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An Estimation of Engel's Food Elasticity of Demand across Urban, Rural and Estate Sectors in Sri Lanka: A Quadratic Double Log Model Approach

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ABSTRACT

Engel's Food elasticity of demand is one of the indicators of food consumption behaviour. Identifying food consumption patterns in sectors, this study aims to estimate Engel's food elasticity of demand among sectors in Sri Lanka. For that purpose, microdata was gathered from the Household Income and Expenditure Surveys of 2006/7, 2009/10, 2012 and 2016 with a total of 13,881 households selected from Badulla, Kandy, Nuwara-Eliya and Ratnapura districts. Households were chosen from the urban - 2010, rural - 8508 and estate – 3363 sectors. A quadratic double-log model based on the OLS techniques was applied in the analysis, while the Wald test was involved to find out that explanatory variables are significant in a model. Twelve quadratic double log models were estimated and they were strongly significant. All estimated Engel food elasticity of demands were strongly significant and less than unity in all three sectors while showing a marginally decreasing pattern over time. The estate sector demonstrated a relatively higher Engel food elasticity as food expenditure was more responsive to income changes than in the other two sectors. Further, the household size, age and education elasticities were obtained from the model. All the household size elasticities were positive and strongly significant in all three sectors. Age and education elasticities indicated negative signs for all three sectors in some periods. The results revealed that estimated Engel food elasticities were positive and less than unity, so it conformed with Engel's law. Hence, the government can promote relevant income opportunities in sectors to increase family income and pay special attention to designing tax policies on foods.

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1. Introduction

Engel's Law states that as a household's (or a nation's) income rises, the percentage of income spent on food decreases and the percentage spent on other goods and services increases. The Engel curve describes the relationship between household expenditure on a particular good and total household income. The shape of Engel curves plays an important role in the determination of macroeconomic demand relationships. Engel curves are very important because they give us a means to study the evolution of our consumption habits (and consequently of our customs) with changes in the standard of living. These relationships have attracted considerable attention in various models of income distribution (Bewley, 1982 & 1986). Engel (1857) concluded that the proportion of income spent on food declines as income increases, implying that "food is a necessity whose consumption rises less rapidly than does income" (Nicholson, 1992). The analysis of the Engel curve had some salient characteristics. First, characterization was accomplished by searching for the most appropriate mathematical form for Engel's function. The most popular forms of equations subject to empirical tests include the linear and double-log functions. Second, a feature of the existing studies was the test of Engel's law using disaggregated consumption items, including food and non-food items. Third, the feature was marked by some tests of Engel's law using panel and time series data. The estimation of Engel curves and Engel elasticities occupies the central position in all family budget studies.

Sri Lanka was categorized as a Low-Income Food-Deficit Country by the Food and Agriculture Organization (FAO) in 2016, and food is the most important item in a household's consumption basket. Households living in residential areas in Sri Lanka are categorized as urban, rural and estate sectors, where food consumption patterns are differently available obviously. There is a lack of literature on food elasticity of demand across sectoral variations in Sri Lanka. Further, there were very few studies that used non-linear errors in variable estimators and looked at Engel curves' behaviour in developing countries. Moreover, the issue was not looked into using information from households living in sectors, and none of the studies done in developing countries have looked at how measurement error in the expenditure variable might affect the Engel relationship of food consumption.

Objective of the Study

The primary objective of this study is to estimate Engel food demand elasticity in urban, rural and estate sectors in Sri Lanka. Further, this study intends to find out other elasticities in the quadratic double log model, such as household size elasticity of food expenditure, age of household head elasticity of food expenditure and education level of household head elasticity of food expenditure.

2. Literature Review

Using the theoretical framework of the Engel curve, many studies have been conducted to analyze how households spend their money on various food and non-food commodities, employing different econometric models. In general, quadratic models have been used to estimate the Engel curves for consumer demand since the logarithm of total expenditure can provide a good approximation to the Engel relationship. For

instance, Abdulai et al. (1999) estimated Engel food elasticity in India using a complete demand system and they found that all food groups were necessities. Cagayan & Astar (2012) analyzed the Engel curve for household food consumption in Turkey and the results revealed that the estimated food elasticity was less than one. Lewbel & Pendakur (2006) applied nine functional forms in Turkey and revealed that the income elasticity of food was smaller than one and significantly different from zero. Betti (2000) showed clear evidence of nonlinearities in Engel curves based on Kernel estimates in Italy. Further, some remarkable studies on Engel curve were estimated in developing countries (Okunade, 1985; Strauss, 1982, 1984), Tanzania (Kulliane, 1989; Kapunda 1988, 1983; Kulindwa, 1985; Mashindano, 1988; Sechambo, 1988; Ferdinand, 1984), China (Wan, 1996), Ethiopia (Kebede, 2000), Pakistan (Khan & Khalid, 2010; Kiani, 2013), Jordan (Al-Habashneh et al., 2014) and found Engel food elasticities were below one.

Different econometric methods were applied to different groups of commodities to study their Engel food elasticities and Engel curve patterns. For example, Houthakker (1957) looked at the Engel food elasticity of thirty different countries using four different methods for calculating food expenditures. Banks et al. (1997) analyzed the Engel curve and consumer demands using non-parametric analyses. Blundell et al. (1998) examined consumer demands with semi-parametric methods whereas McDowell et al. (1997) analyzed household consumption expenditures with the Tobit model. Moreover, Hausman et al. (1995) and Bryne et al. (1996) examined Engel curves using parametric methods. Kumar et al. (2011), Mittal (2010) and Molina (1994) used the QUAIDS model to estimate the Engel curves for consumer food demand. The literature revealed that food characteristics of both luxuries and necessities varied among different income levels of households and countries, further income elasticities for food items were lower in urban areas compared to rural areas.

Some scholars (Bierens et al., 1990; Banks et al., 1997; Blundell et al., 1998) estimated a combination of linear and quadratic Engel curves for different goods using household data from rural Pakistan. These studies typically found a linear relationship between the share of food expenditure and income. Whereas, Bhalotra & Attfield (1998) examined the shape of the food Engel curve in Pakistan using a semi-parametric technique. They found that Engel's curve for food has a quadratic shape. Working (1943) found the food Engel curve was quadratic in developing countries, which are characterized by a large number of low-income households. In such countries, at low-income or expenditure levels, the shared expenditure on food may either remain constant or decrease more slowly as household income increases.

Many empirical studies have been carried out utilizing the conceptual framework of the Engel curve to study the consumption patterns of households. Different econometric models have been proposed and used to estimate the Engel curves for various commodities. Banskota et al. (1986) and Praise & Honthakker (1955) used the semi-logarithmic model to estimate the Engel curve for food and non-food commodities. They found higher expenditure elasticity for all commodities for lower-income households. Further, all food and non-food items were luxuries for lower-income households, while for higher-income households only non-food items

were luxuries. Using a more flexible semi-parametric model, Kedir & Girma (2007) estimated quadratic Engel food curves for Ethiopian urban households. Results revealed that food share increased with expenditure and started to decline after some threshold level of expenditure, which confirms the inverted-U shape relationship. Ndanshau (1998) explored empirical evidence on the applicability of Engel's law in Northern Tanzania. He demonstrated that household size and income factors significantly and positively determine expenditure on food and some other consumption items, depending on the area of the study. Other factors, such as age and education of the household, did not have a significant influence on food consumption.

3. Research Methodology

Data Collection

The Household Income and Expenditure Surveys (HIES) were used to extract the data for this study. The survey was designed as a two-stage stratified random sampling of Neymann allocation from urban, rural, and estate sectors. Each district was selected as the main domain used for the stratification. Micro-level data was collected at the field in twelve consecutive monthly rounds to capture seasonal variations in income, expenditure, and consumption of households' weekly records. The HIES gathered information related to the demographic characteristics of the members of the surveyed households, total expenditure on food and non-food items, and total income received by each household member from all the different sources in a compulsory manner. Household-level data is used as the sample unit, and the four districts are selected as the study area. The study area was chosen based on two conditions. First, districts should consist of all three sectors; second, each district comprises a minimum of 5% of the population in each sector. According to the latest population of Sri Lanka by district and sector-wise breakdown in 2012, only four districts namely Badulla, Kandy, Nuwara-Eliya, and Ratnapura districts are satisfying the above two conditions and employed as the study area. The surveyed sample households selected for this study were Badulla - 2998; Kandy - 4378; Nuwara Eliya - 2878 and Ratnapura - 3627 districts from HIES during the periods of 2006/07, 2009/10, 2012/13, and 2016. Totally 13881 households were selected as the samples for this study. Household data on monthly total expenditure, monthly total all food expenditure, family size, age of the household head and education level of household head were employed and STATA 15 was applied to analyze data for this study.

Table 1: Numbers of Survey Sampled Households by Sectors

HIES Survey Year	Number of households surveyed			
	Urban	**Rural**	**Estate**	**Total**
2016	323	2883	726	3932
2012/13	615	1830	885	3330
2009/10	509	1849	881	3239
2006/07	563	1946	871	3380
Total Households	**2010**	**8508**	**3363**	**13881**

Source: HIES Reports in 2006/07, 2009/10, 2012/13 and 2016

Table 1 on numbers of survey sampled households by sectors shows the distribution of the sample by sector. It explains that the given seven HIES consist of 2010, 8508 and 3363 households selected in urban, rural and estate sectors respectively.

Quadratic Double Log Functional Model

The Engel curve describes how the expenditure on a commodity varies with household income. It provides useful insight into many aspects of consumer behaviour. Firstly, the Engel curve has important implications for the design of tax policies. For example, in the case of a quadratic Engel food curve, a higher tax on food items compared to non-food items implies a higher proportion of the tax burden that is borne by low-income people. Secondly, Engel curves permit a study of intra-household disparity in the distribution of resources. Thirdly, Engel curves are crucial in estimating the impact of demographic changes on demand. In a growing economy, these estimates assist in forecasting the demand for some important items such as food and energy. Fourthly, Engel curves provide the basis for the estimation of equivalence scales and thereby permit welfare comparisons between households. It is also useful for poverty estimation because the minimum consumption varies with the demographic characteristics of the family. Finally, Engel curves are useful for predicting the change in a country's trade and production patterns. As a result, the formulation of government policy heavily relies on the Engel curve (Deaton & Muellbauer, 1980; Blundell, Duncan & Pendakur, 1998; Banks, Blundell & Lewbel, 1997).

A quadratic double-log functional model is appropriate to use a set of data when the relationship between the variables demonstrates a certain level of curvature, such as when there is a maximum or minimum point, or where the rate of change is not constant. The advantages of quadratic models are (1) Flexibility: Quadratic models are more flexible than linear models and can better capture non-linear relationships between variables. (2) Accuracy: Quadratic models can provide a more accurate representation of the data compared to linear models, especially when the data exhibits a curved trend (Gujarati, 2004).

The theory of consumer behaviour is based upon the assumption that a consumer attempts to maximize the utility of goods and services subject to the given budget constraint. Consumption of commodities is usually taken in terms of expenditure rather than quantities in Engle's curve approximation because the expenditure takes much care of the quantity and the quality of the goods consumed to confiscate the problem of aggregation of heterogeneous items (Burney & Khan, 1991). It is further assumed for cross-sectional data that all the households face identical prices for all commodities.

The basic function for examining Engle's law includes expenditures on food items as a regressand and income as the only explanatory variable. The total household expenditures are used as a proxy for income as an explanatory variable because income data generally suffer from measurement errors and may also include a transitory component of income (Burney & Khan, 1991). The use of total expenditures instead of income is a common practice in Engel curves estimation because the expenditures mostly reflect the permanent income of the households (Kapunda, 1983, 1988; Okunade, 1985; Ndanshau, 1998). Therefore, the Engel curve equation can be written as:

$$\boldsymbol{lnFE_i = \alpha_i + \beta_1 lnTI_i + u} \quad (1)$$

Where, FE – monthly food expenditure on the ith household;
TI – monthly total income on the ith household;
α, β are the unknown parameters to be estimated and
u is the stochastic error term.

However, following the theory of consumer behaviour, the function used for estimation also includes demographic factors such as household size, education and age of the household head. Quadratic double log form was applied based on the Ordinary Least Square (OLS) technique. The total income and family size explanatory variables are computed in the natural log form because they directly determine elasticities, avoiding the loss of information problem and giving more efficient results regarding the household members (Malik & Sarwar, 1993). The quadratic double log form is given by

$$\boldsymbol{lnFE_{it} = \alpha_{it} + \beta_1 lnTI_{it} + \beta_2 (lnTI_{it})^2 + \beta_3 lnS_{it} + \beta_4 A_{it} + \beta_5 E_{it} + u_{it}} \quad (2)$$

Where FE and TI are as explained in equation (1),
S – family size of ith household;
A – age of head-on ith household;
E – education level of ith household head;
α, β_1, β_2, β_3, β_4, β_5 are the unknown parameters to be estimated and
u is the stochastic error term.
The following elasticities can be then derived from Equation (2).

Engel Food Elasticity of Demand $\varepsilon_{EF} = \beta_1 + 2\beta_2\, lnTI$ (3)

Household Size Elasticity of food expenditure $\varepsilon_S = \beta_3$ (4)

Age of Household Head Elasticity of food expenditure $\varepsilon_A = \beta_4$ (5)

Education Level of Household Head Elasticity of food expenditure $\varepsilon_E = \beta_5$ (6)

Wald Test

The Wald test was performed to check whether explanatory variables are statistically significant. It assesses constraints on statistical parameters based on the weighted distance between the unrestricted estimate and its hypothesized value under the null hypothesis, where the weight is the precision of the estimate.

4. **Analysis and Discussion**

The quadratic double log functional model was applied to estimate the Engel food elasticity, household size elasticity of food expenditure, age of household head elasticity of food expenditure and education level of household head elasticity of food expenditure for each sector and year. The results were obtained using OLS techniques.

Wald Test for Quadratic Double Log Functional Model

To execute the quadratic double log form in Equation (2) and check the variables, first, every sectoral year-wise data was estimated by OLS and then checked by Wald test to find out the significance of explanatory variables in the model. For the Wald test log of total income and square of log total income explanatory variables are involved in hypothesis testing.

Table 2: Results of Wald Test for Quadratic Double Log Functional Model

Prob	Prob |α|	Hypothesis Test
0.0000	0.05	H_0: The values of the log of total income and the square of the log of total income are equal. H_1: The values of the log of total income and the square of the log of total income are not equal

Source: Author's calculations.

According to the results of the Wald test for the quadratic double log functional model in Table 2, since the probability value is less than the 5% significance level, the null hypothesis, i.e., the values of the log of total income and square of the log of total income are equal, is rejected; consequently, it is concluded that the values of the log of total income and the square of the log of total income are not equal based on the statistical evidence. Therefore, total income and square of total income variables were not incorporated in the quadratic double log model. Afterwards, the significance of the quadratic double log model is checked.

Table 3: Results of Model Significance under Quadratic Double Log Models

HIES Year	Urban	Rural	Estate
2006/7	F (2, 533) = 70.93***	F (2, 1749) = 524.98***	F (2, 685) = 271.72***
2009/10	F (2, 479) = 79.42***	F (2, 1703) = 405.85***	F (2, 729) = 120.58***
2012/13	F (2, 586) = 109.38***	F (2, 1722) = 254.04***	F (2, 770) = 157.61***
2016	F (2, 305) = 16.22***	F (2, 2717) = 340.56***	F (2, 630) = 3.99***

*Note: *** indicates that variables are significant at 1 % level of significance*

Source: Author's calculations.

Results of model significance under quadratic double log models indicated in Table 3 reveal that all the F values of the twelve functional forms were strongly significant. F test is a statistical test that is used in hypothesis testing to check whether the variances of two populations or two samples are equal or not. Therefore, here the log of total income and the square of the log of total income variables were not equal in all twelve quadratic double-log models.

Engel Food Elasticity of Demand $(\boldsymbol{\varepsilon_{EF}})$

The results of Engel food elasticity of demand for three sectors in the 2006/7, 2009/10, 2012/13 and 2016 periods are given in Table 4. Results reveal that estimated Engel food elasticities for all three sectors in the given years are strongly significant and all the elasticities are lower than one which explains that all food items

were necessities in nature. Also, food expenditure contributes a significant level of the total expenditure of households in all three sectors.

Table 4: Results of Estimated Engel Food Elasticity

Sector	2006/7	2009/10	2012/13	2016
Urban	0.450***	0.471***	0.440***	0.282***
Rural	0.659***	0.512***	0.415***	0.376***
Estate	0.852***	0.534***	0.502***	0.515***

*Note: *** indicates that variables are significant at 1% level of significance*

Source: Author's calculations

Engel's food elasticity in the urban sector has marginally increased in 2009/10 compared to 2006/07. It was the reason for the shift in dietary preferences, diversification in food choices, urbanization and lifestyle changes. Afterward, it marginally decreased in 2012/13 followed by a dramatic fall in 2016. This was due to the income saturation effect and shifting to non-food expenditures. In the context of the rural sector, Engel's food elasticity continuously decreased over the period. The reasons were the income saturation effect, cultural and demographic factors and increasing efficiency in food consumption. In addition, in the estate sector, Engel's food elasticity exhibited a decline from 0.852 in 2006/07 to 0.534 in 2009/10. Afterwards, a marginal decrease occurred in 2012/13. It was due to the shift to non-food expenses and price inelasticity of staple foods. Then it succeeded by a modest increase in 2016. This was the reason for economic inequality and cultural and social factors.

Further, in 2006/07, a civil war existed in Sri Lanka; consequently, the prices of food items were relatively high. As a result, in 2006/07, Engel's food elasticities were relatively high. After the end of the war in 2009, Engel's food elasticities decreased continuously. The Estate sector has demonstrated relatively higher Engel's income elasticities of food expenditure as this sector experienced a lack of income sources or income opportunities. As a result, the estate sector's households had relatively low income, and food expenditure was more responsive to income than in the other two sectors (Paraneetharan *et al.,* 2021). In other words, an increase in household monthly total income has increased the estate sector's food expenditure relatively more than in the other two sectors. Thus, the changes in income of the estate sector households had a relatively greater impact on their food consumption than in the other two sectors. The urban sector has illustrated a relatively low Engel's income elasticity of food expenditure since they were exposed to more income opportunities; therefore, the urban-sector households were earning relatively more income (Paraneetharan *et al.,* 2021). As a result, the urban sector displayed a lower level of responsiveness in food expenditure concerning income in comparison to the remaining two sectors. Specifically, an increase in the monthly total income of households within the urban sector led to a comparatively more significant reduction in food expenditure compared to the other sectors. Thus, urban sector households were experiencing a relatively less impact on food consumption from a change in income than rural and estate sectors. Overall, the magnitude of Engel's food elasticity of the rural sector relied on between the estate and urban sectors.

The rural sector had fewer income opportunities compared to the urban sector. Therefore, the rural sector households earned less monthly income than the urban-sector households. Thus, food expenditure was relatively less responsive to income and had a relatively smaller impact on food consumption from a change in income than the urban sector.

Household Size Elasticity of food expenditure (ε_S)

The results of the estimated household size elasticity of food expenditure for all three sectors with given four periods obtained from the quadratic double log model are shown in Table 5.

Table 5: Results of Estimated Household Size Elasticity of food expenditure

Sector	2006/7	2009/10	2012/13	2016
Urban	0.583***	0.609***	0.399***	0.622***
Rural	0.294***	0.450***	0.482***	0.541***
Estate	0.103***	0.411***	0.466***	0.420***

*Note: *** indicates that variables are significant at 1 % level of significance*

Source: Author's calculations

Results in Table 5 reveal that the estimated household size elasticities of food expenditure for all three sectors in all periods are statistically significant, and all the elasticities are less than one, implying that all included household members such as husband, wife, children, grandparents, and domestic servants were necessary for all sectors. The household size elasticity of food expenditure in the rural sector has shown a slightly increasing pattern. This was due to the shifting in cultural and demographical factors such as a decline in extended families & increasing dependency ratios and technological advancements with access to shared services. The urban and estate sectors had indicated fluctuating patterns. Urban sector household size elasticity of food consumption has increased from 2006/7 to 2009/10 due to urbanization and housing constraints. Then it declined in 2012/13 due to the stabilization of consumption needs and homogenization of consumption patterns. After that, it increased in 2016 due to the rising costs of living and economic inequality and income effects. The estate sector has increased up to 2012/13 due to the shifting of cultural and demographic activities and economic inequality and income effects. Then it slightly declined in 2016 due to rising affluence and disposable income, and weakened economies of scale.

The urban sector had relatively more household size elasticity of food expenditure compared to the other two sectors, and the estate-sector households had a relatively small household size elasticity of food expenditure. The rural sector household size elasticities of food expenditure have reported values between that of the estate and urban sectors. Further, an increase in household size has increased the urban-sector monthly food expenditure higher than the other two sectors. Therefore, the food consumption of the urban-sector households was relatively more due to a change in the family size than in the other two sectors. Additionally, in the estate sector, a one percent decrease in household size has led to a relatively lesser reduction in monthly food expenditure compared to both the urban and rural sectors. Therefore, the food expenditure of

the estate-sector households was relatively less affected due to a change in the family size than the other two sectors.

Age Elasticity of food expenditure $(\boldsymbol{\varepsilon_A})$

The results of the estimated age elasticity of food expenditure for all three sectors in all periods are shown in Table 6. Results reveal that the estimated age elasticities of food expenditure for all three sectors in the given years are less than unity. The age of the household head was a negative significant determinant of the food expenditure in the urban sector in 2006/07 and a positive significant determinant in the rural sector in 2016 only. The pattern of age elasticity of food expenditure shows a slight decrease up to 2012/13 for urban and rural sectors due to the stabilization of income across ages, reduced life-cycle consumption variability, urbanization & standardized living costs and a shift toward non-age-dependent goods and services. Then it marginally increased in 2016 due to lifecycle changes in income, shifts in expenditure priorities, retirement & savings behaviour and generational wealth gaps. In the estate sector, it marginally decreased in 2009/10 due to the cultural & demographic changes and economic policies & social safety nets. Then it marginally increased due to the rising costs of age-specific needs, retirement & savings behaviour and shifts in expenditure priorities. The urban sector had relatively more age elasticity of food expenditure compared with other sectors as the age of household heads was more responsive to food expenditure. The rural sector has relatively less age elasticity as less food expenditure. Further increase in household head age increases urban sector food expenditure more than the other two sectors. So, urban households were more food-responsive to age than the other two sectors.

Table 6: Results of Estimated Age Elasticity of food expenditure

Sector	2006/7	2009/10	2012/13	2016
Urban	-0.179**	0.053	0.021	0.094
Rural	0.029	-0.016	0.007	0.061**
Estate	-0.034	0.033	-0.041	0.088

*Note: ** indicates that variables are significant at 5% level of significance*

Source: Author's calculations

On the other hand, the positive sign of the age elasticity of food expenditure captures the fact of life that an ageing effect, whereas the negative sign depicts a case in which the expenditures on food reduce as the household head grows old. Therefore, the negative effect of the household head's age on food expenditure could be attributed to the gradual dwindling of the household size as it ages. This could be the case if some of the members of the household move away to form their own households (Ndanshau, 1998).

Education Elasticity of food expenditure ($\boldsymbol{\varepsilon_E}$)

The results of the estimated education elasticity of food expenditure for all three sectors in all periods are given in Table 7.

Table 7: Results of Estimated Education Elasticity of food expenditure

Sector	2006/7	2009/10	2012/13	2016
Urban	0.032	0.003	-0.080**	0.070
Rural	0.045**	-0.037**	0.032*	0.066***
Estate	0.044*	-0.028	-0.038*	-0.007

*Note: ***, **, * indicates that variables are significant at 1%, 5% and 10% level of significance respectively;*
Source: Author's calculations

Table 7 displays results indicating that the estimated education elasticities of food expenditure for all three sectors in every year demonstrate values above one, notably smaller in magnitude. This elasticity is statistically significant in the rural sector in all years. Additionally, it is observed that the urban sector exhibits a statistically significant elasticity coefficient solely during 2012/13. In contrast, the estate sector indicates statistically significant elasticities in both 2006/07 and 2012/13. The education elasticity of food expenditure fluctuated over time in the urban and estate sectors while marginally decreasing up to 2012/13 then marginally increased in the rural sector. The reasons for decreasing education elasticity of food expenditure were the essential nature of education, technological barriers & access issues and economic stability in the urban sector, while the cultural emphasis on education and decreasing variability in education costs in the rural sector, while reduced disposable income for education, demographic shifts and technological barriers & access issues in the estate sector. On the other hand, reasons for increasing education elasticity of food expenditure were rising perceived value of education, increased availability of educational options and cost sensitivity & rising education costs found in the urban sector, while cultural shifts & awareness and technological advancements found in the rural sector, while demographic & population dynamics and labour market pressures found in the estate sector.

The positive impact of education on monthly food expenditure was found in the urban sector except in 2012/13, the rural sector except in 2009/10, and the estate sector in 2006/07 only. The urban sector had relatively more education elasticity compared with other sectors as the education level of household heads is more responsive to food expenditure. Further, an increase in household education level increases urban and rural sectors' food expenditure while decreasing monthly food expenditure in the estate sector. So, urban households were more food-responsive to education than the other two sectors.

5. Conclusion

In general, the households' total income and household size are important determinants of their food expenditure. Income has relatively more explanatory power than household size. This result underscores income as the single most important variable that influences household expenditure. The estimated Engel food elasticities of demand for all the consumption items are positive, therefore it conforms with Engel's law. Moreover, magnitudes of the Engel's food elasticities estimated by this study lie within the range of 0 to 1. Furthermore, it is observed that the elasticities of food expenditure are not reporting consistently significant

results to the age and education level of the household head, except in some cases. This could probably be explained by the unweighted household size used in the estimated functions.

Engel food elasticity of demand increased when food consumption shifted away from necessities to luxury, convenience, and speciality items as income grew. This is most evident in middle and high-income households and during periods of economic transition. In summary, Engel's food elasticity of demand decreases as economies mature, basic needs are met, and food demand stabilizes, spending shifts from food to non-food categories and the utility gained from additional food consumption declines. This trend is particularly evident in high-income households and developed economies.

Household size elasticity of food expenditure demand increases when consumption patterns become more sensitive to the number of household members due to shared costs, resource constraints, cultural changes, or policy influences. These effects were particularly pronounced in low-income or resource-constrained settings and urbanized environments with rising costs of living. While it decreased when consumption became less sensitive to the number of household members. This can result from weakened economies of scale, rising affluence, technological advancements and cultural shifts that prioritize individual consumption. These trends were particularly evident in affluent, urbanized, and ageing societies.

The education elasticity of food expenditure demand increased due to rising costs, heightened awareness of its value, government incentives, technological advancements, and changing labour market dynamics. These factors made demand for education more sensitive to variations in income, price, or quality, particularly in economies transitioning towards knowledge-driven sectors. However, it decreases when education is treated as a necessity, supported by government subsidies, or standardized in cost and access. Other factors like cultural priorities, demographic shifts, and stable economic conditions also contribute to less sensitivity in demand for education to income, price, or other variables.

Policy Implications

The estate sector households have the lowest income level among the sectors because the majority of the estate households are estate workers. There are very low-income opportunities available in the sector. This will affect the food consumption of the estate-sector households as they are allocating a relatively large part of their budget to food. Hence, the government can take necessary steps to provide job openings to the youth and women as well as other income opportunities appropriate to the estate sector such as up-country commercial vegetable cultivations, floriculture, dairy farming (milking cow, goat, sheep, etc.), and poultry (laying hen, duck, swan, etc.) and its processing centres. This will lead to an increase in their household family income. Further, the food budget share is even higher in the estate sector, especially in poor households (Paraneetharan *et al.,* 2021). Therefore, special attention is required while designing tax policies on food, as most of the tax on food is borne by poor households. Hence, it is advisable to implement tax policies that minimize the burden on low-income groups, particularly concerning essential expenses categorized as compulsory expenditures.

Competing internet

I have no conflict of interest among others.

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