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# A Two-Stage ELES-AIDS Model Rural Household Demand Analysis: Evidence from South-Eastern, Cambodia

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## Abstract

A two-stage budgeting ELES-AIDS system employs to explore the household expenditure and food demand consumption in rural Cambodia. In the first stage, we apply the Extended Linear Expenditure System (ELES) to access household expenditure including food, health, education, clothing, living, transportation, fuel, and equipment. A 1% increase in price would increase marginal budget share ($\beta_i$) by 0.0538%, 0.0127%, 0.018%, 0.0124%, 0.0193%, 0.0059%, 0.0115% and 0.0113% for food, health, education, clothing, housing, transportation, fuel and equipment, respectively. In addition, the study applied the Almost ideal Demand

System to assess the demand for food consumption. The results indicate that a 1% price increase of food items would increase prices by 0.1575%, 0.00645%, 0.0061%, 0.0222%, 0.0464%, 0.0464% and 0.0174% for rice, maize, potato, eggs, vegetables, meat and fruits, while beverages price would decrease by 0.1497%. Furthermore, expenditure elasticity of rice, maize, potato, eggs, and vegetables is less than one, implying that rice, maize, potato, eggs, and vegetables are necessary commodities, while the elasticity of meat, fruit, and beverages is significantly and greater than one, thus, categorizing them as luxury commodities.

**Keywords:** ELES model, Cambodian rural households, Expenditure elasticity, AIDS model

## 1. Introduction

Cambodia gained its independence in the year 1953 after being colonized by France with the aim of establishing development and growth through industrialization[1]. Through the French colonization from the era of 1863 to 1953, Cambodia after its independence retained the methods of emphasizing agriculture and development of a low industrial base for its economic growth[2]. The agricultural product focused on mainly was house-hold rice and rubber plantation[3]. Unfortunately in 1970 Cambodia plunged into a civil war and there were changes in regimes until 1993 when the first democratic election took place[4]. After elections, the government put up policies in efforts to attract foreign investments while at the same time creating tax exemptions to imported immediate goods and exporting finished products[5]. After effective policies and implementations, Cambodia progressed at a rapid growth of 7% from the year 1998 to 2007[1].

However, in the year 2008, Cambodia faced price increase on food items and fuel. Food prices rose by 36.8% trailed by a 27% increment in the price of transportation and housing materials. The aforementioned inflation was caused by local demand but mainly due to the rising price. Moreover, the price from the supply side increased due to the rise in fuel costs [1]. From the year 2009 to 2016, the household consumption of food and non-alcoholic beverages has shown a slight decrease with a decline from 49% to 44%. On the other hand, transportation expenses have taken an increase from 5% to 11% between the same measured years while the healthcare cost displayed a decrease from 8% to 6%[6]. There was a decrease in agricultural GDP due to severe weather conditions between the years 2013 to 2015[7]. Furthermore, there was a growth in the consumer price index (CPI)to 4.3 percent year-on-year

in March 2017,compared with 2.8 percent at end-2015, which resulted from strong domestic consumption to promote better standards of living and domestic household consumption certain approaches were focused on[8],[9].

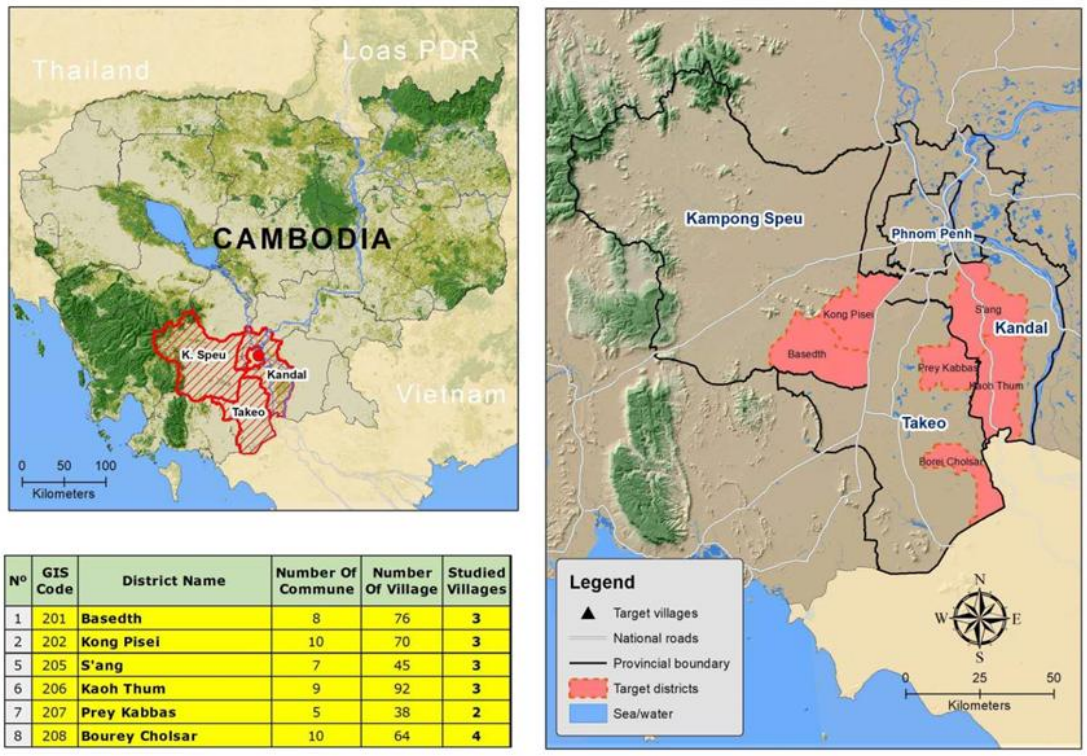
For instance, to accommodate and promote adequate access to food in rural households of Cambodia, it was suggested that the policies need to be integrated with food-related issues at all levels of implementations[10]. Thus, the agriculture sector ought to be incorporated in policy developmen [11]. Hence, it can be stated that adequate inputs to improving access to food for households can be sufficient in expanding and diversifying small farmers[12]. In return, not only will the household be able to produce food for own consumption but also have enough for market sales. Moreover, additional efforts in developing an entrepreneurial culture for households can additionally help in gaining income through non-farming employments[13].

This paper is an assessment of price and income elasticity using the ELES-AIDS model. The variables used in this paper include health, food, clothing, living, transportation, fuels and equipment. The outline of the paper contains an explanation of Two-Stage ELES-AIDS Models, results, conclusion, and recommendations.

## 2. Methodology

### 2.1 Data Collection

Approximately 440 household farmers were interviewed using a structured questionnaire in three provinces of rural Cambodia. The questionnaire was created at the Agricultural Information Institute (AII) of the Chinese Academy of Agricultural Science (CAAS). It is divided into eight parts: household demography, the expenditure of household, food demand expenditure, the input of rice production, agricultural extension, agricultural technology, rice market and production constraints. Collected data was first transferred into EpiData software and then exported to STATA software. The Extended Linear Expenditure System (ELES) and Almost Ideal Demand System (AIDS) were chosen to explore household expenditure and food demand consumption in a rural household.




| N° | GIS Code | District Name | Number Of Commune | Number Of Village | Studied Villages |
|---|---|---|---|---|---|
| 1 | 201 | **Basedth** | 8 | 76 | **3** |
| 2 | 202 | **Kong Pisei** | 10 | 70 | **3** |
| 5 | 205 | **S'ang** | 7 | 45 | **3** |
| 6 | 206 | **Kaoh Thum** | 9 | 92 | **3** |
| 7 | 207 | **Prey Kabbas** | 5 | 38 | **2** |
| 8 | 208 | **Bourey Cholsar** | 10 | 64 | **4** |

**Figure1:** Map of Cambodia and Sample Site

## 2.2 Econometric Application, Two-Stage ELES-AIDS Model

### *a) Extended Linear Expenditure System (ELES)*

In the first stage, we carried out the Extended Linear Expenditure System (ELES) function. Based on the linear expenditure system and demand by [14],and the extended linear expenditure system applied housing affordability comparative research of urban households[15]. Thus, the Extended Linear Expenditure of demand function is put forward over utility function. The expression of the ELES model is as follow:

$$V_i = p_i q_i = p_i x_i + b_i(M - \sum_{j=1}^{n} p_j x_j) \text{ (For i = 1, 2, 3,……,n )} \quad (1)$$

Where:

- $V_i$is the per capita consumption of household expenditure of the ith commodity
- $M = \sum_{i=1}^{n} V_i$is total consumption expenditure
- $p_i$is the price of the ith commodity
- $q_i$is the per capita demand of the commodity
- $p_i$is the basic price of the ith commodity

- $x_i$is the basic demand of the ith commodity
- $p_i x_i$is the expenditure for the basic demand of the ith commodity
- $b_i$is the percentage of expenditure for the ith commodity in exceeded expenditure for basic demand ($0<b_i<1$), that is the ratio of marginal budget
- $\sum_{j=1}^{n} p_j x_j$is the basic consumption expenditure of different commodities

Consumption expenditure of the ith commodity is separated into two parts by equation (1). The first part of $p_i x_i$ is the basic consumption expenditure of a given commodity and the second part of $b_i(M - \sum_{j=1}^{n} p_j x_j)$ is the rest of the ith commodity next removing the basic consumption expenditure for all commodities from total consumption expenditure M . Otherwise, there are two weaknesses in the linear expenditure model. One is total expenditure M thatis a dependent variable, and the other is many time series data are required for coefficient estimation, but there is usually a short of historical data in practice and is also trouble in the launch of the model. To resolve these issues without shifting its basic principles, that y is replaced by total consumption expenditure and $b_i$ is replaced by marginal consumption$\beta_i$. Hence the extended linear expenditure system is:

$$V_i = p_i q_i = p_i x_i + \beta_i \left(Y - \sum_{j=1}^{n} p_j x_j\right) (i=1, 2,\ldots\ldots\ldots\ldots,n) \quad (2)$$

Let$\beta = \sum_{i=1}^{n} \beta_i$we have the consumption equation

$$M = (1 - \beta) \sum_{j=1}^{n} p_j x_j + \beta Y \quad (3)$$

where βis the total marginal consumption propensity.

$\alpha_i = p_i x_i + \beta_i \left(\sum_{j=1}^{n} p_j x_j\right)$, we have:

$$V_i = \alpha_i + \beta_i Y \quad (4)$$

The uncompensated own- price elasticities with equation (3) are:

$$\eta_{ii} = \frac{(1-\beta_i) p_i x_i}{(p_i q_i) - 1} \quad (5)$$

The cross-price elasticities are:

$$\eta_{ij} = -\beta_i \frac{p_j q_j}{p_i q_i} \quad (6)$$

And the income/ expenditure elasticities are:

$$\varepsilon_i = \frac{\partial q_i}{q_i} \div \frac{\partial Y}{Y}$$

$$= \frac{\partial q_i}{q_i} \times \frac{Y}{\partial Y}$$

$$= \frac{\partial q_i}{\partial Y} \times \frac{Y}{q_i}$$

$$= \frac{\partial q_i}{\partial Y} \times \frac{p_i}{p_i} \times \frac{Y}{q_i}$$

$$= \frac{\partial p_i q_i}{\partial Y} \times \frac{1}{p_i} \times \frac{Y}{q_i}$$

$$\varepsilon_i = \frac{\beta_i Y}{P_i q_i} \tag{7}$$

***b) Almost Ideal Demand System (AIDS) model***

The second stage, we employ the linear approximate almost ideal demand system(AIDS) were developed by[16] with budget share of expenditure ($w_i$)

$$w_i = \alpha_i + \sum_j \gamma_{ij} \ln p_j + \beta_i \ln\left\{\frac{m}{p_{(p)}}\right\} + \mu_i \tag{8}$$

From equation (8), we derive as follow:

$$w_1 = \alpha_1 + \gamma_{11}\ln p_1 + \gamma_{12}\ln p_2 + \ldots + \gamma_{18}\ln p_8 + \beta_1 \ln\left\{\frac{m}{p_{(p)}}\right\} + \mu_1 \tag{9}$$

$$w_2 = \alpha_2 + \gamma_{21}\ln p_1 + \gamma_{22}\ln p_2 + \ldots + \gamma_{28}\ln p_8 + \beta_2 \ln\left\{\frac{m}{p_{(p)}}\right\} + \mu_2 \tag{10}$$

$$w_3 = \alpha_3 + \gamma_{31}\ln p_1 + \gamma_{32}\ln p_2 + \ldots + \gamma_{38}\ln p_8 + \beta_3 \ln\left\{\frac{m}{p_{(p)}}\right\} + \mu_3 \tag{11}$$

$$w_4 = \alpha_4 + \gamma_{41}\ln p_1 + \gamma_{42}\ln p_2 + \ldots + \gamma_{48}\ln p_8 + \beta_4 \ln\left\{\frac{m}{p_{(p)}}\right\} + \mu_4 \tag{12}$$

$$w_5 = \alpha_5 + \gamma_{51}\ln p_1 + \gamma_{52}\ln p_2 + \ldots + \gamma_{58}\ln p_8 + \beta_5 \ln\left\{\frac{m}{p_{(p)}}\right\} + \mu_5 \tag{13}$$

$$w_6 = \alpha_6 + \gamma_{61}\ln p_1 + \gamma_{62}\ln p_2 + \ldots + \gamma_{68}\ln p_8 + \beta_6 \ln\left\{\frac{m}{P_{(p)}}\right\} + \mu_6 \quad (14)$$

$$w_7 = \alpha_7 + \gamma_{71}\ln p_1 + \gamma_{72}\ln p_2 + \ldots + \gamma_{78}\ln p_8 + \beta_7 \ln\left\{\frac{m}{P_{(p)}}\right\} + \mu_7 \quad (15)$$

$$w_8 = \alpha_8 + \gamma_{81}\ln p_1 + \gamma_{82}\ln p_2 + \ldots + \gamma_{88}\ln p_8 + \beta_8 \ln\left\{\frac{m}{P_{(p)}}\right\} + \mu_8 \quad (16)$$

Where $w_i$ is the budget share of good i in commodity group i, $p_j$ is the price of commodity j in group i, m is the ith group's total expenditure, and $P_{(p)}$ is the ith group price index.

$$\ln P_{(p)} = \alpha_0 + \sum_{i=1}^{n} \ln p_i + \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} \gamma_{ij} \ln p_i \ln p_j \quad (17)$$

However, equation (8) has a nonlinear estimation. To avoid the complication with nonlinear estimation Stone's geometric price index

$$\ln P_{(p)} = \sum w_i \ln p_i \quad (18)$$

With the following restrictions:

$$\sum \alpha_i = 1,\ \sum_i \beta_i = 0, \sum_j \gamma_{ij} = 0, \gamma_{ij} = \gamma_{ji} \quad (19)$$

The demand expenditure elasticity, Marshallian (uncompensated) price elasticity and Hackisian (compensated) were calculated by the estimated parameters of the LA-AIDS model was developed by Green and Alston (1990), that is formed, and its equation is:

Expenditure elasticity:

$$\varepsilon_i = 1 + \frac{\beta_i}{w_i} \quad (20)$$

Marshallian (uncompensated) price elasticity:

$$\eta_{ij} = -\delta_{ij} + \frac{\gamma_{it}}{w_i} - \frac{\beta_i w_j}{w_i} \quad (21)$$

Hicksian (compensated) price elasticity:

$$\eta_{ij}^{*} = \eta_{ij} + w_j \varepsilon_i \quad (22)$$

While i=j, δ=1， or δ=0.

## 3. Data Description

### 3.1 Household Expenditure

Table 1 presents the summary statistics of household expenditure. Majority Cambodina people live in rural region highly expending on food while an average food expenditure accounte 3,314thousands riels, a maximum and a minimum food expenditure are approximatly 5,800 and 150 thousand riels, respectively. The mean health expenditure accounts for 512 thousand KHR, the maximum is 2,500 thousand KHR and the minimum is 100 thousand KHR. The mean education expenditure is 1,147 thousand KHR, the maximum is 7,000 thousand KHR and the minimum is 1,095 thousand KHR. The mean living expenditure is 1,601thousand KHR and the maximum is 7,000 thousand KHR and the minimum is 100 thousand KHR. For the mean transportation expenditure, fuel expenditure and equipment are 305, 670, and 327thousand KHR, respectively. The maximum expenditure on transportation, fuel, and equipment is 2,000, 3,000 and 1,400 thousand KHR, respectively.

**Table1:** Summary Statistics of Household Expenditure (‘000 Khmer Riel/Year)

| Variables | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|
| Food expenditure | 3,314.84 | 1,067.28 | 150 | 5,800 |
| Health expenditure | 512.02 | 410.92 | 100 | 2,500 |
| Education expenditure | 1,147.90 | 1,095.08 | - | 7,000 |
| Clothing expenditure | 433.56 | 291.04 | 100 | 2,000 |
| Living expenditure | 1,601.73 | 979.79 | 100 | 7,000 |
| Transportation expenditure | 305.09 | 299.16 | - | 2,000 |
| Fuel expenditure | 670.73 | 616.74 | 80 | 3,000 |
| Equipment expenditure | 327.80 | 262.64 | - | 1,400 |

### 3.2 Food Consumption and Expenditure

Table 2 illustrates the summary statistics of household food consumption. The average rice consumption amounts to 1,622 kilograms per household. The maximum and the minimum are perhaps 4,200 kilograms, 500 kilograms respectively. Rice plays an important role in the

national economy, and it is known as the staple food for Cambodian people [17]. The average maize consumption and potato are like about 15 kilograms, the maximum is 80 kilograms. The vegetable consumption is on average o83 kilograms per household, the maximum accounts to510 kilograms and the minimum accounts 12 kilograms. About the average meat consumption accounts approximately 121 kilograms, an amount 450 kilograms is the maximum, and the minimum is 20 kilograms. The household farmer in the rural area normally consumes meat includes fish, pork, chicken, duck, and beef. The drinks consumption is an average of 46 kilograms, a maximum of 832 kilograms per household.

**Table2:** The summary Statistics of Food Consumption (Kg/Household/Year)

| Variables | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|
| Rice consumption | 1621.83 | 709.66 | 500 | 4,200 |
| Maize consumption | 15.02 | 12.13 | - | 80 |
| Potato consumption | 13.55 | 11.85 | - | 70 |
| Egg consumption | 21.52 | 11.94 | - | 80 |
| Vegetables consumption | 82.76 | 61.53 | 12 | 510 |
| Meat consumption | 120.89 | 63.57 | 20 | 450 |
| Fruit consumption | 21.78 | 16.58 | - | 120 |
| Beverage consumption | 45.62 | 90.50 | - | 832 |

Table 3 provides a summary of household food expenditure statistics. The average rice expenditure is approximately 1,456thousand KHR, a maximum of 4,200 thousand KHR and a minimum of 450,000 KHR. The maize expenditure is 29,875 KHR, a maximum of 180 thousand KHR. The average potato expenditure is approximately 26,273 KHR and 150 thousand KHR of the maximum. The household consumes the egg amount 93,948 KHR, a maximum of 400 thousand KHR. Approximately 187 thousand KHR is the average of vegetable expenditure, a maximum of 1,275 thousand KHR and a minimum of 24 thousand KHR. The average meat expenditure, fruit expenditure, and drink expenditure are 1,908, 111, and 293 thousand KHR respectively. Furthermore, the maximum meat, fruit, and drinks are 8,180, 600, and 4,160 thousand KHR respectively.

**Table 3:** The summary Statistics of Food Expenditure (000'Khmer Riels /Year)

| Variables | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|
| Rice expenditure | 1,457 | 638 | 450 | 4,200 |
| Maize expenditure | 30 | 26 | - | 180 |
| Potato expenditure | 26 | 24 | - | 150 |
| Eggs expenditure | 94 | 57 | - | 400 |
| Vegetables expenditure | 188 | 148 | 24 | 1,275 |
| Meat expenditure | 1,908 | 1,018 | 265 | 8,180 |
| Fruit expenditure | 112 | 89 | - | 600 |
| Beverages expenditure | 294 | 504 | 70 | 4,160 |

Figure 2 indicates that the non-parameter of eight foods consumed by rural households in Cambodia includes: rice, maize, potato, egg, vegetables, meat (fish, pork, beef, chicken and duck), fruit and beverages. Rice, vegetables, and meat. The shapes of the curve do not demonstrate a clear linearity in budget shares; these food groups' share represents consumer behavior that had different levels of expenditure on food.

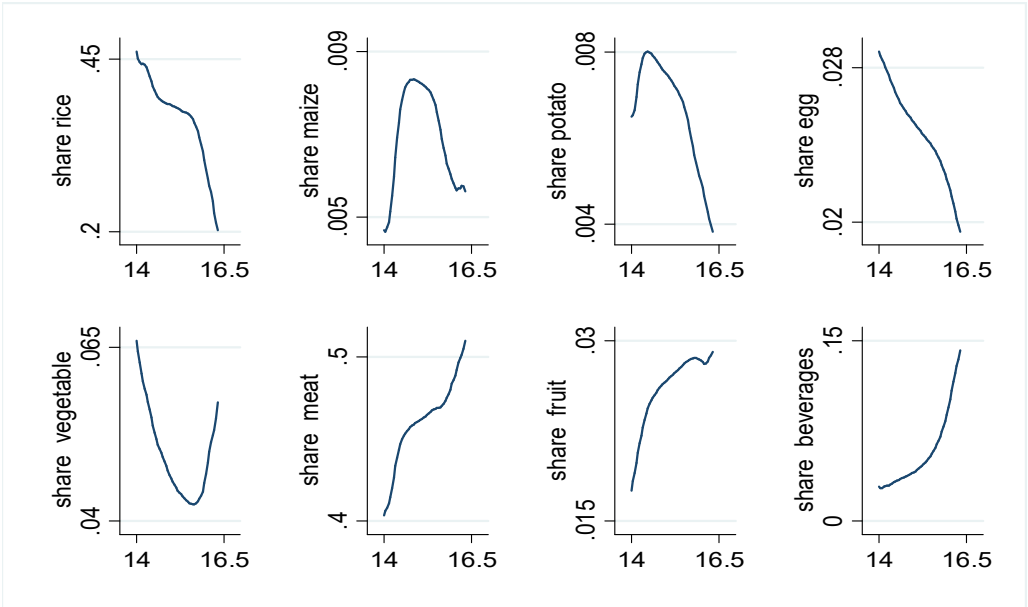



**Figure 2:** Engle curve Non-parametric for Share Food Demand

## 4. Results and Discussion

There are eight commodities for the first stage of the demand system namely: food, health, education, clothing, living, transportation, fuel, and equipment. While the second stage consists of eight commodities which includes: rice, maize, potato, egg, vegetable, meat, fruit, and drinks.

### 4.1 The First Stage: The Extended Linear Expenditure System (ELES)

The results of the first-stage commodities are demonstrated in table4.The parameters estimation of the Extended Linear Expenditure (ELES) from table 3, indicate that the lowest required amounts values ($qi^0$) for all commodities are positive, implying that they are price inelastic commodities. The expenditure level for food commodities is higher than that of another commodity, account for 2,979 thousand riels. Secondly, a living commodity has the minimum required quantity of 1,509 thousand riels. The education commodity is the third-largest demand having the minimum requirement of 1,069 thousand riels and the lowest minimum quantity is transportation commodity which accounts for 283 thousand riels. Parameter βi's shown in table 3 indicates that the food commodity had also the highest estimated marginal budget share of 0.0538. For food (rice, vegetables, and fish) consumed almost 7 days per week. The second-highest marginal budget share, 0.0193, was for the living commodity. The third highest is for the education commodity with aminimal budget share of 0.0180. The lowest marginal budget share is transportation representing 0.0059 and marginal budget share of equipment, fuel, clothes, health is 0.0113, 0.0115, 0.0124, and 0.0127, respectively. Elasticity estimates for the ELES model such as own-price elasticities and income elasticities have also been calculated based on the parameters estimated in table 3.Regarding the estimation, own-price elasticities indicate relative inelastic demand for all commodities. The highest price elasticity of food commodity is 0.149, implying that the consumption of this commodity is more sensitive to price changes followed by equipment, clothes, health, and fuel are 0.135, 0.115, 0.104, and 0.078, respectively. Own-price of living commodities and transportation are lowest and with also a similar amount of 0.075. The estimated commodity expenditure elasticities for the ELES model indicate that all commodities are comparatively essential, that is, the expenditure elasticity is smaller than one. This confirms Engle's Law "decreasing share of expenditure on food when an individual's income goes up". On the other hand, findings show positive income elasticity. The equipment has the highest income elasticity I 0.374. The second highest income elasticity is clothes, 0.310 and the third highest in healthis 0.269. The living has the lowest income

elasticity of 0.130, which indicates that all commodities appear to be of necessity for Cambodian. The income elasticities are lower than one for all commodities, implies that as the general level of income rise, demand for such as goods will increase rapidly.In economic theory, if income elasticities of demand all commodities are smaller than 1, those commodities are characterized as necessities.These results from the analysis suggest that commodities such as food, health, education, clothes, living, transportation, fuel, and equipment are among the most preferred items in the consumer's budget and their consumption is sensitive to changes in income, according to Engel's Law is an economic theory introduced in 1857 by Ernst Engel, a German statistician "the percentage of income allocated for food purchases decreases as income increases. As household income increases, the percentage of food-expenditure income decreases, while the proportion spent on other commodities (such as luxury goods) increases." Such results are appropriate for developing countries, where commodities are suitable and relatively of necessity.

### 4.2 The Second Stage: Almost Ideal Demand System (AIDS) model

a) ***The Estimated Parameters of the Food Items***

Table 6 demonstrates the estimated parameters of food items. The majority significant price and income effect illustrates that the degree of shifting of share food items. The own-price of the food items was significant including 0.157, 0.006, 0.006, 0.022, 0.046, 0.064 and 0.017 for rice, maize, potato, egg, vegetables, meat, and fruits, respectively. If the percentage increases in price for rice, maize, potato, egg, vegetables, meat, and fruits would increase the percentage of budget share of food items. They reveal that one the percentage increase of the food commodities would increase the budget share of food by 0.2, 0.006, 0.006, 0.02, 0.05, 0.05 and 0.02 for rice, maize, potato, egg, vegetable, meat, and fruits, respectively. Furthermore, mostly cross-price food items in the study regions were negatives. They present that a one percent increase in food prices would decrease the budget share food items. Due to the majority cross-price were negative so implying that the food commodities were complements.

***b) Expenditure Elasticity***

Expenditure elasticities of food items were shown in table 7 and calculated by the AIDS model. Food commodities elasticities were 0.750, 0.824, 0.731, 0.608, 0.916, 1.082, 1.214 and 2.284 for rice, maize, potato, egg, vegetables, meat, fruits and beverages, respectively. When income level increases one percentage would increase demand expenditure of food

items by 0.75, 0.73, 0.60, 0.91, 1.08, 1.21 and 2.28 for rice, maize, potato, egg, vegetables, meat, fruits, and beverages, respectively. The positive expenditure elasticities of food items indicate that household income level would increase with the demand expenditure for food items will increase. Meanwhile, the expenditure elasticities for rice, maize, potato, egg, and vegetables were smaller than one. It implies that food commodities are necessities, while meat, fruit and beverages expenditure elasticities were bigger than one with it illustrates that food items are luxury commodities.

The calculated expenditure elasticities were found to be the lowest in terms of egg consumption, while the consumption of beverages was the most variable in food terms of price change, as its elasticity was more than unitary. Thus, beverages can serve as a superior food item, where consumption tends to increase with increasing income.

***c)Own-Price Elasticities***

For own-price elasticity, we mean a change in the quantity demanded of a commodity because of the change in its price. The estimated own-price elasticities for various food commodities will be unbearable to evaluate the insight of the consumption or demand for specific food items on the price change. The estimated Marshallian own-price elasticities are given in table 7. The own-price elasticities for food items show negative sing, implying that the relationship between consumption or demand and price for food commodities change in opposite direction in conformity with the Law of Demand. The own-price is found to be the lowest for vegetables (0.008) and followed by eggs (0.092), while the highest is beverages (4.031) and followed by potato (0.992).

All in all, the eight food items of household demand in the study regions are highly unstable price, the beverages are the most irregularity conformity the change of price. An increase in food prices would decrease food consumption or food demand.

***d)Cross-Price Elasticities***

Cross-price elasticities are known as variation of the demand for one commodity in the change price of other commodities. It is useful to determinant the food items for substitutionary or supplementary. Thus, if the cross-price elasticities for the food commodities are negative, it implies that food commodities to be complimentary, while it is called competitiveness or substitutionary if it is positives cross-price elasticities. The results are presented in Table 7, they modified that cross-price elasticities are significant; mostly cross-price are smaller than own-price elasticities and it's also less than 10 percentage of the total sensitivity price. Therefore, the price of other food commodities doesn't more effective on the

demand food items and thereby, the own-price is still determinant of food demand in the study region.

Meanwhile, cross-price elasticity of rice is competitive or substitution food commodity with vegetables, fruit, and beverages, while it is complimentary food with maize, potato, eggs, and meat, respectively. Similarly, both maize and potato are presented substitution items with meat, while it is complimentary items with rice, eggs, vegetable, fruit, and beverages, respectively. Due to vegetables is a substitute for egg, so rice, maize, potato, meat, fruit, and beverages are complimentary food for an egg, respectively. Cross-price vegetables are substituted by rice, eggs, and beverages, whiles it's supplementary with maize, potato, meat, and fruit, respectively. Cross-price of meat is competitive food with maize, potato, fruit and beverages, and the supplementary food for rice and vegetables. Additional, a cross-price of beverage is the food substitution with vegetables and fruit, while it's supplementary food with rice, maize, potato, and egg, respectively.

In a nutshell, the shift from supplementary to substitutionary food commodities is caused by variation price. So, the increased price food items in the study area are more effective than the increased substitution for some food items in rural household Cambodia such as that some foods were the complement food items before the sensitivity price and they become substitute food items after the shift price.

## Conclusion and Recommendations

This paper carried out the two-stage ELES-AIDS to estimate the price elasticity and income elasticity including food, health, education, clothing, living, transportation, fuel, and equipment. The minimum required qualities ($q_i^0$) parameters for all commodities are positive, implying that they are price inelastic commodities. The estimated commodities own-price elasticity for the ELES model indicates that all commodities are relative requisite commodities; that is, commodities own-price elasticities are smaller than one. Although it is less than one, the commodities are still essential in a rural household. These results of the analysis suggest that commodities such as food, health, education, clothes, living, transportation, fuel, and equipment are preferred items in the consumer's budget and their consumption is fairly sensitive to changes in income. These results are appropriate for developing countries, where commodities are suitable price commodities and may be viewed as relative necessities. The cross-price elasticities $\eta_{ij}$ are negative for the price elasticities of the goods, indicating that they are complementary.

On the other hand, for food price expenditure increase one percent affect food expenditure elasticities commodities of rice, maize, potato, egg, vegetable, meat, fruit, and drinks will increase by 0.75%, 0.82%, 0.73%, 0.60%, 0.91%, 1.08%, 1.21% and 2.28%, respectively. According to the analysis, the daily food people usually consume in a remote area has rice, maize, potato, egg, vegetable, meat, fruit, and drinks. The rice is mostly dairy consumption and also meat, vegetable. Furthermore, if A household can produce own agricultural product, they will reduce to consume commodities from the market.

As shown, the results show a great deal of interest for policymakers, planners and government to make a good policy to deserve commodities inflation. An analysis of household expenditure shows that there is a relationship between household income and family needs. Especially family size, type agricultural household, rural area seems to have a significant impact on household consumption expenditure such as food, education, education, housing, transportation, fuel, and equipment. Own-price elasticities of all commodities are smaller than one, indicating a low response to changes in commodities price. The enormity of the estimated cross-price elasticities is usually lower than of own-price elasticities, suggesting that income policies may be less effective to impact consumption patterns than price policies.
The low expenditure marginal budget share of transportation commodity is also an important issue that the policymaker should consider. The analysis of the determinants of household consumption clearly indicates that changes in income will influence household demand. The estimated income elasticities for the commodities range from 0.13 for fuel to 0.37 for equipment. These results reflect the higher income elasticities for all commodities meaning that the demand for these commodities will increase with increasing income.
Overall, our study has created significant insights into families' expenditure in Cambodia. This analysis is also relevant to the Government's manufacturing strategies regarding pricing policies and the promotion of social welfare standards. Prices are likely to be negatively correlated with the demand for goods. The findings also show that fuel will decrease with increasing food prices, so it seems reasonable to conclude that a low-cost food policy can benefit consumers.

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**Table4:** The estimated Parameters and Own-Price of Household Expenditure

| **Items** | **Marginal budget share ($\beta_i$)** | **Minimum required quantities ($q_i^0$)** | **Expenditure allocated to groups i($p_i$ $q_i$)** | **Own-price elasticities $_{ii}$** |
|---|---|---|---|---|
| Food | 0.0538 | 2979.145 | 3314.842 | -0.1496 |
| Health | 0.0127 | 464.296 | 512.020 | -0.1047 |
| Education | 0.0180 | 1069.746 | 1147.900 | -0.0849 |
| Clothes | 0.0124 | 388.122 | 433.562 | -0.1159 |
| Living | 0.0193 | 1509.450 | 1601.729 | -0.0758 |
| Transport | 0.0059 | 283.676 | 305.091 | -0.0757 |
| Fuel | 0.0115 | 625.589 | 670.729 | -0.0780 |
| Equip | 0.0113 | 286.741 | 327.800 | -0.1351 |

**Table5:** The Expenditure Elasticities

| **Items** | **Marginal budget share $_i$** | **Household Expenditure (M)** | **Expenditure allocated to groups i ($p_iq_i$)** | **Income Elasticities $_I$)** |
|---|---|---|---|---|
| Food | 0.0538 | 10860.25 | 3314.842 | 0.17626 |
| Health | 0.0127 | 10860.25 | 512.020 | 0.26937 |
| Edu | 0.0180 | 10860.25 | 1147.900 | 0.17030 |

| | | | | |
|---|---|---|---|---|
| Clothes | 0.0124 | 10860.25 | 433.562 | 0.31061 |
| Living | 0.0193 | 10860.25 | 1601.729 | 0.13086 |
| Transport | 0.0059 | 10860.25 | 305.091 | 0.21002 |
| Fuel | 0.0115 | 10860.25 | 670.729 | 0.18620 |
| Equip | 0.0113 | 10860.25 | 327.800 | 0.37438 |

**Table6:** Parameters Estimates of Food Items

| $\gamma_{ij}$ | Rice | Maize | Potato | Eggs | Vegetables | Meat | Fruit | Drinks | $\alpha_i$ | $\beta_i$ | R-sq |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Rice | 0.1575 | -0.0038 | -0.0031 | -0.0040 | 0.0069 | -0.1659 | 0.0018 | 0.0105 | 1.1240 | -0.0909 | 0.9153* |
| Maize | -0.0038 | 0.0064 | -0.0005 | -0.0020 | -0.0049 | 0.0092 | -0.0017 | -0.0026 | -0.0037 | -0.0013 | 0.6944* |
| Potato | -0.0031 | -0.0005 | 0.0061 | -0.0032 | -0.0043 | 0.0077 | -0.0011 | -0.0017 | 0.0004 | -0.0019 | 0.6092* |
| Eggs | -0.0040 | -0.0020 | -0.0032 | 0.0222 | 0.0050 | -0.0083 | -0.0075 | -0.0023 | 0.0610 | -0.0097 | 0.7856* |
| Vegetables | 0.0069 | -0.0049 | -0.0043 | 0.0050 | 0.0464 | -0.0476 | -0.0069 | 0.0054 | 0.1549 | -0.0040 | 0.8496* |
| Meat | -0.1659 | 0.0092 | 0.0077 | -0.0083 | -0.0476 | 0.0464 | 0.0088 | 0.1497 | -0.2228 | 0.0378 | 0.9523* |
| Fruit | 0.0018 | -0.0017 | -0.0011 | -0.0075 | -0.0069 | 0.0088 | 0.0170 | -0.0104 | -0.0074 | 0.0057 | 0.7688* |
| Drinks | 0.0105 | -0.0026 | -0.0017 | -0.0023 | 0.0054 | 0.1497 | -0.0104 | -0.1486 | -0.1064 | 0.0643 | - |

**Table7:** Estimated Own-price, Cross-price and Expenditure Elasticities within Food Items

| | Rice | Maize | Potato | Eggs | Vegetables | Meat | Fruit | Drinks | Expenditure Elasticity |
|---|---|---|---|---|---|---|---|---|---|
| Rice | -0.4892 | -0.0084 | -0.0065 | -0.0046 | 0.0299 | -0.3302 | 0.0113 | 0.0401 | 0.758 |
| Maize | -0.4373 | -0.1610 | -0.0603 | -0.2584 | -0.6376 | 1.2954 | -0.2255 | -0.3393 | 0.824 |
| Potato | -0.0032 | -0.0006 | -0.9916 | -0.0043 | -0.0058 | 0.0117 | -0.0014 | -0.0022 | 0.731 |
| Eggs | -0.0144 | -0.0777 | -0.1260 | -0.0920 | 0.2211 | -0.1536 | -0.2938 | -0.0721 | 0.608 |
| Vegetables | 0.1793 | -0.1039 | -0.0910 | 0.1089 | -0.0084 | -0.9761 | -0.1441 | 0.1197 | 0.916 |
| Meat | -0.3896 | 0.0193 | 0.0160 | -0.0199 | -0.1069 | -0.9375 | 0.0169 | 0.3198 | 1.082 |
| Fruit | -0.0107 | -0.0676 | -0.0423 | -0.2891 | -0.2692 | 0.2339 | -0.3641 | -0.4046 | 1.214 |
| Drinks | -0.2719 | -0.0626 | -0.0424 | -0.0770 | 0.0480 | 2.3956 | -0.2425 | -4.0309 | 2.284 |

**Appendix**

To fit model, we type

nlsur aids8 @ w1 w2 w3 w4 w5 w6 w7 lnp1 lnp2 lnp3 lnp4 lnp5 lnp6 lnp7 lnp8 lnm, parameters(a1 a2 a3 a4 a5 a6 a7 b1 b2 b3 b4 b5 b6 b7 g11 g12 g13 g14 g15 g16 g17 g22 g23 g24 g25 g26 g27 g33 g34 g35 g36 g37 g44 g45 g46 g 47 g55 g56 g57 g66 g67 g77) neq(7) ifgnls

(obs = 240)

* Uncentered R-sq

---

| Coef. Std. Err. z P>|z| [95% Conf. Interval]

---+---

/a1 | 1.123987 .1373841 8.18 0.000 .8547189 1.393255

/a2 | -.0036978 .0060457 -0.61 0.541 -.0155471 .0081514

/a3 | .0004272 .006636 0.06 0.949 -.0125792 .0134336

/a4 | .0609891 .0147729 4.13 0.000 .0320348 .0899434

/a5 | .1548979 .0221427 7.00 0.000 .111499 .1982968

/a6 | -.2227558 .1170181 -1.90 0.057 -.452107 .0065955

/a7 | -.0074139 .0168835 -0.44 0.661 -.0405049 .0256771

/b1 | -.0909328 .0194274 -4.68 0.000 -.1290098 -.0528557

/b2 | -.001336 .0009528 -1.40 0.161 -.0032033 .0005314

/b3 | -.0018808 .0010548 -1.78 0.075 -.003948 .0001865

/b4 | -.0096874 .0022922 -4.23 0.000 -.01418 -.0051948

/b5 | -.003959 .0034927 -1.13 0.257 -.0108046 .0028867

/b6 | .0378403 .0175384 2.16 0.031 .0034657 .0722149

/b7 | .0056619 .0026246 2.16 0.031 .0005177 .0108061

/g11 | .1574752 .0492587 3.20 0.001 .0609299 .2540205

/g12 | -.0038236 .0025299 -1.51 0.131 -.0087821 .0011348

| | | | | | | |
|---|---|---|---|---|---|---|
| /g13 | -.0030726 | .0027337 | -1.12 | 0.261 | -.0084305 | .0022853 |
| /g14 | -.0039892 | .0058853 | -0.68 | 0.498 | -.0155242 | .0075458 |
| /g15 | .0069286 | .0089524 | 0.77 | 0.439 | -.0106177 | .0244749 |
| /g16 | -.1658545 | .0400814 | -4.14 | 0.000 | -.2444126 | -.0872965 |
| /g17 | .0018401 | .0069585 | 0.26 | 0.791 | -.0117983 | .0154785 |
| /g22 | .006364 | .0013054 | 4.88 | 0.000 | .0038056 | .0089225 |
| /g23 | -.0004678 | .000919 | -0.51 | 0.611 | -.0022689 | .0013333 |
| /g24 | -.0019966 | .0011738 | -1.70 | 0.089 | -.0042972 | .0003041 |
| /g25 | -.0049068 | .0015191 | -3.23 | 0.001 | -.0078841 | -.0019294 |
| /g26 | .0092247 | .0023595 | 3.91 | 0.000 | .0046002 | .0138492 |
| /g27 | -.0017488 | .0018657 | -0.94 | 0.349 | -.0054054 | .0019078 |
| /g33 | .0060953 | .0011658 | 5.23 | 0.000 | .0038103 | .0083802 |
| /g34 | -.0031836 | .0012313 | -2.59 | 0.010 | -.0055969 | -.0007703 |
| /g35 | -.0042964 | .00164 | -2.62 | 0.009 | -.0075108 | -.0010819 |
| /g36 | .0076805 | .0025516 | 3.01 | 0.003 | .0026794 | .0126815 |
| /g37 | -.0010808 | .0018709 | -0.58 | 0.563 | -.0047478 | .0025861 |
| /g44 | .0222203 | .0031646 | 7.02 | 0.000 | .0160178 | .0284228 |
| /g45 | .0050146 | .0030663 | 1.64 | 0.102 | -.0009953 | .0110245 |
| /g46 | -.0082751 | .0055091 | -1.50 | 0.133 | -.0190727 | .0025224 |
| /g47 | -.007523 | .0028917 | -2.60 | 0.009 | -.0131906 | -.0018554 |
| /g55 | .046352 | .0058884 | 7.87 | 0.000 | .0348109 | .0578931 |
| /g56 | -.047642 | .008098 | -5.88 | 0.000 | -.0635138 | -.0317701 |
| /g57 | -.0068699 | .0037818 | -1.82 | 0.069 | -.0142822 | .000542 |

**TABLE 8**: ELES ELASTICITY MATRIX FOR EIGHT COMMODITIES

| $p_1q_1^0$ | $p_2q_2^0$ | $p_3q_3^0$ | $p_4q_4^0$ | $p_5q_5^0$ | $p_6q_6^0$ | $p_7q_7^0$ | $p_8q_8^0$ | C | $p_iq_i^0$ | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | -0.0538 | -0.0538 | -0.0538 | -0.0538 | -0.0538 | -0.0538 | -0.0538 | 2730.179 | $x_1$ = 2979.145 | Food |
| -0.0127 | 1 | -0.0127 | -0.0127 | -0.0127 | -0.0127 | -0.0127 | -0.0127 | 373.587 | $x_2$ = 464.2964 | Health |
| -0.0180 | -0.0180 | 1 | -0.0180 | -0.0180 | -0.0180 | -0.0180 | -0.0180 | 952.080 | $x_3$ = 1069.7464 | Edu |
| -0.0124 | -0.0124 | -0.0124 | 1 | -0.0124 | -0.0124 | -0.0124 | -0.0124 | 298.611 | $x_4$ = 388.1222 | Clothes |
| -0.0193 | -0.0193 | -0.0193 | -0.0193 | 1 | -0.0193 | -0.0193 | -0.0193 | 1391.772 | $x_5$ = 1509.4502 | Living |
| -0.0059 | -0.0059 | -0.0059 | -0.0059 | -0.0059 | 1 | -0.0059 | -0.0059 | 240.47 | $x_6$ = 283.6762 | Trans |
| -0.0115 | -0.0115 | -0.0115 | -0.0115 | -0.0115 | -0.0115 | 1 | -0.0115 | 545.305 | $x_7$ = 625.5885 | Fuel |
| -0.0113 | -0.0113 | -0.0113 | -0.0113 | -0.0113 | -0.0113 | -0.0113 | 1 | 204.025 | $x_8$ = 286.7413 | Equi |

***Notice**:Homogeneous linear equations, Solution of equations by Cramer rule (www.yunsuanzi.com/matrixcomputations)

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