cereals. Compared to the rural sector, this consumption behaviour is clearly expressed by the negative relationship between the estate sector and the budget shares of grains. Further, higher prices of fish in estate regions due to shortages and higher transportation costs may be the cause for the low consumption of fish.

Convincing rice is the staple food in Sri Lanka; increase in the household size will boost the budget shares of grains. On the other hand, when a family has more members, they are limited to some extent which can however satisfy their needs, by eliminating expensive materials. It is evident the results revealed that, with the increase of household size, the budget allocations for expensive fish, meat, milk products and fruits have been reduced.

Table 4: Descriptive statistics of expenditure and budget shares

Food group	Budget share		Expenditure (SLR)	
	Mean	Standard deviation	Mean	Standard deviation
Grains	0.2282	0.1119	324.5505	186.8938
Prepared foods	0.0972	0.1163	139.1716	149.9063
Yams	0.0261	0.0236	38.2883	37.3550
Fruits	0.0410	0.0565	67.0166	95.1158
Fruit vegetables	0.0906	0.0507	132.5763	89.0363
Leafy vegetables	0.0163	0.0158	24.0560	24.3377
Pulses	0.0490	0.0374	69.7876	58.8455
Meat	0.0466	0.0778	95.3654	189.0252
Fish	0.1701	0.1018	281.9557	243.6147
Eggs	0.0130	0.0184	20.8309	31.1074
Milk	0.0015	0.0131	2.4723	23.0119
Milk products	0.1034	0.0917	162.4456	159.9819
Nuts	0.0815	0.0461	111.6005	61.2460
Fats and oils	0.0332	0.0276	47.2771	40.2480
Dried fruits	0.0009	0.0103	1.4966	12.4081

1 US \$ = 132 SLR

Source : Authors' Estimations

Table 5: Model significance

Equation	Chi-square value	P value
W1 – Grains	11977.84	0.0000
W2 - Prepared foods	4064.41	0.0000
W3 – Yams	628.25	0.0000
W4 – Fruits	1294.19	0.0000
W5 – Fruit vegetables	2328.85	0.0000
W6 – Leafy vegetables	1622.20	0.0000
W7 – Pulses	2150.60	0.0000
W8 - Meat	2779.18	0.0000
W9 – Fish	3388.07	0.0000
W10 – Eggs	299.11	0.0000
W11 – Milk	253.48	0.0000
W12 – Milk products	1657.30	0.0000
W13 – Nuts	5013.77	0.0000
W14 – Fats and oils	1788.36	0.0000

Source : Authors' Estimations

Households where the head is a male, expend more on fruit vegetables and pulses and less on meat and eggs, than female headed households. Education level of both household head and spouse will have a significant impact on most of the food budget shares in a similar manner. With the increase of the level of education, it will create a higher demand for milk products and a lower demand for grains. Further, results indicated that households where the head and spouse are employed go for more grains and lesser prepared foods and fish. HIES has considered a respondent as an employed person, if he is engaged in any occupation (i.e. he can either be a government employee, semi government employee, private sector employee, employer, own account worker or an unpaid family worker), despite the state of collar workers. As a result, there is a very small correlation between the educational attainment and employment status, in both the head of the household and spouse. Therefore, opposite effects could occur with respect to education and occupation variables.

When children are present in a family, parents give the first priority for their children's diet. This priority becomes more strengthened during the early childhood. Consequently, during early stages of children, parents are more concerned on consumption of foods which facilitate protection from diseases, growth and maintenance of teeth and bones etc. As this study includes children up to three years of age, not surprisingly, the parameter estimates signified that the presence of children in a household leads to an increased demand for milk products and fruits and a lower level

of demand for grains and prepared foods. When health issues are considered, presence of blood pressure, heart diseases and diabetes will negatively affect the expenditure allocations for meat, fats and oils, and grains, respectively.

With reference to the all income groups compared to the lowest income group, results clearly denoted that all levels of higher income groups will allocate their budget more on milk products, fish, prepared foods and fish, and less on grains, fruit vegetables and yams. Moreover, apart from the aforementioned food groups, with the increase of income, people will gradually go for milk and then, meat and eggs while moving away from pulses and after that, from fats and oils. With the increase of owned land extent, budget allocations for prepared foods will be dropped, inferring that when people have more lands to cultivate, they will certainly subsist from their own cultivations.

Price and Expenditure Effects

Table 6 represented that own-price coefficients of grains, fruit vegetables, leafy vegetables, pulses, fish, eggs, nuts, fats and oils and dried fruits are positive while the rest is negative. Further, all own-price coefficients were significant at 5% level except dried fruits (4.89×10^{-4}).

The parameters of real expenditure were significant for all food groups except fruit vegetables (-1.04×10^{-3}), milk (3.39×10^{-4}), milk products (2.91×10^{-3}) and dried fruits (1.42×10^{-2}). The negative coefficients for the budget shares of grains, prepared foods, fruit vegetables, leafy vegetables, pulses, nuts and fats and oils inferred that their consumption would increase less proportionately as income rises. Moreover, positive coefficients denoted that consumers would spend more on yams, fruits, meat, fish, eggs, milk, milk products and dried fruits with an income increase. This implies that consumers would reallocate their dietary choices away from grains, prepared foods, fruit vegetables, leafy vegetables, pulses, nuts and fats and oils towards the pricey yams, fruits, meat, fish, eggs, milk, milk products and dried fruits, as income increases.

Own Price, Cross Price and Expenditure Elasticities

Table 8 showed that own price elasticities of all food groups carry a negative sign as expected. The values denoted that prepared foods, yams, fruits, meat, milk and milk products are more responsive to their own price changes, while all others are less responsive. It infers that, in case of a general price increase, consumption of abovementioned food groups would drop by a larger proportion. Not surprisingly, grains, fruit vegetables, leafy vegetables and pulses showed inelasticities with their own price changes.

It may be because; rice is the staple food in Sri Lanka and meals consisting of several vegetables and pulses together with rice. This inelastic behaviour of staple foods with respect to price and expenditure displays an identical pattern as other developing countries, which is reflected by the studies of Weliwita *et al.*, 2003, Kumar *et al.* 2011 and Fashogbon and Oni, 2013. Since coconuts were taken into the nuts group, its elasticity value also can be accepted as; most of the curries are prepared using coconut milk. However, the own price elasticities were shown to have a similar pattern as the past study done by Pradhan and Tudawe, (1997), except for the milk products. According to Pradhan and Tudawe, (1997), rice and other cereals, pulses, vegetables, fish, milk products, and fats and oils were price inelastic while meat and fruits were price elastic; and they have reasoned that low sensitivity for price changes may have been due to the market liberalization which induces low competitive food prices and income growth.

Cross price elasticities highlighted that people may switch between grains and prepared foods according to the price changes, in order to get carbohydrates. Moreover, it implied that people may substitute yams, either with grains or prepared foods, but never as vice versa because, grains and yams, and prepared foods and yams were identified as complements. Fruits, fruit vegetables and leafy vegetables are mainly the sources of vitamins and minerals. Fruits show complementarities with fruit vegetables and leafy vegetables. Conversely, it signified that fruit vegetables and leafy vegetables can be substituted with fruits. The negative relationship between fruit vegetables and leafy vegetables proved the usual dietary pattern of Sri Lankans i.e.; fruit vegetables and leafy vegetables together with rice.

Among the protein sources, pulses and fish are substitutable either with meat or eggs, whereas complementary behaviours were discovered vice versa. However, it is quite unusual to notice complementarities between meat and fish, since it is contradictory to the usual consumption patterns of Sri Lankans. As a wholesome food which is a useful source of energy, protein, minerals & vitamins for every age group, milk can be substituted with milk products. In addition, fats are commonly consumed in the form of oils, nuts and coconut milk. In Sri Lanka, coconut is the main source of fat. Other than that, animal sources like meat, milk & milk products may also contribute to dietary fat. It is evident, cross price elasticities revealed that nuts, dried fruits, and fats and oils are substitutable with meat and milk products.

The positive values of expenditure elasticities of all food groups implied that all of them are normal and thus, increase in income would lead to higher consumption. Inferring that grains, prepared foods, fruit vegetables, leafy vegetables, pulses, nuts, and fats and oils play an important role in household diets and hence won't cut back even during tough times, the estimates showed that they are necessities. Furthermore, it is evident

from Weliwita *et al.* 2003, Kumar *et al.* 2011, Mudassar, 2012 and Fashogbon and Oni, 2013, cereal grains like rice, wheat, maize etc. hold a dominant position of diets not only in Asian countries, but also in African countries.

Yams, fruits, meat, fish, eggs, milk, milk products and dried fruits were recognized as luxuries, which people devote an increasingly larger share of income as they receive more. With regard to other developing nations, South Africa (Agbola, 2003) and Pakistan (Mudassar, 2012) also display a luxurious consumption pattern for meat and fish. The expenditure elasticity of dried fruits holds a very high value compared to the others. It may be because, dried fruits group contains cashew nuts and it is rather expensive in Sri Lanka. Therefore, consumers would very rarely purchase cashew and also, only a small group of high income households could afford higher prices. Apart from dried fruits, meat group also has comparatively higher expenditure elasticity, which implies that higher income households would spend proportionately more on meat. With compared to the Pradhan and Tudawe (1997) studies, rice, other cereals, pulses and vegetables which were luxuries in 1990/91 due to the decline of economic growth as a result of the civil war, have now been turned out to necessities.

Table 6: Parameter estimates of the AIDS model

Coefficients of i^{th} budget shares								
Variables	W1	W2	W3	W4	W5	W6	W7	W8
Constant	$5.28*10^{-1*}$	$6.08*10^{-1*}$	$-7.83*10^{-3}$	$-2.78*10^{-2*}$	$5.53*10^{-2*}$	$1.94*10^{-2*}$	$1.36*10^{-1*}$	$-2.69*10^{-1*}$
IMR	$-2.37*10^{-2*}$	$-1.15*10^{-3}$	$6.13*10^{-3*}$	$4.02*10^{-3*}$	$6.42*10^{-3*}$	$-8.50*10^{-3*}$	$-1.01*10^{-3}$	$-4.53*10^{-3*}$
lnp_i								
lnp1	$4.14*10^{-2*}$	$2.22*10^{-2*}$	$-3.94*10^{-3*}$	$5.62*10^{-4}$	$-4.02*10^{-2*}$	$-4.05*10^{-3*}$	$-1.19*10^{-2*}$	$2.26*10^{-2*}$
lnp2	$2.22*10^{-2*}$	$-3.45*10^{-2*}$	$2.48*10^{-3*}$	$-7.83*10^{-4}$	$8.62*10^{-3*}$	$-1.44*10^{-4}$	$2.89*10^{-3*}$	$1.80*10^{-3*}$
lnp3	$-3.94*10^{-3*}$	$2.48*10^{-3*}$	$-3.14*10^{-3*}$	$2.17*10^{-4}$	$1.94*10^{-3*}$	$-2.95*10^{-4}$	$1.36*10^{-3*}$	$1.48*10^{-3}$
lnp4	$5.62*10^{-4}$	$-7.83*10^{-4}$	$2.17*10^{-4}$	$-4.12*10^{-3*}$	$-5.84*10^{-4}$	$3.19*10^{-5}$	$1.17*10^{-3*}$	$4.85*10^{-4}$
lnp5	$-4.02*10^{-2*}$	$8.62*10^{-3*}$	$1.94*10^{-3*}$	$-5.84*10^{-4}$	$2.44*10^{-2*}$	$-1.49*10^{-3*}$	$-3.73*10^{-3*}$	$1.61*10^{-2*}$
lnp6	$-4.05*10^{-3*}$	$-1.44*10^{-4}$	$-2.95*10^{-4}$	$3.19*10^{-5}$	$-1.49*10^{-3*}$	$1.24*10^{-2*}$	$-1.20*10^{-3*}$	$-1.09*10^{-3}$
lnp7	$-1.19*10^{-2*}$	$2.89*10^{-3*}$	$1.36*10^{-3*}$	$1.17*10^{-3*}$	$-3.73*10^{-3*}$	$-1.20*10^{-3*}$	$3.18*10^{-2*}$	$-1.32*10^{-2*}$
lnp8	$2.26*10^{-2*}$	$1.80*10^{-3*}$	$1.48*10^{-3}$	$4.85*10^{-4}$	$1.61*10^{-2*}$	$-1.09*10^{-3}$	$-1.32*10^{-2*}$	$-8.31*10^{-3*}$
lnp9	$-2.55*10^{-2*}$	$-1.98*10^{-3*}$	$5.35*10^{-4}$	$4.18*10^{-3*}$	$1.60*10^{-3}$	$-5.22*10^{-4}$	$1.19*10^{-3}$	$5.52*10^{-3*}$
lnp10	$4.00*10^{-3*}$	$4.28*10^{-4*}$	$4.39*10^{-4}$	$-3.40*10^{-4}$	$9.16*10^{-4}$	$-1.86*10^{-3*}$	$-1.30*10^{-3*}$	$-1.88*10^{-3}$
lnp11	$-1.60*10^{-3*}$	$-8.55*10^{-5}$	$-5.93*10^{-4*}$	$-3.49*10^{-5}$	$-1.29*10^{-3*}$	$1.55*10^{-3*}$	$6.90*10^{-4}$	$7.20*10^{-4}$
lnp12	$1.11*10^{-2*}$	$-1.75*10^{-3*}$	$2.31*10^{-3*}$	$1.09*10^{-3}$	$6.23*10^{-3*}$	$-5.76*10^{-4}$	$-4.39*10^{-3*}$	$-8.20*10^{-3*}$
lnp13	$-6.90*10^{-3*}$	$-2.32*10^{-3*}$	$-2.74*10^{-3*}$	$-2.85*10^{-3*}$	$-7.49*10^{-3*}$	$-1.24*10^{-3*}$	$-3.98*10^{-3*}$	$-4.10*10^{-3*}$
lnp14	$-6.91*10^{-3*}$	$1.30*10^{-3*}$	$2.25*10^{-4}$	$-3.70*10^{-4}$	$-4.66*10^{-3*}$	$-3.64*10^{-4}$	$-1.26*10^{-3}$	$-6.55*10^{-3*}$
lnp15	$-8.86*10^{-4}$	$1.84*10^{-3*}$	$-2.83*10^{-4}$	$1.35*10^{-3*}$	$-3.62*10^{-4}$	$-1.11*10^{-3*}$	$1.79*10^{-3*}$	$-5.44*10^{-3*}$

lnxp	-4.77*10 ^{-2*}	-3.98*10 ^{-2*}	3.21*10 ^{-3*}	1.07*10 ^{-2*}	-1.04*10 ⁻³	-4.92*10 ^{-3*}	-9.70*10 ^{-3*}	5.18*10 ^{-2*}
Variables	W9	W10	W11	W12	W13	W14	W15	
Constant	-3.83*10 ^{-1*}	-1.23*10 ⁻²	-2.65*10 ^{-2*}	1.01*10 ^{-1*}	3.32*10 ^{-1*}	7.55*10 ^{-2*}	-1.30*10 ⁻¹	
IMR	1.85*10 ^{-2*}	-4.76*10 ⁻⁵	-5.99*10 ⁻⁴	-1.37*10 ⁻³	-1.19*10 ^{-1*}	8.95*10 ^{-3*}	1.16*10 ⁻¹	
lnp_i								
lnp1	-2.55*10 ^{-2*}	4.00*10 ^{-3*}	-1.60*10 ^{-3*}	1.11*10 ^{-2*}	-6.90*10 ^{-3*}	-6.91*10 ^{-3*}	-8.86*10 ⁻⁴	
lnp2	-1.98*10 ^{-3*}	4.28*10 ^{-4*}	-8.55*10 ⁻⁵	-1.75*10 ^{-3*}	-2.32*10 ^{-3*}	1.30*10 ^{-3*}	1.84*10 ⁻³	
lnp3	5.35*10 ⁻⁴	4.39*10 ⁻⁴	-5.93*10 ^{-4*}	2.31*10 ^{-3*}	-2.74*10 ^{-3*}	2.25*10 ⁻⁴	-2.83*10 ⁻⁴	
lnp4	4.18*10 ^{-3*}	-3.40*10 ⁻⁴	-3.49*10 ⁻⁵	1.09*10 ⁻³	-2.85*10 ^{-3*}	-3.70*10 ⁻⁴	1.35*10 ⁻³	
lnp5	1.60*10 ⁻³	9.16*10 ⁻⁴	-1.29*10 ^{-3*}	6.23*10 ^{-3*}	-7.49*10 ^{-3*}	-4.66*10 ^{-3*}	-3.62*10 ⁻⁴	
lnp6	-5.22*10 ⁻⁴	-1.86*10 ^{-3*}	1.55*10 ^{-3*}	-5.76*10 ⁻⁴	-1.24*10 ^{-3*}	-3.64*10 ⁻⁴	-1.11*10 ⁻³	
lnp7	1.19*10 ⁻³	-1.30*10 ^{-3*}	6.90*10 ⁻⁴	-4.39*10 ^{-3*}	-3.98*10 ^{-3*}	-1.26*10 ⁻³	1.79*10 ⁻³	
lnp8	5.52*10 ^{-3*}	-1.88*10 ⁻³	7.20*10 ⁻⁴	-8.20*10 ^{-3*}	-4.10*10 ^{-3*}	-6.55*10 ^{-3*}	-5.44*10 ⁻³	
lnp9	2.15*10 ^{-2*}	-1.21*10 ^{-3*}	7.87*10 ^{-4*}	6.97*10 ^{-3*}	-1.26*10 ^{-2*}	-1.10*10 ⁻³	7.28*10 ⁻⁴	
lnp10	-1.21*10 ^{-3*}	6.93*10 ^{-3*}	-2.62*10 ⁻⁴	-3.06*10 ^{-3*}	-1.63*10 ^{-3*}	-1.81*10 ^{-3*}	6.46*10 ⁻⁴	
lnp11	7.87*10 ^{-4*}	-2.62*10 ⁻⁴	-2.50*10 ^{-3*}	1.68*10 ^{-3*}	2.30*10 ^{-3*}	-1.99*10 ^{-3*}	6.36*10 ⁻⁴	
lnp12	6.97*10 ^{-3*}	-3.06*10 ^{-3*}	1.68*10 ^{-3*}	-1.15*10 ^{-2*}	2.68*10 ^{-3*}	-1.74*10 ^{-3*}	-8.91*10 ⁻⁴	
lnp13	-1.26*10 ^{-2*}	-1.63*10 ^{-3*}	2.30*10 ^{-3*}	2.68*10 ^{-3*}	4.02*10 ^{-2*}	1.56*10 ^{-3*}	-8.86*10 ⁻⁴	
lnp14	-1.10*10 ⁻³	-1.81*10 ^{-3*}	-1.99*10 ^{-3*}	-1.74*10 ^{-3*}	1.56*10 ^{-3*}	2.13*10 ^{-2*}	2.38*10 ⁻³	
lnp15	7.28*10 ⁻⁴	6.46*10 ⁻⁴	6.36*10 ^{-4*}	-8.91*10 ⁻⁴	-8.86*10 ^{-4*}	2.38*10 ^{-3*}	4.89*10 ⁻⁴	
lnxp	7.54*10 ^{-2*}	2.74*10 ^{-3*}	3.39*10 ⁻⁴	2.91*10 ⁻³	-5.10*10 ^{-2*}	-7.01*10 ^{-3*}	1.42*10 ⁻²	

*significant at 5% level.

Note: W_i = i^{th} budget share; $\ln p_i$ = natural logarithm of i^{th} food price; $i = 1, \dots, 15$: 1 = grains, 2 = prepared foods, 3 = yams, 4 = fruits, 5 = fruit vegetables, 6 = leafy vegetables, 7 = pulses, 8 = meat, 9 = fish, 10 = eggs, 11 = milk, 12 = milk products, 13 = nuts, 14 = fats and oils, 15 = dried fruits, $\ln XP$ = natural logarithm of real expenditure

Source : Authors' Estimations

Table 7: Parameter estimates of socio-economic and demographic variables

Coefficients of i^{th} budget shares								
Variables	W1	W2	W3	W4	W5	W6	W7	W8
D1	-4.40*10 ^{-2*}	3.79*10 ^{-2*}	-6.14*10 ^{-3*}	3.77*10 ^{-3*}	-1.56*10 ^{-2*}	-1.21*10 ^{-3*}	-6.28*10 ^{-3*}	1.55*10 ^{-2*}
D2	8.06*10 ^{-2*}	-2.04*10 ^{-2*}	-2.28*10 ^{-3*}	-1.29*10 ^{-2*}	-3.31*10 ⁻⁴	-3.20*10 ^{-3*}	9.63*10 ^{-3*}	8.95*10 ⁻⁴
D3	1.69*10 ^{-2*}	5.00*10 ^{-3*}	-5.83*10 ^{-4*}	-3.73*10 ^{-3*}	-1.25*10 ^{-3*}	-2.46*10 ^{-4*}	1.67*10 ^{-3*}	-4.25*10 ^{-3*}
D4	6.66*10 ⁻³	-4.65*10 ⁻³	1.95*10 ⁻³	4.20*10 ⁻³	8.17*10 ^{-3*}	4.05*10 ⁻⁴	3.59*10 ^{-3*}	-1.44*10 ^{-2*}
D5	-1.69*10 ^{-3*}	9.47*10 ⁻⁵	1.45*10 ⁻⁵	7.04*10 ^{-4*}	-7.31*10 ⁻⁵	1.42*10 ^{-4*}	1.47*10 ⁻⁴	6.58*10 ⁻⁵

D6	1.19*10 ^{-2*}	-7.43*10 ^{-3*}	7.29*10 ⁻⁴	-5.83*10 ^{-3*}	9.61*10 ⁻⁴	-8.98*10 ^{-4*}	-1.31*10 ⁻³	3.56*10 ^{-3*}
D7	-7.47*10 ^{-4*}	-7.40*10 ^{-4*}	4.86*10 ⁻⁵	7.72*10 ^{-4*}	-2.36*10 ⁻⁵	7.44*10 ^{-5*}	3.17*10 ^{-4*}	-4.41*10 ^{-4*}
D8	1.79*10 ^{-2*}	-5.91*10 ^{-3*}	4.73*10 ⁻⁴	1.02*10 ⁻³	4.79*10 ^{-3*}	-3.52*10 ⁻⁴	4.39*10 ^{-3*}	-4.87*10 ^{-3*}
D9	-2.69*10 ^{-2*}	-7.92*10 ^{-3*}	-1.43*10 ^{-3*}	6.20*10 ^{-3*}	-3.97*10 ^{-3*}	-1.71*10 ^{-3*}	-4.40*10 ^{-3*}	1.77*10 ⁻⁴
D10	-3.26*10 ⁻³	4.74*10 ⁻³	-1.39*10 ⁻³	-7.45*10 ⁻⁴	-8.88*10 ⁻⁴	-7.65*10 ⁻⁴	1.37*10 ⁻³	-4.41*10 ⁻³
D11	-3.82*10 ⁻³	1.70*10 ⁻³	-3.25*10 ⁻⁴	-4.49*10 ⁻⁵	1.05*10 ⁻³	9.87*10 ^{-4*}	1.11*10 ⁻³	-5.13*10 ^{-3*}
D12	-9.63*10 ^{-3*}	5.11*10 ^{-3*}	-3.12*10 ^{-3*}	4.34*10 ^{-3*}	-9.49*10 ⁻⁴	1.47*10 ^{-3*}	1.43*10 ⁻³	4.46*10 ⁻³
D13	-1.74*10 ^{-2*}	6.09*10 ^{-3*}	-2.57*10 ^{-3*}	4.20*10 ^{-3*}	-3.83*10 ^{-3*}	1.67*10 ⁻⁴	-1.17*10 ⁻³	-5.52*10 ⁻⁴
D14	-3.15*10 ^{-2*}	6.90*10 ^{-3*}	-2.41*10 ^{-3*}	9.78*10 ^{-3*}	-5.60*10 ^{-3*}	2.20*10 ⁻⁴	-2.14*10 ^{-3*}	-8.76*10 ⁻⁵
D15	-4.77*10 ^{-2*}	1.01*10 ^{-2*}	-3.73*10 ^{-3*}	1.72*10 ^{-2*}	-8.20*10 ^{-3*}	-7.11*10 ⁻⁵	-4.22*10 ^{-3*}	4.38*10 ^{-3*}
D16	6.83*10 ^{-3*}	-9.43*10 ^{-3*}	1.30*10 ^{-3*}	2.19*10 ^{-3*}	4.27*10 ^{-3*}	-5.62*10 ⁻⁵	5.98*10 ⁻⁴	-1.28*10 ⁻³
Variables	W9	W10	W11	W12	W13	W14	W15	
D1	1.46*10 ^{-2*}	1.13*10 ^{-3*}	-1.67*10 ⁻⁴	9.32*10 ^{-3*}	-8.87*10 ^{-3*}	1.16*10 ^{-3*}	-1.09*10 ⁻³	
D2	-5.39*10 ^{-2*}	1.14*10 ⁻³	8.24*10 ⁻⁴	3.88*10 ⁻³	-1.47*10 ^{-2*}	6.10*10 ^{-3*}	4.69*10 ⁻³	
D3	-1.23*10 ^{-2*}	-4.38*10 ^{-4*}	8.90*10 ⁻⁵	-4.08*10 ^{-3*}	3.68*10 ^{-3*}	2.04*10 ⁻⁴	-6.63*10 ⁻⁴	
D4	-5.03*10 ⁻³	-2.04*10 ^{-3*}	-1.77*10 ⁻⁵	-1.12*10 ⁻³	1.52*10 ⁻³	1.25*10 ⁻³	-5.11*10 ⁻⁴	
D5	-6.17*10 ^{-4*}	1.13*10 ^{-4*}	-1.80*10 ⁻⁵	1.13*10 ^{-3*}	4.29*10 ⁻⁵	-7.94*10 ⁻⁵	3.14*10 ⁻⁵	
D6	-1.01*10 ⁻³	1.74*10 ^{-3*}	3.81*10 ⁻⁴	-7.12*10 ^{-3*}	6.17*10 ⁻⁴	2.36*10 ^{-3*}	1.39*10 ⁻³	
D7	-4.15*10 ^{-4*}	1.27*10 ^{-4*}	-2.25*10 ⁻⁵	1.20*10 ^{-3*}	-4.03*10 ⁻⁵	6.83*10 ⁻⁶	-1.12*10 ⁻⁴	
D8	-1.37*10 ^{-2*}	-4.53*10 ⁻⁴	4.24*10 ⁻⁴	-6.20*10 ^{-3*}	1.42*10 ⁻³	1.11*10 ^{-3*}	-1.87*10 ⁻⁵	
D9	-8.60*10 ⁻⁴	4.33*10 ⁻⁴	-2.68*10 ⁻⁴	4.65*10 ^{-2*}	-4.54*10 ^{-3*}	-3.44*10 ⁻⁴	-9.81*10 ⁻⁴	
D10	2.35*10 ⁻³	-1.57*10 ^{-3*}	-3.79*10 ⁻⁴	2.63*10 ⁻³	2.74*10 ⁻³	-1.83*10 ^{-3*}	1.41*10 ⁻³	
D11	1.70*10 ⁻³	-5.80*10 ⁻⁴	-2.16*10 ⁻⁴	1.35*10 ⁻³	1.63*10 ⁻³	1.13*10 ⁻³	-5.42*10 ⁻⁴	
D12	-4.70*10 ⁻³	-1.58*10 ^{-3*}	-1.31*10 ⁻⁴	2.49*10 ⁻³	7.60*10 ⁻⁴	-2.52*10 ⁻⁴	3.11*10 ⁻⁴	
D13	5.40*10 ^{-3*}	2.46*10 ⁻⁴	4.66*10 ⁻⁴	9.69*10 ^{-3*}	2.29*10 ⁻⁵	-7.80*10 ⁻⁴	-1.57*10 ⁻⁵	
D14	1.03*10 ^{-2*}	7.74*10 ⁻⁴	6.97*10 ^{-4*}	1.66*10 ^{-2*}	-5.17*10 ⁻⁴	-9.94*10 ⁻⁴	-2.03*10 ⁻³	
D15	1.24*10 ^{-2*}	1.46*10 ^{-3*}	9.09*10 ^{-4*}	2.24*10 ^{-2*}	1.65*10 ⁻³	-2.05*10 ^{-3*}	-4.57*10 ⁻³	
D16	-4.58*10 ^{-3*}	-3.80*10 ⁻⁴	6.64*10 ^{-4*}	-3.72*10 ^{-3*}	3.46*10 ^{-3*}	6.13*10 ^{-4*}	-4.73*10 ⁻⁴	

*significant at 5% level.

Note: $W_i = i^{th}$ budget share; $i = 1, \dots, 15$: 1 = grains, 2 = prepared foods, 3 = yams, 4 = fruits, 5 = fruit vegetables, 6 = leafy vegetables, 7 = pulses, 8 = meat, 9 = fish, 10 = eggs, 11 = milk, 12 = milk products, 13 = nuts, 14 = fats and oils, 15 = dried fruits, $\ln XP$ = natural logarithm of real expenditure; D1 = urban sector, D2 = estate sector, D3 = household size, D4 = gender of the head, D5 = education level of the head, D6 = employment status of the head, D7 = education level of the spouse, D8 = employment status of the spouse, D9 = presence of children, D10 = presence of heart diseases, D11 = presence of blood pressure, D12 = presence of diabetes, D13 = Income group 2, D14 = Income group 3, D15 = Income group 4, D16 = owned land extent

Source : Authors' Estimations

CONCLUSIONS

This study examined the demand for a healthy diet in Sri Lanka, employing the LA/AIDS model. Several socio economic and demographic characteristics such as sector (whether rural, urban or estate), household size, presence of children, income and land extent owned significantly influence the dietary choices.

The demand for milk products and fruits is quite responsive to the presence of children in a household. Since both milk products and fruits are price and expenditure elastic, any policy related to price or income would affect the health of children and hence, government should be more careful when establishing policies in order to ensure adequate nutritional status of the younger generation in Sri Lanka. Thus, policies such as tariff reductions on imported milk products, although it might have a supply side effect on domestic producers, will have a beneficial impact by reducing child malnutrition.

Furthermore, majority of own price and expenditure coefficients of food budget shares were significant, indicating that people will respond well to price and income related policies. This implies that controlling food price inflation is of high importance. However, most of the food groups were more responsive to income than to their own prices. Thus, income oriented policies will have a more impact on promoting food consumption. Therefore, safety nets programs on rural/estate sector poor will have a marked impact on access to food and their dietary choices.

Table 8: Own price, cross price and expenditure elasticities

ε_{ij}	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	-0.7710	0.5190	1.5585	0.9491	0.4592	2.6134	0.8893	0.6343	0.1420	3.1228	27.728 1	0.3935	0.6506	1.2943	41.382 4
2	0.1174	-1.3144	0.8374	0.5146	0.2455	1.3916	0.4712	0.3673	0.0871	1.6770	14.850 2	0.2114	0.3327	0.6876	22.538 5
3	-0.0118	-0.0298	-1.1234	-0.1026	-0.0431	-0.2340	-0.0751	-0.1134	-0.0347	-0.3069	-2.6472	-0.0388	-0.0319	-0.1130	-4.6695
4	0.0110	0.0226	0.0165	-1.1110	0.0067	0.0470	0.0196	-0.0335	-0.0149	0.0344	0.3678	0.0043	0.0326	0.0256	-0.0216
5	-0.1568	-0.3756	-1.5497	-1.0014	-0.7300	-2.4399	-0.8007	-0.9618	-0.2760	-3.0937	-	-	-	-	-
6	-0.0143	-0.0349	-0.1570	-0.1027	-0.0444	-0.2365	-0.0792	-0.1048	-0.0310	-0.3131	26.959 8	-0.3904	-0.4356	-1.1892	44.928 2
7	-0.0418	-0.1022	-0.4618	-0.3024	-0.1306	-0.7161	-0.3419	-0.3096	-0.0916	-0.9211	-2.7169	-0.0395	-0.0394	-0.1183	-4.6346
8	0.1088	0.2517	0.8614	0.5390	0.2501	1.4047	0.4706	-1.2299	0.1123	1.7231	-	-	-	-	-
9	-0.0762	-0.1928	-0.9995	-0.6661	-0.2796	-1.5178	-0.4870	-0.7368	-0.9494	-1.9912	15.172 5	0.2173	0.3067	0.6909	23.819 6
10	0.0202	0.0464	0.1514	0.0939	0.0442	0.2494	0.0840	0.0711	0.0177	-0.4722	-	-	-	-	-
11	-0.0067	-0.0159	-0.0616	-0.0394	-0.0176	-0.0980	-0.0324	-0.0360	-0.0101	-0.1230	17.172 6	-0.2514	-0.2066	-0.7326	30.305 7
12	0.0702	0.1564	0.4124	0.2434	0.1235	0.7131	0.2467	0.1230	0.0193	0.8280	2.6765	0.0382	0.0571	0.1229	4.1294
13	-0.0132	-0.0375	-0.2744	-0.1891	-0.0751	-0.3992	-0.1245	-0.2385	-0.0766	-0.5453	-2.6799	-0.0155	-0.0187	-0.0479	-1.7599
14	-0.0233	-0.0574	-0.2686	-0.1767	-0.0757	-0.4142	-0.1342	-0.1850	-0.0553	-0.5356	7.4209	-1.1135	0.2008	0.3558	10.439 1
15	-0.0037	-0.0087	-0.0341	-0.0218	-0.0098	-0.0542	-0.0179	-0.0200	-0.0056	-0.0680	-4.6466	-0.0689	-0.4561	-0.1904	-8.7324
16	-0.0233	-0.0574	-0.2686	-0.1767	-0.0757	-0.4142	-0.1342	-0.1850	-0.0553	-0.5356	-4.6393	-0.0676	-0.0639	-0.3526	-7.9957
17	-0.0037	-0.0087	-0.0341	-0.0218	-0.0098	-0.0542	-0.0179	-0.0200	-0.0056	-0.0680	-0.5946	-0.0086	-0.0103	-0.0265	-0.4842
η_i	0.7911	0.5912	1.1230	1.2594	0.9885	0.6978	0.8024	2.1102	1.4427	1.2095	1.2276	1.0281	0.3746	0.7890	16.363 6

Note: 1 = grains, 2 = prepared foods, 3 = yams, 4 = fruits, 5 = fruit vegetables, 6 = leafy vegetables, 7 = pulses, 8 = meat, 9 = fish, 10 = eggs, 11 = milk, 12 = milk products, 13 = nuts, 14 = fats and oils, ε_{ij} : diagonal values = own price elasticities, off diagonal values = cross price elasticities, η_i = expenditure elasticities

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