

Determine the Cost of Over Consumption for Energy based on Location and Income: A Case in Malaysia

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Abstract Energy subsidy is an important assistance to improve households' wellbeing. It can be seen that the most significant amounts of subsidy go to energy subsidy. However, misallocation of energy subsidy may lead to over consumption and cause national deficit and eventually lead the country to bankruptcy. Therefore, the aim of this study was to determine who is the deserve subsidy recipient and which type of energy should subsidy be given. The study used cross sectional data collected from 385 respondents in each Sabah and Sarawak respectively using open-ended questionnaire. The study looked into the proportion of energy expenditure over monthly income, energy consumption pattern and calculating the cost of over consumption based on location and income groups. The findings showed that energy expenditure was the third largest usage over monthly income. The energy consumption pattern referred to multiple fuel model where households preferred to use combination of energy. The highest cost of over consumption in Sabah accounted to electricity meanwhile households in Sarawak led the most wastage in diesel consumption.

Keywords Energy subsidy, Monthly expenditure, Consumption pattern, Cost of over consumption, Malaysia

1. Introduction

For the most of last century, Malaysian government had a great deal of leeway in administrating an effective and efficient subsidy allocation mechanism. But the deficits had consistently exceeded the figure forecast since 1999. Malaysia's subsidy bill was severe when it comprised 15 percent of the entire national budget in 2009 which amounted to RM12,900 worth of subsidy per household ([1]). In 2013, the government has allocated almost RM47 billion for various type of subsidies, incentives and assistances including subsidies for petroleum products, food, health, agriculture and fisheries, utilities, toll, welfare and education. Among the total amount of subsidies given, the largest allocation was distributed to fuel and energy which comprise of RM24.8 billion or 53 percent ([2]).

Malaysia government has been employing universal subsidies scheme to distribute energy subsidy where all segment of society like high income group, businessman and foreigner can enjoy it. This caused the unsustainable and consistent energy subsidy figures to keep increasing and finally may lead to bankruptcy for the nation. The symptom can be viewed when the national debt of Malaysia stood at 53.4 percent of GDP (RM455.7 billion) in 2001

and it remained as high as 54.8 percent (RM503.2 billion) in 2012 ([3]). However, energy subsidy cannot be totally removed as long as there is a government and it fulfils its role in collecting tax from its citizen. Therefore, the government should decide what type of energy should be given subsidy and who should receive it.

Besides, based on energy ladder model, households may switch their energy consumption from traditional to modern energies as the countries develop and incomes increase ([4]). On the other hand, multiple fuel model revealed that households in developing countries do not switch from traditional to modern fuels but favour in using combination of fuels depending on the characteristics of the household itself ([5]). The behaviour to use certain energy can be influenced by the subsidy distributed. Therefore, measures should be taken to evaluate the energy consumption pattern with and without subsidy distribution.

This study concentrates on the state of Sabah and Sarawak in Malaysia instead of Peninsular Malaysia. This is due to large of disparities in terms of geographical location, socio-economic factors, economic activities, affordability, demographic structure and infrastructure. For instance, the separated physical entity between Peninsula Malaysia with Sabah has made the Malaysian government unable to constitute a single entity in the infrastructure planning ([6]). Besides, Peninsular Malaysia is more densely populated than Sabah and Sarawak ([6]). Meanwhile electricity grid in Sabah was found to be much smaller than Peninsular Malaysia ([7]). According to Department of Statistics

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Malaysia, Sabah topped the list with 19.7 percent poverty rate among all the states in Malaysia in 2009 meanwhile Sarawak ranked at the third position with 5.3 percent. Nevertheless, the poverty line income for Sabah and Sarawak were RM1,048 and RM912 respectively which were higher compared to RM763 in Peninsular Malaysia[8].

Therefore, study was carried out in Sabah and Sarawak to determine whether the objective of energy subsidy distribution to the eligible household was achieved. Meanwhile the cost of over consumption was also being identified to enable the redistribution of national resources which encourages economic diversification and infrastructure development.

1.1. Research Objectives

The specific objectives of this study are stated as follow:-

- a. To estimate the monthly expenditure for various types of consumption over the income earned per household in Sabah and Sarawak based on location and income group.
- b. To determine the consumption pattern for each type of energy consumed in Sabah and Sarawak based on location and income group.
- c. To estimate the cost of over consumption for each type of energy consumed in Sabah and Sarawak based on location and income group.

2. Literature Review

2.1. Energy Demand Theories

Energy Ladder Model explains the movement of energy consumption from traditional sources to more sophisticated sources along an imaginative ladder with the improvement in the economic status of households especially in terms of income ([11],[12],[13]). Besides, households in developing countries are discovered not to switch to modern fuels but favour in using combination of fuels. This fuel usage method is known as multiple fuel model ([5]). According to[14], households shift to multiple fuels with increasing income in a bidirectional process. The separate and existing factors simultaneously push households away from solid fuels and pull them back towards solid fuels again. The “push” factors include cleanliness, more convenience and status meanwhile the “pull” factors refer to food flavour, insufficient of modern devices and demand for new skills.

2.2. Previous Studies on the Effect of Subsidy on Energy Consumption

Descriptive analysis was carried out by[15] to determine the level of the affordability of electricity cost for poor urban households in Zimbabwe. The data collected were monthly energy consumption with and without subsidy, income categories, and energy budget from the total household expenditure. The findings revealed that different household income had different ability to pay. Large portion of the

urban poor income earners were devoted to energy expenditure compared to the non-poor on non-electrical energy. Energy cost incurred by the poor on non-electrical energy sources could cover the current subsidized electricity costs.

Reference[16] also used the price with and without subsidy to examine the effect of subsidies on kerosene and electricity affordable among Ethiopian urban households. The mean energy budget was used as proxy for purchasing power. The energy sources were considered affordable if mean energy budget was found greater than the estimated energy costs. The results indicated that both poor and non-poor households still afford to purchase kerosene when subsidy was removed. Meanwhile, electricity was extra expensive until subsidies did not bring the impact to the poor households. Thus, amortization should be given to the poor for purchasing equipments or paying electricity bills.

Moreover,[17] measured the impact of reducing subsidies on the welfare and the consumption of the poor in India. The findings showed that 86 percent of the rural households used biomass energy while the urban people preferred to use modern fossil fuel as main energy source. The percentage of kerosene used declined as the total consumption expenditure increased but the fall was small for the rural area. At the higher expenditure level for rural area, the usage of kerosene was mainly for lighting. In the urban area, the higher expenditure was directed to the use of LPG. This clearly indicated that kerosene and LPG subsidies do not benefit the rural households but favoured urban households.

The study of[18] showed that energy subsidies in Trinidad and Tobago were mainly distributed to gasoline and diesel. The share of GDP to energy subsidies had increased from 0.66 percent to 1.9 percent within year 2005 to 2009. The findings also revealed that 95 percent of gasoline subsidy and 73 percent of diesel subsidy were allocated to ground transport. This is due to government aimed to increase the consumers' disposable income and enable life affordable. Furthermore,[19] claimed that the fuel subsidy was encouraged to be removed to increase economy efficiency in the long run. However, consumers will face the problem of raising fuel price in the short run. Energy demand was reduced averagely by 7 percent as energy price increased since 1991. This leads to the conservation and sustainability of energy resources.

3. Methodology

A descriptive survey study carried out utilizing cross-sectional data to determine the consumption of various type of energy in Sabah and Sarawak based on location and income group. The research instrument used was a questionnaire with open-ended questions.

3.1. Source of Data

The areas covered in this study were the state of Sabah and Sarawak in Malaysia. The respondents were chosen based on

probability sampling using two-stage cluster sampling method. Sabah (530,572 households[20]) was divided into 5 clusters meanwhile three clusters were established in Sarawak (540,990 households[20]). The respondents were further distinguished into urban or rural areas. Simple random sampling method was used to choose the representative districts. Lastly, the respondents are chosen randomly from the selected districts.

3.2. Method of Analysis

Firstly, percentage of the monthly expenditure for various type of consumption over the income earned per household was estimated. The income group was distinguished into three groups where income RM3,000 and below denoted low income group, the middle income group referred to household who earned between RM3,001 and RM6,000 and the high income group were those with income RM6,001 and above ([21]). Secondly, the quantity of monthly energy consumption was illustrated to determine the pattern of consumption. Lastly, the quantity of over consumption for each type of energy was calculated by subtracting the quantity consumed with subsidy and without subsidy. When the quantity of over consumption multiplied with the subsidy given, the cost of over consumption for each type of energy can be estimated.

4. Findings and Discussion

4.1. Monthly Expenditure over Income per Household

Table 1 and Table 2 showed the monthly expenditure for various types of consumption over the income earned per household in Sabah and Sarawak respectively based on location (urban and rural) and income group (high, middle and low). In Sabah, loan instalment occupied the highest proportion of income which covered over 20 percent of monthly income among high and middle income groups in both urban and rural areas. Urban household found be paying out higher on loan instalment like housing loan and car loan compared to rural households. The situation was similar in Sarawak. This indicated that urban people were concern about their dwelling place and the convenience of transportation. This was followed by food expenditure. In contrast, the low income group spend most on food expenditure in both Sabah and Sarawak. Due to the limited affordability of their income, food was the first preferred because it was a basic requirement of life.

Next, energy expenditure accounted to the third largest usage of household expenditure. Low income groups spent the highest percentage on energy compared to middle and high income groups in Sabah. It recorded as much as 12.38 percent and 11.50 percent in urban and rural areas respectively. This indicated that subsidy should be given for energy consumption to assist the low income group. In Sarawak, low income group with 13.11 percent showed the highest percentage in energy expenditure in urban area.

However, the highest percentage in rural area went for high income group with 13.83 percent. In overall, energy expenditure from income in Sarawak was higher than in Sabah.

Table 1. Monthly Expenditure over Income in Sabah

Area	Sabah					
	Urban			Rural		
Income Group	High (%)	Middle (%)	Low (%)	High (%)	Middle (%)	Low (%)
Loan	25.20	26.69	17.02	19.78	23.82	12.35
Food	10.51	15.28	21.90	11.27	13.27	20.12
Energy	9.69	11.44	12.38	8.84	10.79	11.50
Utility	3.38	4.31	5.66	2.76	3.85	5.24
Entertainment	3.89	5.16	5.58	3.66	3.63	3.15
Education	4.52	3.86	4.15	4.68	4.22	3.61
Investment	5.86	5.73	1.75	3.15	3.77	1.22
Medical	1.65	1.45	1.20	1.26	1.56	1.06
Clothing	1.71	1.93	1.20	1.45	1.87	1.31
Transport	0.20	0.45	1.68	0.29	0.42	1.75

Table 2. Monthly Expenditure over Income in Sarawak

Area	Sarawak					
	Urban			Rural		
Income Group	High (%)	Middle (%)	Low (%)	High (%)	Middle (%)	Low (%)
Loan	24.30	22.04	14.67	22.97	18.84	14.26
Food	11.65	14.76	17.50	14.52	16.55	20.45
Energy	10.55	11.37	13.11	13.83	13.12	12.90
Utility	3.88	4.37	5.77	4.39	4.58	5.40
Entertainment	4.41	4.53	4.45	4.08	3.27	1.78
Education	7.13	6.54	6.18	4.77	5.31	3.60
Investment	7.07	6.07	4.76	7.31	4.52	1.18
Medical	1.36	1.62	1.37	2.12	1.46	0.96
Clothing	1.14	1.30	0.98	1.59	0.83	0.64
Transport	0.23	0.44	0.77	0	0.45	1.55

The utility expenditure illustrated the similar pattern in both states where the percentage ascended from high income group to low income group. On the other hand, low income group in urban area spent 5.58 percent of monthly income on entertainment expenses which was higher than high income group with 3.89 percent in Sabah. The situation was on the contrary in rural area where the high income group possessed higher expenses on entertainment compared to low income group. In Sarawak, the percentage spent on entertainment expenditure in urban area was fairly same for those three income groups meanwhile high income group consumed the most as expected in rural area. However, urban household was found to spend more on entertainment compared to rural household. This may be due to the different type of life style in different areas among different income groups.

In addition, higher income groups claimed to emphasize on educational line where they spent more for education purpose like furthering their study for themselves and their children. In comparison, the education expenditure in Sarawak was higher than Sabah. This may be due to the

availability of universities and colleges in Sarawak were obviously more than Sabah. Furthermore, high income group has immensely interest in investment. Meanwhile, both high and middle income group found to be more concern about their health. Besides, middle income group purchased clothes most frequently in both states. Lastly, the range of public transport expenditure percentage over income was from 0 percent to 1.75 percent. High income group was found not to use any public transport in Sarawak rural area. This expenditure was favoured by low income group.

4.2. Energy Consumption Pattern

Table 3 and Table 4 showed the quantity of consumption for each type of energy consumed with subsidy per household in Sabah and Sarawak. The quantity of all energy consumption decreases in both states when the subsidy was removed. This fulfilled the law of demand where the demand for the commodity will fall when the price of the same commodity increased.

Table 3. Quantity of Energy Consumption With Subsidy in Sabah

Types of Energy	Petrol (Litre)	Diesel (Litre)	Electricity (kWh)	LPG (kg)	Kerosene (Litre)
Urban					
High	188.14	122.55	553.25	19.17	0.04
Middle	135.85	43.08	437.23	18.00	0
Low	72.16	6.77	286.40	14.04	0.10
Rural					
High	168.89	86.00	502.82	22.79	1.87
Middle	120.34	46.79	387.31	19.13	0.17
Low	57.33	9.69	249.17	14.75	1.30

Table 4. Quantity of Energy Consumption With Subsidy in Sarawak

Types of Energy	Petrol (Litre)	Diesel (Litre)	Electricity (kWh)	LPG (kg)	Kerosene (Litre)
Urban					
High	198.90	126.86	581.44	23.14	0
Middle	126.92	42.81	383.64	18.49	0
Low	73.39	11.34	192.58	13.70	0.30
Rural					
High	239.95	132.22	606.65	29.96	0
Middle	122.97	50.29	426.92	20.18	0.12
Low	59.51	6.09	178.78	14.24	2.00

High income group found to be the largest consumer for all types of energy in Sabah except kerosene in urban area. The average petrol consumption in Sabah urban area was vastly consumed by high income group with 188.14 litre compared to 135.85 litre and 72.16 litre for middle income and low income group respectively. In rural area, high income group still dominated the petrol consumption with 168.89 litre followed by middle income and low income group which amounted to 120.34 litre and 57.33 litre respectively. In Sarawak, urban households had more petrol consumption than rural households except high income group who consumes 239.95 litre in rural area while 198.90 litre in urban area. Middle income group consumed averagely 126.92 litre and 122.97 litre while low income

group only used 73.39 litre and 59.51 litre in urban and rural areas respectively. In comparison, petrol consumption for each income group in Sarawak was greater than Sabah households except for urban middle income group.

For diesel, the largest consumption in Sabah and Sarawak was also made by high income group in both urban and rural areas. The quantity of consumption was recorded as 122.55 litre and 86 litre in Sabah while 126.86 litre and 132.22 litre by Sarawak households in urban and rural areas respectively. Middle income group appeared as the second largest diesel consumer in both states, however, it was found that the consumption in rural area was higher than urban area. Low income group in Sabah rural area consumes diesel more than urban group with 9.69 litre and 6.77 litre respectively. The situation was contrary to Sarawak where the diesel consumption in urban households (11.34 litre) was higher than rural households (6.09 litre). It was obviously to be seen that low income group only consumes a little amount of diesel compared to high income group.

It can be proved that all the income groups were in favour of using combination of energy since both petrol and diesel were consumed by households. But the quantity of petrol consumption was found to be higher than diesel in both states. This may be due to the “push” factor where petrol was more convenient and adapted in most of the car model. The “pull” factor can refer to subsidy removal that caused the price of petrol to increase and household shift to consume diesel. This consumption pattern was known as multiple fuel model.

In addition, high income household in Sabah urban spent the highest expenditure on electricity with the average quantity of 553.25 kWh. This was followed by an average consumption of 437.23 kWh and 286.40 kWh per household for middle income and low income groups respectively in Sabah urban. The largest quantity of electricity consumption in rural area was also mostly used by high income group, subsequently middle income and low income group where the figures recorded were 502.82 kWh, 387.31 kWh and 249.17 kWh respectively. The similar circumstance was found in Sarawak. High, middle and low income groups consumed 581.44 kWh, 383.64 kWh, and 192.58 kWh respectively in urban area while 606.65 kWh, 426.92 kWh, and 178.78 kWh respectively. The finding was in line with the study in Zimbabwe[15] where high income group consumed the most electricity and absorb the largest amount of subsidy. The findings also showed that each income group were affordable to consume electricity. This was different from the study in Ethiopia[16] where urban households could not afford to use electricity as it was too expensive.

The consumption for LPG in Sabah urban was estimated as 19.17 kg, 18 kg and 14.04 kg for high income, middle income and low income group respectively meanwhile it achieved 22.79 kg, 19.13 kg and 14.75 kg in rural area. In Sarawak, the quantity of consumption was also descending from high income group to low middle group in both urban and rural areas. The figures were estimated as 23.14 kg, 18.49 kg, and 13.70 kg respectively in urban area meanwhile 29.96 kg, 20.18 kg, and 14.24 kg respectively in rural area.

This was similar to the study of [17] in India where LPG was mostly consumed by high income group.

Furthermore, Sabah households either in urban or rural was not favour in using kerosene. The findings showed that 1.87 litre, 0.17 litre and 1.3 litre amounted to high income, middle income and low income group respectively in rural area. Low income group as the largest kerosene consumer in urban area with 0.10 litre while high income group only used 0.04 litre per month. Sarawak households also did not consume much kerosene where only low income group in urban area (0.30 litre) together with middle income group (0.12 litre) and low income group (2 litre) in rural area. Kerosene was only frequently consumed by the low income group while high income group preferred to use modern energy sources. This supported the energy ladder model when the household income increased, more sophisticated sources will be consumed. Overall, high income group was the largest energy consumer for petrol, diesel, electricity and LPG in both states. This means that the majority of subsidy has gone for high income group where the objective of subsidy distribution was distorted.

4.3. Cost of Over Consumption

Table 5 and Table 6 showed that the cost of over consumption per household for each type of energy based on location and income group in Sabah and Sarawak respectively. According to Table 5, the highest cost of over consumption in Sabah was accounted to electricity with RM62.73 and RM55.79 per household in urban and rural areas respectively. Surprisingly this indicated that low income group was considered as the main group of over consumption for electricity. Low income group achieved 40 percent of the total amount in urban while 43.07 percent in rural. This finding showed that electricity subsidy did not carry out the true assistance to both urban and rural households which was similar to the study of [16] in Ethiopia.

This was followed by the cost of over consumption for petrol with RM17.85 and RM19.14 per household in urban and rural areas respectively. This indicated that rural household consumed petrol wastefully compared to urban household in Sabah. Middle income group was the group that achieved the largest over consumption for petrol. Meanwhile the cost of over consumption for diesel in Sabah was estimated as RM18.82 and RM13.55 per household in urban and rural areas respectively. It can also be seen that high income group dominated the cost of over consumption for diesel. It was estimated as RM12.86 and RM7.66 per household in urban and rural areas respectively compared to low income group with RM1.27 and RM1.75 per household.

For LPG over consumption cost, urban and rural households recorded RM9.72 and RM15.11 per household respectively. Low income group in urban areas achieved the most over consumption with RM4.99 per household while it went to high income group with RM6.26 per household in rural area. The lowest cost of over consumption in Sabah referred to kerosene which was only estimated as RM0.18

and RM0.92 in urban and rural areas respectively. This was due to kerosene was not the first energy choice for households nowadays since they preferred to use more convenient and cleaner energy source within their affordability.

Referring to Table 6, diesel was the main energy with over consumption in Sarawak where it recorded as high as RM21.14 and RM20.55 per household in both areas. It can be found that high income group leads the cost of over consumption which amounted to RM12.92 and RM14.03 per household in urban and rural areas respectively. The situation was similar to Sabah. For petrol, rural household cause higher cost of over consumption compared to urban household which stated as much as RM20.01 and RM19.60 per household respectively. High income group tops the list of over consumption for petrol in both areas.

Table 5. Cost of Over Consumption in Sabah

Types of Energy	Petrol (RM)	Diesel (RM)	Electricity (RM)	LPG (RM)	Kerosene (RM)
Urban					
High	6.10	12.86	15.95	1.94	0.08
Middle	6.65	4.69	21.14	2.79	0
Low	5.10	1.27	25.64	4.99	0.10
Total	17.85	18.82	62.73	9.72	0.18
Rural					
High	6.67	7.66	13.02	6.26	0
Middle	7.59	4.14	18.74	4.32	0.12
Low	4.88	1.75	24.03	4.53	0.80
Total	19.14	13.55	55.79	15.11	0.92

Table 6. Cost of Over Consumption in Sarawak

Types of Energy	Petrol (RM)	Diesel (RM)	Electricity (RM)	LPG (RM)	Kerosene (RM)
Urban					
High	9.37	12.92	2.16	1.44	0
Middle	6.14	6.32	3.27	2.66	0
Low	4.09	1.90	1.62	2.69	0.26
Total	19.60	21.14	7.05	6.79	0.26
Rural					
High	9.51	14.03	3.53	1.33	0
Middle	5.55	5.44	4.26	1.81	0.04
Low	4.95	1.08	1.96	3.86	0.86
Total	20.01	20.55	9.75	7.00	0.90

Moreover, the over consumption cost for electricity in Sarawak only estimated as RM7.05 and RM9.75 in urban and rural respectively. It was a clearly large distinct of over consumption for electricity between Sabah and Sarawak. This may be due to the subsidy given for electricity in Sabah was higher than Sarawak, thus it incurred wastage. Middle income group was the main group to give the highest cost of over consumption for electricity in both areas. Both urban and rural households recorded fairly same figure for the cost of over consumption for LPG which was estimated as RM6.79 and RM7.00 per household respectively. Furthermore, kerosene was also the most unpopular energy source in Sarawak. Therefore, its cost of over consumption

was recorded as low as RM0.26 and RM0.90 respectively in urban and rural areas. This indicated that kerosene subsidy does not affect its consumer. It was similar to the study of [16] and [17] while in contrast of [15].

5. Conclusions

In this study, energy expenditure was found to be the third largest usage over monthly income in both states. This showed that subsidy should be distributed to energy since it was an important commodity for households. Besides, the energy consumption either with or without subsidy in both states referred to multiple fuel model where all income groups preferred to use combination of energy. With this, energy subsidy can be the “pull” or “push” factor to affect households in using the type of energy.

Furthermore, the cost of over consumption in Sabah indicated that subsidy given to electricity should be removed or reduced since enormous wastage was found. Meanwhile it was seen that most of the over consumption for petrol and diesel was caused by high income group in both states. For diesel, low income group consumes only a small portion of total consumption. Therefore, diesel subsidy was considered to be reduced since it always benefited the high income group. On the other hand, the over consumption for LPG was caused by low income group, thus LPG subsidy should be recommended to remain due to its objective in helping poor.

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