

Chapter 7

Biomass Consumption and Survey in the Household Sector

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Chapter 7

Biomass Consumption Survey in the Household Sector

7.1 Introduction

The MEM, Lao PDR, in cooperation with ERIA, initiated a project to establish energy statistics regulation as a sub-decree in the existing statistic regulation. The regulation is necessary to strengthen MEM to be sustainable and capable of collecting energy data on a mandatory basis. The MEM could systematically collect energy data from various energy supply companies and other government agencies and corporations to compile accurate energy statistics for sustainable energy planning through this regulation.

Based on MEM energy statistics, biomass energy still accounted for most of the total final energy consumption in 2018 (46.1%), with the residential sector being the main consumer. Biomass consumption was estimated from studies and surveys conducted by several national and international institutions. No official data on biomass consumption is available. In this regard, a biomass consumption survey was conducted, which can be the basis for MEM to estimate residential biomass consumption.

This survey aims to collect urban and rural household data on biomass energy consumption to estimate national consumption. A local company will conduct the survey based on the questionnaires prepared by the MEM and ERIA.

This chapter summarises the survey's major results and assesses further if the results can be used to estimate the national biomass consumption in the residential sector from 2020 to 2025.

2. Survey Samples and Questionnaire

2.1. Survey samples

The urban and rural areas surveyed are in Vientiane Capital and Vientiane Province. The target villages were selected according to three criteria: (i) rural and or urban villages in Vientiane and Vientiane Province, (ii) covering a wide geographical spread within the two provinces, and (iii) accessible by car.

A total of 27 villages (10 urban and 17 rural), with a target of 20 surveys per village, were selected for the surveys.

2.2. Survey questionnaire

The questionnaire was prepared in close consultation with the MEM staff and the ERIA expert team. The questionnaire consisted of two parts: general information and consumption data. The questionnaire included information on the survey location, household type, family size, monthly expenditure, use of biomass by type (fuelwood, charcoal, etc.), frequency of usage, and consumption (kg). The survey also covered LPG and electricity consumption as an alternative to biomass, especially

in urban households (kg/month and kwh/month). The survey questionnaire was developed using an Excel spreadsheet (Figure 7.1)

Figure 7.1 Biomass Survey Questionnaire of Household Sector, Lao PDR

Sample Biomass Consumption Survey Questionnaire Lao PDR Residential Sector

Province : Location*) : Select Location*) : Urban
 Rural

Interview Date : Interviewer ID/HP/Email :

Name of Household Head :

Type of Dwelling/Residence* : *) Specify types detail : House
 Apartment
 Flat
 Others (Specify)

Main Occupation of Household Head : Phone number / email addr :

Household Size : Person/HH

Average monthly Expenditure**) : USD/month **)Select Expenditure Le : <150 US\$/month
 151-350 US\$/month
 351-500 US\$/month
 501-1000 US\$/month
 1001-2000 US\$/month
 >2000 US\$/month

Do you have business area in your house***) ***) Select Business Type : No business area
 Retail shop
 Restaurant
 Others (Specify)

Biomass Consumption

1. Total biomass consumption in your household? A kg

2. Usage of wood and wood waste, ... and other biomass

KIND OF BIOMASS	TYPE OF USAGE *1	HOW OFTEN DOES your HOUSEHOLD CONSUMES BIOMASS?		
		TIMES PER DAY	DAYS PER MONTH	KG PER USE
B	D	E	F	G
Firewood	Cooking			
	Water Heating			
	Others			
Wood waste	Cooking			
	Water Heating			
	Others			
Rice husk	Cooking			
	Water Heating			
	Others			
Charcoal	Cooking			
	Water Heating			
	Others			
Other biomass	Cooking			
	Water Heating			
	Others			

*1TYPE OF USAGE
 1. Cooking
 2. Heating water for bathing
 3. Lighting
 4. Others such as clothes ironing, etc.

LPG Consumption

1. Total LPG consumption A kg
 B m3

2. Does your household use LPG for the following?

KIND OF EQUIPMENT	UNITS PER HOUSEHOLD	TYPE OF USAGE *1	HOW OFTEN DOES YOUR HOUSEHOLD BUY LPG?		
			NUMBER OF PURCHASES PER MONTH	KG/m3 PER SIZE OF TANK	NUMBER OF TANKS PER PURCHASE
C	D	E	F	G	H
Stove		cooking			kg m3
Water heater		water heating	0		kg m3
Other Uses					kg m3

*1TYPE OF USAGE
 1. Cooking
 2. Heating water for bathing
 3. Other uses such as lighting, etc.

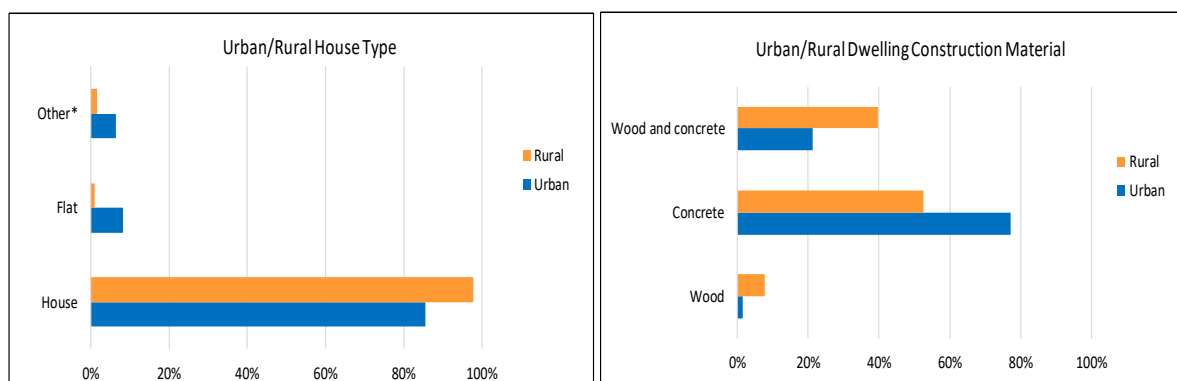
The questionnaire was reviewed and revised by a consultant to suit the Lao context. The questionnaire format was also changed to an online survey platform to enable Android tablets and cell phones to collect data.

2. Major Results from the Survey

The biomass energy consumption surveys covered 551 households in urban and rural villages in Vientiane Capital and Vientiane Province of central Lao PDR. The average household size is around 4.7 persons in rural and urban areas based on the survey results. Most respondents live in houses (97% rural and 85% urban) while the remaining live in flats and others.

All dwellings surveyed are made of either wood or concrete or both. Concrete-only dwellings constituted 77% of the total dwellings surveyed in urban areas. The remaining (1%) are made of only wood, and 21% of both materials (concrete and wood). Concrete-only dwellings also made up most of the dwellings (52%) in the rural areas. Around 8% of the surveyed dwellings in rural areas are made of wood only, and the remaining 40% are made of both concrete and wood (Figure 7.2).

Figure 7.2 Profile of Surveyed Households



Source: Consultant report.

The household energy consumption survey focused on biomass consumption, but the questionnaire also includes households' LPG and electricity consumption. Based on the survey result, the majority of households consume biomass (63% in urban areas and 80% in rural areas), and only a small portion (4%–5%) consume LPG (Table 7.1). The remaining share is that of electricity.

In terms of biomass type, fuelwood is consumed more in rural areas than urban areas. The average monthly consumption, which is the unit consumption or intensity, of fuelwood in rural areas is around 163 kg/household, while in urban areas, it is about 55 kg/household. Charcoal, on the other hand, is consumed more in urban areas than rural areas. The average monthly consumption of charcoal is around 60 kg/household in urban areas and 35 kg/household.

Table 7.1 Share of Household Fuel Consumption and Average Monthly Consumption

Urban/Rural	Household Fuel Consumption Share, %				Average Monthly Fuel Consumption			
	Biomass		LPG	Electricity	Biomass (kg/hh/month)		LPG (kg/hh/month)	Electricity (KWh)
	Wood	Charcoal			Wood	Charcoal		
Urban	21%	42%	5%	32%	54,95	60,28	4,33	373,97
Rural	58%	22%	4%	16%	163,33	35,4	3,89	196,2

Source: Consultant report.

Household fuel consumption includes consumption in households with businesses. Examples of business activities in households are retail shops, restaurants, beauty salons and /barbers, mechanic shops, and others (upholstery business, handicraft, vase business, tailoring, etc.). Table 7.2 shows the breakdown of average energy consumption of households with and without business in urban and rural areas.

Table 7.2 Average Monthly Fuel Consumption in Household with/without Business Activities

Urban/Rural	Average Fuelwood (kg/hh/month)		Average Charcoal (kg/hh/month)		Average LPG (kg/hh/month)		Average Electricity (kWh/hh/month)	
	Business	Without business	Business	Without business	Business	Without business	Business	Without business
Urban	53,61	55,63	97,69	29,03	6,83	3,35	456,65	305,27
Urban Survey Average	54,95		60,28		4,33		373,97	
Rural	144,90	170,48	52,24	22,82	6,53	3,37	277,38	141,50
Rural Survey Average	163,33		35,40		3,89		196,20	

Source: Consultant report.

Amongst households with business activities, those with restaurants in rural and urban areas have the highest consumption of fuelwood and charcoal compared with other business activities (Table 7.3). This is because biomass (fuelwood and charcoal) is mainly used for cooking. For charcoal, the consumption of households with restaurants in urban areas is more than double that in rural areas.

The average LPG consumption was also highest in rural area households with restaurants while average electricity use was highest amongst retail shops in urban areas. Unlike other forms of energy use, average electricity consumption was higher in urban areas for all types of businesses covered in the survey.

Table 7.3 Average Monthly Fuel Consumption in Households with Business Activities

Business Type	Energy Consumption for HH with Business							
	Average Fuelwood (kg/hh/month)		Average Charcoal (kg/hh/month)		Average LPG (kg/hh/month)		Average Electricity (kWh/hh/month)	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Retail Shop	33,16	150,44	84,22	53,89	6,59	7,57	536,34	303,94
Restaurant	138,5	253	303,3	137	11,9	17,3	464,8	354,2
Beauty Salon/Barber	0	31	25,23	15,70	3	7,67	432,15	207,52
Mechanic Shop	27	106,6	77	40,3	10	9,2	395,5	255,8
Others	81,5	138	36,6	41,9	16,3	4,6	455,4	346,9

Source: Consultant report.

Fuelwood consumed by households is mainly self-collected, especially in rural areas. In urban areas, its purchase has a slightly higher share than self-collected fuelwood. Households mainly buy charcoal (97.8% in urban areas and 87% in rural areas). The remaining charcoal sources are self-produced (1.6% urban and 10% rural) and a small amount is free.

The number of surveyed households producing charcoal is 32 (3 in urban areas and 29 in rural areas). About two-thirds of those households (2 urban and 18 rural) produce charcoal for domestic use only while 1 urban and 11 rural households also produce charcoal for sale. The amount of charcoal production is relatively small across the survey sample, with an average total of 338 kg per month in urban areas and an average total of 2,608 kg per month in rural areas (Table 7.4).

Table 7.4 Charcoal Production in Surveyed Urban and Rural Villages

Urban/Rural	No. of HH Producing Charcoal	Volume of Charcoal Produced/Month (kg)	No. of HH Producing Charcoal for Household Used	No. of HH Producing Charcoal for Sale
Urban	3	338	2	1
Rural	29	2.608	18	11

HH = household.

Source: Consultant report.

3. Estimating National Biomass Consumption based on Survey Results

The survey results estimate the monthly biomass consumption of households for fuelwood and charcoal. This unit consumption of household (intensity) will be the basis for calculating the national biomass consumption.

Inflating the survey result to the residential sector's national total was done by multiplying the specific energy consumption (intensity/unit consumption) with the number of households. Since not all households in the Lao PDR consume biomass, it is necessary to estimate the households' share using biomass in each urban and rural area. In general, the estimation formula is as follows:

$$Fuel_i = \sum_{i=regions}^n (PFuel * N_i * UR_i)$$

Where,

$Fuel_i$ is the total fuel consumption (biomass) for area i

$PFuel$ is the fuel consumption per household (fuel intensity/unit consumption)

N_i is the number of households for area i

UR_i is the share of households for area i using biomass

Estimating the national level consumption will require data on the number of households in the Lao PDR by urban and rural areas. If the national statistics have detailed data on the household type by business and non-business activities, it is possible to estimate the consumption in more detail by household activity. Otherwise, the estimation will be only by urban and rural areas.

The data on the number of households by urban and rural areas is available in the (latest) 2015 Lao Population and Housing Census. There is no information on the number of households broken down by the presence and absence of business activities in each rural and urban area. Consequently, the estimation of biomass residential consumption will be based only on the breakdown by urban and rural areas.

Not all surveyed households use biomass. Based on the result, 94% (551) of the surveyed households use biomass in the form of fuelwood and charcoal (Table 7.5). Only one of these households uses biomass in the form of sawdust. The households using sawdust are assumed to be part of the households using fuelwood. By area, 91% of surveyed households in urban areas consume biomass. The share of those in the rural areas is higher (97%).

Table 7.5 Number and Portion of Surveyed Households Using Biomass

Region	Number of Households Surveyed	Households Surveyed Using Biomass	Household Surveyed Using Biomass	Household Surveyed Using Fuelwood	Household Surveyed Using Charcoal	Household Surveyed Using Fuelwood	Household Surveyed Using Charcoal
Urban	206	187	91%	110	183	53%	89%
Rural	345	333	97%	269	246	78%	71%
Total	551	520	94%	379	429	69%	78%

Source: Author's calculation.

The data on the number of households for 2018 was based on the Laos Statistical Information Service data. The breakdown of the number of households between rural and urban areas was not available. In this case, the share of urban and rural households from the 2015 Lao Population and Housing Census was used to estimate the total urban and rural households for 2018.

The share of households using biomass in rural and urban areas (*URi*) were based on the shares from the biomass survey for the residential sector (Table 7.5). These households are further broken down by those using biomass and charcoal.

The average monthly consumption (unit consumption/intensity) of fuelwood and charcoal as shown in Table 7.1 was calculated as the total consumption/month divided by the total number of households surveyed. Since some of these households do not consume biomass, total monthly consumption should be divided only by the number of households consuming biomass. In this regard, a revised unit consumption/fuel intensity of fuelwood and charcoal was used in estimating the national consumption of biomass (fuelwood and charcoal) (Table 7.6).

Table 7.6 Estimated Biomass Consumption at the National Level Using Surveyed Household Shares, 2018

Region	Number of Households	Household Using Biomass	Households Consuming Fuelwood	Households Consuming Charcoal	Fuelwood Intensity (kg/HH/month)	Charcoal Intensity (kg/HH/month)	Fuelwood Consumption (kton)	Charcoal Consumption (kton)
Urban	440.854,80	400.193,43	235.407,90	391.633,15	102,88	67,85	290,62	318,85
Rural	835.916,20	806.840,85	651.772,34	596.044,59	210,53	49,69	1.646,60	355,43
Total	1.276.771,00	1.207.034,29	887.180,24	987.677,74	179,28	57,44	1.937,22	674,29

HH = household.

Source: Author's calculation.

The result shows that the national fuelwood consumption is 1,937 kton while charcoal consumption is 674 kton.

4. Comparison of Results

Compared to the 2018 MEM data on the residential sector's biomass consumption, the estimated national consumption using the survey result is much smaller for fuelwood and extremely high for charcoal (Table 7.7).

Table 7.7 Comparison of Biomass Consumption at the National Level (2018)

Biomass Type	MEM Data	Survey Result
Fuelwood	2.697,39	1.937,22
Charcoal	95,97	674,29
Total	2.793,36	2.611,51

Source: Author's calculation.

The current MEM biomass data is an estimation number, not real data. This MEM data might be overestimated. In an old study conducted by the Energy Sector Management Assistance Programme (ESMAP, 1993) on the Lao PDR Urban Electricity Demand Assessment Study, the average fuelwood consumption for cooking was 100 kg/household while for charcoal it was 64 kg/household (Table 7.8)

Table 7.8 Percentage of Household and Average Monthly Fuel Consumption

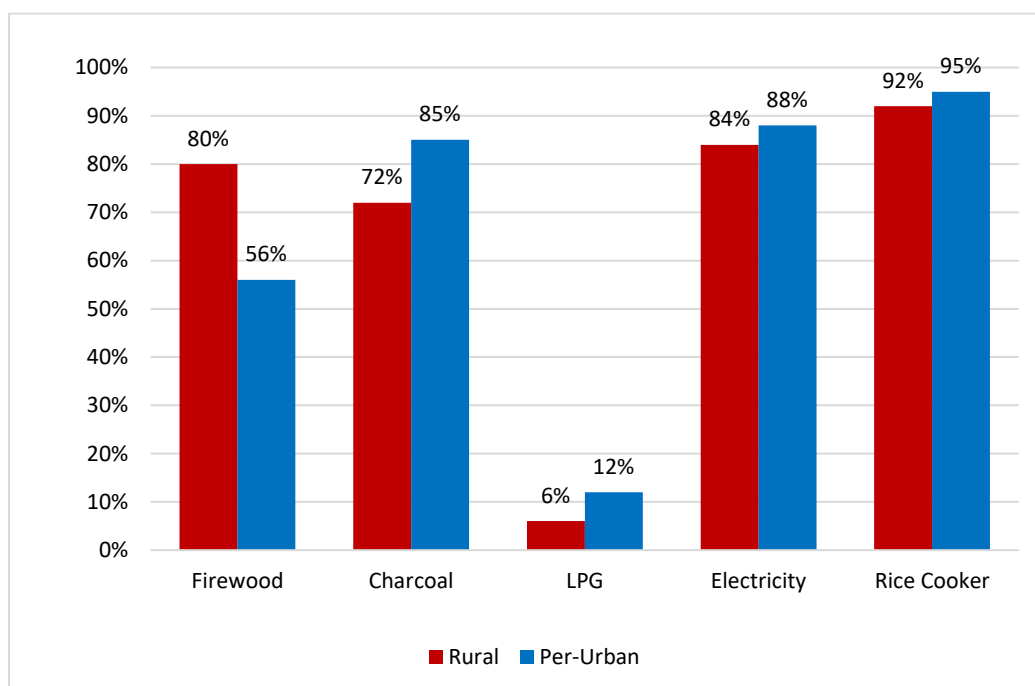
Average Monthly % of HH Using Each Fuel	All Income Classes	Low Less than <75000	Low-Mid 75,000 to 102,000	Middle 103,000 to 150,000	High-Mid 151,000 to 200,000	High 201,000 to 270,000	Very High More than 270,000
Electricity consumption (kWh/household)	271	199	178	197	273	385	606
% of HH electrified	100%	99%	99%	100%	100%	100%	100%
Charcoal consumption (kilogram/household)	64	43	53	47	63	122	70
% of HH using charcoal	54%	36%	42%	55%	67%	74%	65%
Firewood consumption (kilogram/household)	100	50	87	91	139	93	202
% of HH using firewood	64%	67%	68%	66%	63%	58%	48%
Kerosene consumption (Litre/Household)	5	2	2	1	6	10	0
% of HH using kerosene	2%	3%	1%	1%	5%	3%	0%
Diesel consumption (litre/household)	2	3	2	2	2	1	2
% of HH using diesel	9%	4%	8%	12%	10%	11%	10%
LPG consumption (kilogram/household)	15	0	15	0	22	15	5
% of HH using LPG	2%	0%	1%	0%	4%	3%	5%

Source: ESMAP (1993, p.15).

Consumption was higher in higher-income households – 202 kg/household for fuelwood and 122 kg/household for charcoal. On average, 54% of total households consumed charcoal, while the average for fuelwood was 64%. The share of charcoal is highest amongst higher-income households (72%), while fuelwood’s share was only 48% amongst higher-income households.

In a later study conducted by the World Bank (2013) on cleaner household cooking in the Lao PDR (2013), around 85% of peri-urban households and 72% of rural households used charcoal for cooking. Conversely, 80% of rural households, compared to only 56% of peri-urban households, were reported to use fuelwood (Figure 7.3)

Figure 7.3 Biomass Survey Questionnaire in the Household Sector of the Lao PDR



Note: The results are from rural and peri-urban areas in Vientiane capital and Vientiane, Bolikhamsai, and Khammouane provinces.

Source: World Bank (2013).

This study's average monthly fuelwood consumption is slightly higher for a rural household, at 183 kg, than a peri-urban one, at 178 kg. The average monthly consumption for charcoal is higher for an urban household, at 70 kg, than a rural one, at about 56 kg.

Nationally, a family consumes 5 kg a day of fuelwood on average for cooking, which amounts to almost 2,000 kilotons per year. Those using charcoal consume about 1.86 kg a day in rural areas and 2.33 kg per day in urban areas.

Another survey conducted as a baseline for improved cookstove programme in the Lao PDR indicates that 53% and 89% of households use fuelwood and charcoal, respectively. Typically, households that use charcoal also tend to consume fuelwood as a fuel source. The average monthly fuel consumption of fuelwood and charcoal is 163 kg (5.3 kg per day) and 33 kg (1.0 kg per day), respectively.

Based on the different studies above, the result from the biomass consumption survey per urban and rural area is similar to the 2013 World Bank study on cleaner household cooking in the Lao PDR (Table 7.9)

Table 7.9 Comparison Between Biomass Consumption Survey and 2013 World Bank Study

Region	Share of Households Using Fuelwood (%)		Share of Households Using Charcoal (%)		Fuelwood Intensity (kg/HH/month)		Charcoal Intensity (kg/HH/month)	
	Biomass Survey	World Bank Study	Biomass Survey	World Bank Study	Biomass Survey	World Bank Study	Biomass Survey	World Bank Study
Urban	53	56	89	85	103	178	68	70
Rural	78	80	71	72	211	183	50	56

Source: Author's calculation.

Based on this, the MEM can use the residential biomass consumption survey results to estimate the national biomass consumption in the residential sector.

5. Conclusion

The MEM data on biomass has always been based on estimation, not actual data. The biomass consumption survey of the residential sector can be used to estimate the 2019 national biomass consumption (~~2019~~). In this regard, the MEM needs to re-estimate the historical data (2010–2018) to avoid significant differences. The MEM can also forecast the residential consumption of the country from 2020 to 2025.

The residential biomass consumption (fuelwood and charcoal) can be forecasted as follows:

1. Forecast the Lao PDR's total household from 2020 to 2025 and break down by urban and rural area.
2. Use the share of households using fuelwood and charcoal from the survey results to calculate the number of households using fuelwood and charcoal.

Region	Share of Households Using Fuelwood (%)	Share of Households Using Charcoal (%)
Urban	53	89
Rural	78	71

3. For each type of biomass (fuelwood and charcoal), estimate the consumption using the average fuel intensity from the survey results below.

Region	Fuelwood Intensity (kg/hh/month)	Charcoal Intensity (kg/hh/month)
Urban	103	68
Rural	211	50

The unit consumption for biomass and charcoal needs to be updated since household consumption behaviour changes over time. In this regard, it is recommended that the MEM update the biomass unit consumption regularly, such as every 5 years.

References

Energy Sector Management Assistance Programme (ESMAP) (1993), *Lao PDR Urban Electricity Demand Assessment Study*. Washington DC: ESMAP.

World Bank (2013), *Pathways to Cleaner Household Cooking in Lao PDR: An Intervention Strategy*. Washington, DC: World Bank.