GLOBAL PRACTICE FOR SOCIAL, URBAN, RURAL AND RESILIENCE (GPSURR)

Clean Biomass Cookstoves in Central Java, Indonesia

A Quantitative Market Analysis

moving towards gender equality
East Asia & Pacific
Gender Practice

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Background Paper 3

CLEAN BIOMASS COOKSTOVES IN CENTRAL JAVA, INDONESIA:

A Quantitative Market Analysis

An In-Depth Survey of Cooking Habits and Preferences of Households in Peri-Urban Areas around Yogyakarta City, Yogyakarta Special Region

Fieldwork conducted August–October 2013

A product of the EAP Gender and Energy Facility and the EAP Clean Stove Initiative

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Acronyms

CSI	Clean Stove Initiative
IAP	indoor air pollution
kg	kilogram
kWh	kilowatt-hour
L	liter
LPG	liquefied petroleum gas
Rp	Indonesian rupiah

Indonesian rupiah (Rp) 12,000 = $1
$ = U.S. dollar unless otherwise indicated

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The documents produced by the Indonesia CSI may be downloaded from https://www.astae.net/publication/social-gender-support-to-indonesia-CSI. For more information, please contact Helene Carlsson Rex, senior social development specialist at the World Bank (hcarlsson@worldbank.org), or Laurent Durix (ldurix@worldbank.org).

Executive Summary

This report presents the results of an in-deph survey of cooking fuel consumption, biomass cookstove preferences, and cooking habits in peri-urban households outside Yogyakarta City, in central Java. Although the area surveyed was limited the sample and methodology applied ensure that findings can be extrapolated to similar peri-urban areas of Java Island. The survey questionnaire design was largely based on prior qualitative research, including focus group discussions, field visits, and informal interviews. It supports with quantitative data the conclusions of the earlier socio ethnographic work.

The key findings are as follows.

Cooking Environment

Despite a very successful program to encourage the use of liquefied petroleum gas (LPG), and an ongoing price subsidy for LPG, biomass stoves and fuels are still in wide use. The average peri-urban household in the survey sample owns two or more biomass stoves. Approximately one-quarter of households rely exclusively on biomass, and nearly half rely on a combination of biomass and LPG.

The overwhelming majority (95 percent) of surveyed households have a separate room designated as a kitchen; in nearly one-fifth of households, the kitchen or designated cooking area has no ventilation. Low-income households in particular are likely to use biomass fuels and to have poorly ventilated cooking areas. It is confirmed that women are generally responsible for cooking, putting them at greatest risk of exposure to indoor air pollution (IAP).

The vast majority of surveyed households indicated a strong desire to change their cooking setup. But this was not in response to the health threats of IAP; rather, respondents were concerned about soot deposits on the walls and ceilings of kitchens and on pots and pans. Many households in the survey area are not aware of the health risks of exposure to IAP, even though they do not like smoke and would like to have less of it in their kitchens. Yet buying a new stove is a low priority, even for those who want to change their cooking setup, and for households that use biomass fuel, switching to LPG is also a low priority.

Fuel Use

Fuel use can be categorized into two distinct fuel-specific segments and one overlapping segment: (i) only biomass (25 percent), (ii) biomass in combination with LPG (48 percent), and (iii) only LPG (27 percent). The overlapping fuel segment is often poorly captured in official statistics. Electricity is also used, but only for electric rice cookers and rice warmers, which are found in more than half of the households in the survey area. Among these households, approximately 62 percent have a rice cooker; the remaining 38 percent use a rice warmer but use biomass or an LPG stove to cook the rice. The use of an electric rice cooker or warmer can significantly reduce demand for biomass and LPG.

Biomass stoves are more popular among older cooks; LPG stoves, among younger cooks. Perhaps this is because younger people are attracted to modern convenience, whereas older generations tend to be accustomed to traditional ways of cooking.

LPG users appear to have higher levels of education than do users of biomass or of biomass in combination with LPG. Survey results show no association between fuel type or stove preferences and women's status as income earners outside the home. This indicates that time constraints may not have as much influence on fuel and stove selection as do users' education levels.

Regardless of the types of fuel used, households are very careful about their monthly spending on cooking fuels. As expected, most biomass users do not purchase fuel but collect it for free: 78 percent of surveyed households collect biomass fuels, while 12 percent both collect and purchase them. The responsibility for collecting biomass is shared equally among males and females. Most households that collect biomass fuels do not consider the time spent on this task to be a significant burden, which suggests that biomass fuels remain readily available in the survey area.

Type of Stoves and Their Uses

The type of biomass stove most used among surveyed households is the traditional Keren stove, owned by 63 percent of the sample. The second-most used biomass stoves are self-built, fixed, one- and two-pot stoves made from a combination of mud and brick or brick and cement. Self-built, fixed stoves account for approximately one-third (31 percent) of all stoves owned by households. Stoves made of stone, which can last for decades, account for 7 percent; and three- or five-stone stoves account for only 4 percent.

Not surprisingly, lower-cost stoves are more popular among lower-income households; higher-cost stoves, among higher-income households. The average cost of a biomass cookstove varies significantly by type. Lower-cost stoves include Keren stoves, fixed stoves made of mud and brick, and three- or five-stone stoves. Stone stoves and one- and two-pot fixed stoves made of brick and cement are the most expensive.

Nearly every surveyed household boils drinking water once or twice a day. Almost all households boil water in the morning for drinking, and nearly two-thirds boil again in the evening. Biomass stoves are preferred for this purpose, because they produce very high heat in a short period of time. This suggests a market opening for clean stoves that meet this requirement.

Most peri-urban households in the survey area in Central Java do most of their daily cooking in one session, typically in the morning. At this time, all three meals are prepared, to be reheated or combined with other foods for lunch and dinner. Biomass users spend approximately 13–14 minutes longer cooking in the morning than do LPG users. Also, biomass users spend approximately 9 minutes longer preparing food for dinner than do LPG users.

Attitude toward Cooking Stoves

Households cited several stove design features that they value highly. They want a cookstove that (i) uses relatively little fuel; (ii) generates high heat and cooks food fast; (iii) is durable, (iv) ignites quickly;

(v) is easy and convenient to operate; (vi) allows for easy removal and addition of fuel; (vii) reduces or increases heat levels promptly; (viii) emits relatively little smoke; (ix) burns any type of biomass fuel, such as coconut shells and twigs; and (x) can handle various lengths and diameters of biomass. Most households in the survey area consider LPG and electricity very convenient but expensive, and associate their use with rich households. These findings indicate that a biomass cookstove that ignites and cooks as fast as an LPG stove has a good chance of being accepted by households in this area. Approximately 86 percent of the surveyed households agree that pots are more expensive than stoves. Nearly half (44 percent) agree with statements such as “I am willing to spend more on pots than stoves” and “I prefer to buy nice-looking pots.” But, in aggregate, data on households’ attitudes toward investments in primary cooking equipment such as pots, pans, and stoves suggests that, on average, households spend slightly more on clean stoves than on pots. Nearly half (47 percent) of the households surveyed indicated they would be willing to pay double for a biomass stove that would last at least two years.

Women currently decide which stove to buy when replacing an old one. In general, women’s involvement in the decision-making process takes one of two forms: They can (i) independently decide to buy a lower-cost biomass cookstove (including the Keren, Anglo, and three- or five-stone stoves), or (ii) consult with their husband and make a joint decision to purchase a more expensive stove.

This reflects the typical decision-making process involved in buying small home appliances—that is, women decide alone on small home appliances below a given ceiling, but the decision becomes a joint one above that amount. Analysis indicates women’s decision-making power in this area is associated with household income—the higher the household income, the more likely it is that women can make household purchasing decisions on their own. These findings confirm that new and more expensive clean cookstoves should be marketed jointly to men and women in the survey area.

Finally, with respect to buying small home appliances on credit, households in the survey area are financially conservative and reluctant to take on debt, which they consider to be a financial obligation for the entire family.

1. Introduction

Approximately 40 percent of Indonesian households continue to rely on traditional fuel (most often wood) for cooking. Most of these households are in rural areas and are likely to continue using traditional biomass in the near future. Indonesia began implementing improved cookstove programs as early as the 1980s, but most of these programs are still in their pilot phases, and the dissemination of cookstoves remains relatively limited and sporadic. The government's Kerosene-to-Liquefied Petroleum Gas (LPG) Conversion Program (2007–12) is making real progress in providing incentives for households to switch from kerosene to LPG, but it has had minimal success among biomass users. It is estimated that in the next decade the use of biomass as a cooking fuel will continue to be high—and may even increase in some areas—without significant policy interventions. A snapshot of cooking practices in specific peri-urban areas in Central Java confirms that biomass is still widely used, even in places where LPG distribution networks are well established and LPG is widely available at a subsidized price.

The World Bank, together with the Directorate of Bioenergy under the Ministry of Energy and Mineral Resources, launched the Indonesia Clean Stove Initiative (CSI) in early 2012 to help scale up access to clean and efficient stoves through capacity building, policy development, and support of selected government action plans. The first phase of the initiative included a thorough review, stakeholder consultations, and the development of an intervention strategy. This phase was completed at the end of 2012 and is summarized in the report "Indonesia: Toward Universal Access to Clean Cooking." The program is currently in the second phase of implementation, which includes (i) establishing a stove standards, testing, and certification system, (ii) strengthening institutions and building the capacity of key market players, (iii) implementing pilots, and (iv) designing and preparing the third phase of a national clean stove program. This report provides additional information to support the implementation of the pilot projects.

Study Objective

The primary aim of the pilot projects is to introduce new types and models of clean cookstoves into the market, while utilizing the existing stove market and supply chains. Empirical evidence summarized in the report "Indonesia: Toward Universal Access to Clean Cooking" indicates that the major barriers impeding growth in the use of new, clean cookstoves include (i) lack of awareness and ability to pay among poor consumers; (ii) lack of adapted design and of industrial (or manufactured) production capable of meeting the potential demand at scale; and (iii) poor commercial capabilities of wholesalers and retailers (who lack sufficient institutional support to provide unbiased information to consumers as well as to stove designers and manufacturers).

A market approach is believed to be the best way to create a sustainable, clean cookstove supply. Relying on the market mechanism means that local and international stove manufacturers and sellers must provide acceptable, clean cookstoves to consumers. This requires an intimate understanding of the cookstove needs and desires of potential customers. Thus far, the track record of clean cookstove products has not been very encouraging, primarily because customers do not like the performance of available

stoves and find them inconvenient to use or mismatched to household needs. This report aims to detail how Javanese cooks interact with stoves and cooking fuels to provide a better understanding of their needs, desires, and preferred cookstove characteristics.

Study Methods and Survey Instruments

This report relies on two sources of primary information: a quantitative survey and qualitative data. A survey of cooking fuel consumption, biomass cookstove preferences, and cooking habits was conducted in 2013 (August through October) among peri-urban households in the Bantul and Sleman regencies outside Yogyakarta City. The survey was remarkable for its depth and breadth.

For the purposes of the study, peri-urban areas were defined as those located 10 kilometers (km) beyond the ring road of Yogyakarta City. Of 2,143 subvillages in the Bantul and Sleman regencies, 945 are located 10 km beyond the ring road. The sampling involved two stages. In the first stage 100 subvillages were randomly selected from the 945 possibilities. In the second stage 1,434 households were selected for interviews. Approximately 10 to 20 households from each subvillage were randomly selected.

Qualitative data included focus group interviews, participant observations, field visits, and informal interviews with households, conducted by a social development and gender specialist and anthropologist. These data were collected from households in both peri-urban and rural areas outside Yogyakarta City.

Structure of the Report

This report is structured as follows. Chapter 2 presents an overview of the demographic and socioeconomic characteristics of the surveyed households, and physical characteristics of homes and kitchens. Chapter 3 examines household cookstove and cooking fuel use, and chapter 4 outlines household cooking fuel demand and expenditure. Chapter 5 examines household cooking practices and habits. In addition, the chapter explores consumers' preferred cookstove features and attitudes toward indoor air pollution (IAP) and types of cooking fuel. Chapter 6 examines the types and number of biomass stoves owned and used by the surveyed households, as well as the decision-making processes used to purchase stoves and small home appliances.

Throughout this report, the term *biomass* refers to firewood and biomass residue. The most widely used biomass residue in the survey area includes coconut husks, palm and coconut leaves, small twigs, and wood scraps.

2. Household Demographics and Cooking Environments

Java Island is the main and most densely populated island of all of the permanently populated islands in the country of Indonesia. The national 2010 census indicated that close to 125 million people live on Java Island, or about half of the country's population. As described in chapter 1, only peri-urban households in the Bantul and Sleman regencies outside Yogyakarta City were surveyed, but the findings are expected to shed light on household cookstove and fuel use in other areas of Java Island.

This chapter describes the demographic and socioeconomic characteristics of peri-urban households outside Yogyakarta City, as well as the physical characteristics of the homes and kitchens. The final section provides a detailed discussion of survey respondents' interest in changing their cooking setups.

Household Demographics

The vast majority (about 88 percent) of people in the survey area own their own home. Eleven percent live in their extended family's home. Only a small minority (less than 2 percent) rent. The physical structure of almost all homes (approximately 98 percent) have distinct Javanese characteristics and are single-floor homes with baked clay tile roofs. Ninety percent of the homes in the survey area have a concrete, tile, or ceramic tile floor with brick walls and a baked clay tile roof, and 4 percent of the homes have a concrete, tile, or ceramic tile floor but walls made of brick or wood. The remaining 6 percent of homes have an earth floor and walls made of brick or wood.

The average households has four members: two adults and one or two children. The average age of the head of the household (usually a man) is close to 50; spouses are slightly younger, at around 45. Approximately 9 percent of the households in the survey area are headed by women. The average household monthly income is Indonesian rupiah (Rp) 2.415 million (see table 2.1); this figure drops to Rp 2.037 million in households headed by women.

Table 2.1 Household Demographics

Average household income (Rp/month)	Age of head of household	Age of spouse	Family size (number of persons)	Number of persons who earn income	Female-headed household (%)
2,415,869	49.7	44.5	4.0	1.9	8.9%

Source: CSI field survey in peri-urban areas of Yogyakarta City.
Note: Rp = Indonesian rupiah.

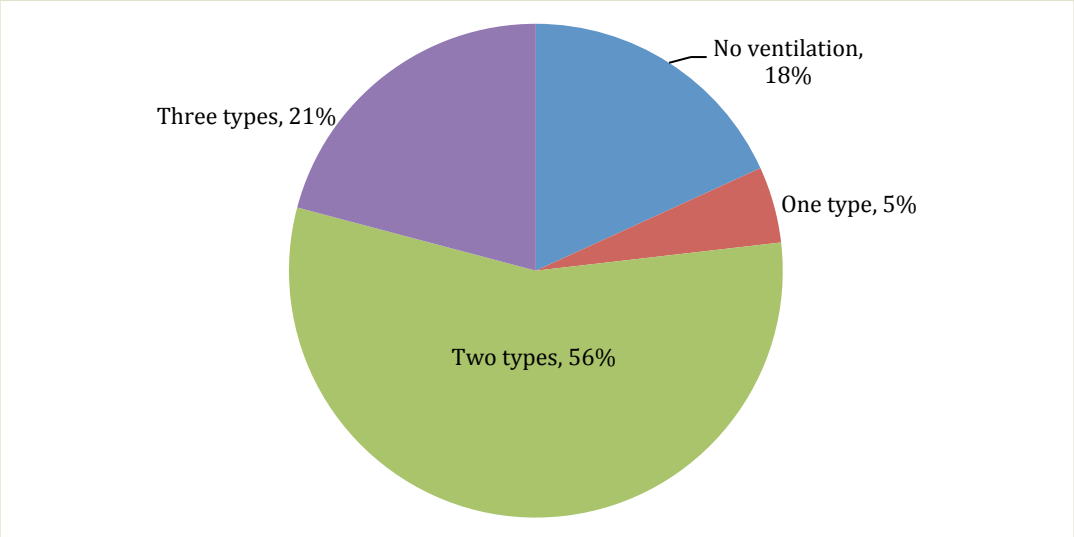
Survey results indicate that heads of the households and their spouses have the same level of education. Nearly 91 percent have completed high school, 6–7 percent hold a college or university degree, and 3 percent have no formal education.

Characteristics of Kitchens and Other Cooking Areas

Cooking conditions are critical to the health and well-being of cooks and other family members, especially children. Poorly ventilated cooking areas trap smoke from burning fuels and create IAP.

An overwhelming majority—95 percent—of the surveyed households have a separate room for cooking. The 5 percent of households that do not have a separate kitchen or cooking area are at greater risk of exposure to smoke. Of those households with a separate kitchen, about 18 percent have no ventilation, and 5 percent have only one type of ventilation (figure 2.1). Without adequate ventilation, smoke from burning fuel is trapped inside the home. Note that the survey defines ventilation in the kitchen or cooking area as one or a combination of a chimney and/or hood, window, vent, and a small open roof called a *jeplakan.* Approximately one-fifth of kitchens have three types of ventilation, and slightly more than half (56 percent) have two types.

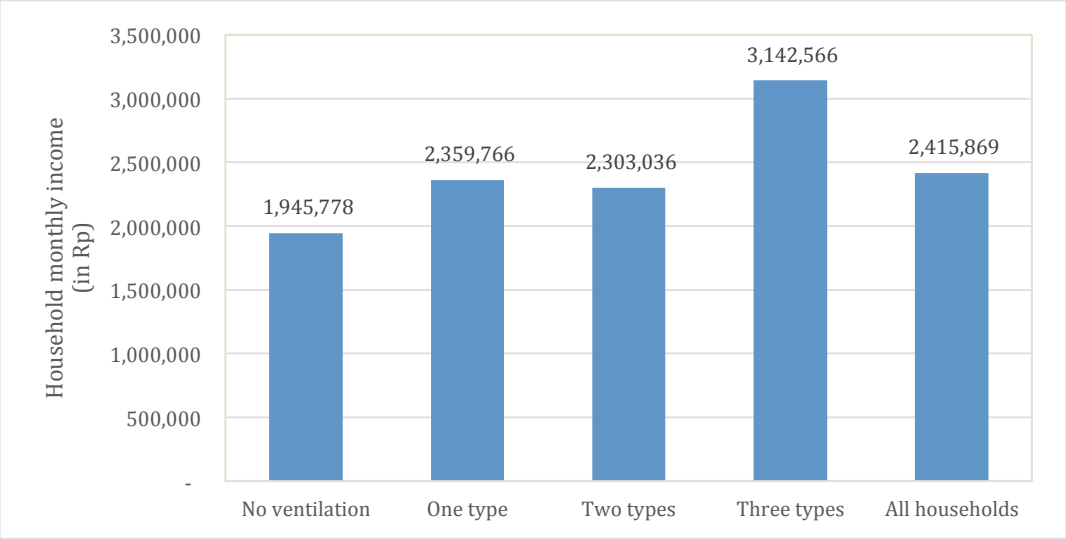
Figure 2.1 Kitchen Ventilation



Source: CSI field survey in peri-urban areas of Yogyakarta City.

Further analysis of the type and level of ventilation in cooking areas reinforces the conventional wisdom that lower-income households are more likely to be exposed to smoke from burning solid fuels than are higher-income households. Lower-income households in the survey area use biomass as their cooking fuel of choice, and their kitchens or cooking areas are poorly ventilated. Women in these households are at particular risk of exposure to IAP. (See chapter 3 for a detailed analysis of types of cooking fuels used by households.) The average monthly income of those households whose kitchens or cooking areas have no ventilation at all is estimated to be only Rp 1.945 million. Conversely, the average household monthly income of those that have at least three types of ventilation is estimated to be Rp 3.142 million, and those with one or two types of ventilation, Rp 2.359 million and Rp 2.303 million, respectively (figure 2.2).

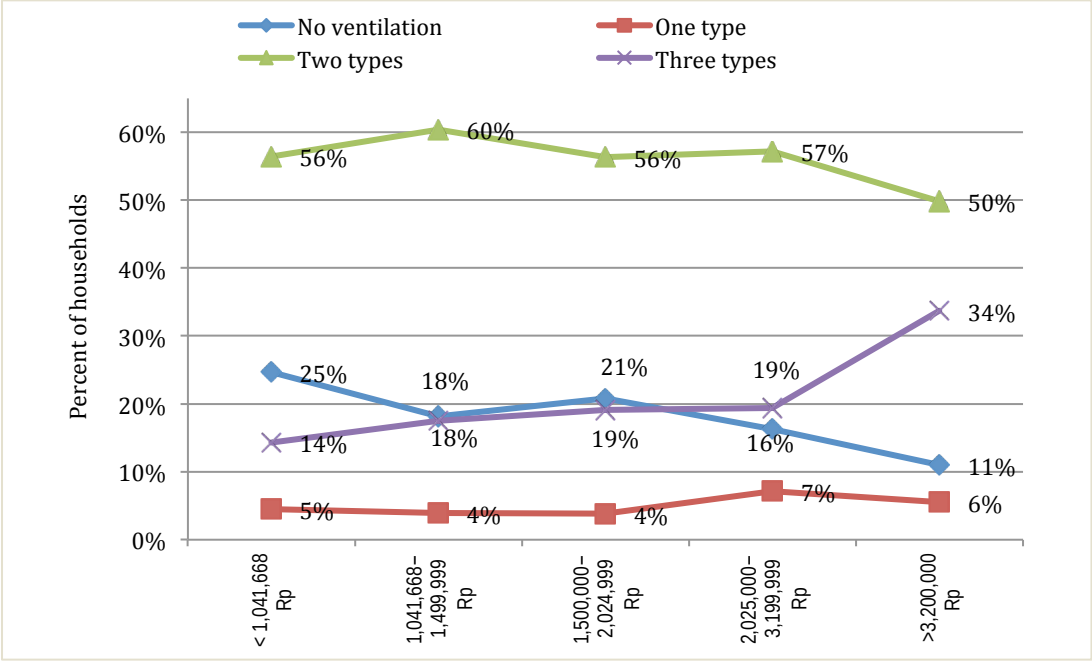
Figure 2.2 Kitchen Ventilation, by Household Monthly Income



Source: CSI field survey in peri-urban areas of Yogyakarta City.

This sharp contrast in household income may be further analyzed as follows. The proportion of households that have kitchens with at least three types of ventilation increased from 14 percent in the bottom income quintile to 18 percent, 19 percent, and 34 percent in the top income quintiles. In contrast, the proportion of households that have no ventilation in the kitchen at all declined from 25 percent among households in the bottom income quintile to only 11 percent among households in the top income quintiles (figure 2.3).

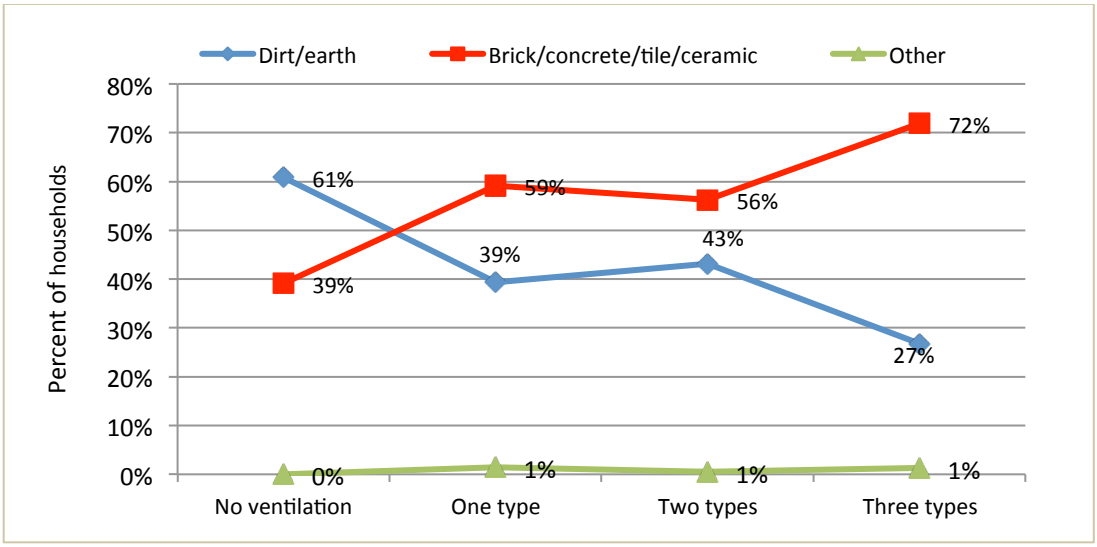
Figure 2.3 Kitchen Ventilation, by Income Quintile



Source: CSI field survey in peri-urban areas of Yogyakarta City.
Note: Rp = Indonesian rupiah.

Another important characteristic of household cooking areas that can compound IAP is floor type. Approximately 57 percent such floors are made of concrete, brick, tile, or ceramic; the remaining 43 percent are made up of dirt or earth. Clearly, dirt or earth floors could exacerbate IAP, especially when the wind blows. As shown in figure 2.4, a cross tabulation among types of ventilation and types of floors reveals that dirt or earth floors tend to be associated with no or fewer types of ventilation, whereas concrete, brick, tile, or ceramic floors tend to be associated with more ventilation.

Figure 2.4 Kitchen Floor and Ventilation



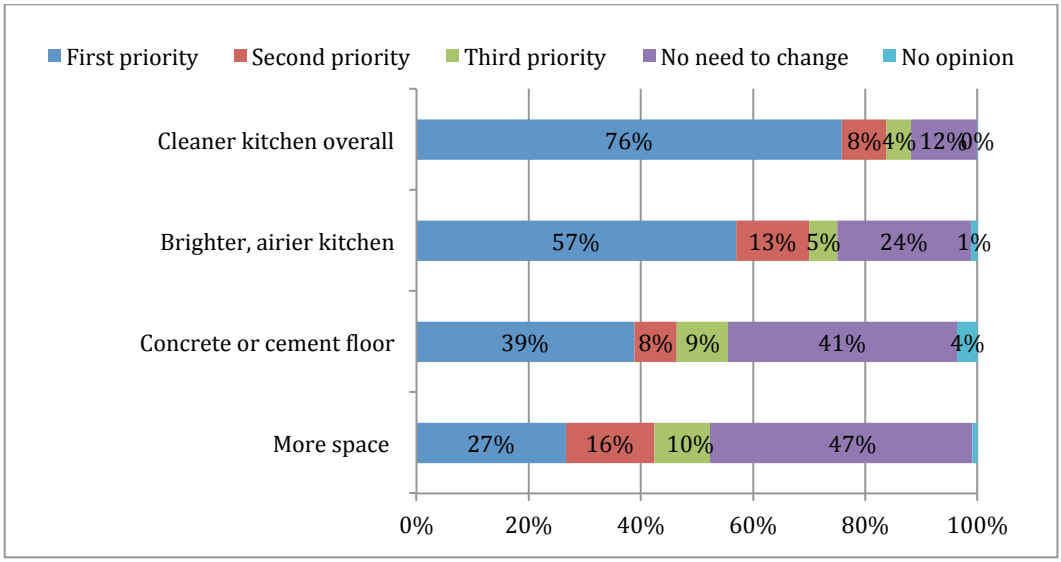
Source: CSI field survey in peri-urban areas of Yogyakarta City.

Households' Interest in Changing Their Cooking Arrangements

The survey divided questions about households' interest in changing their cooking arrangements into three parts: the first pertained to the physical structure of the kitchen; the second, to the problem of smoke and soot resulting from burning cooking fuels; and the final part was designed to gauge household interest in switching to LPG, reducing the time spent collecting biomass, and buying a new stove.

Figure 2.5 shows that approximately three-quarters (76 percent) of the households in the survey area would like to have a cleaner kitchen. Note that this finding does not mean that kitchens in the surveyed households are unhygienic; rather, it reflects the fact that smoke and soot deposits, in many instances combined with grease, create an unclean appearance. Approximately 57 percent of households would like to change the physical structure of their kitchen or cooking area to ensure that it is more airy and bright. Other priorities, listed much lower, include having concrete or cement floors and more space.

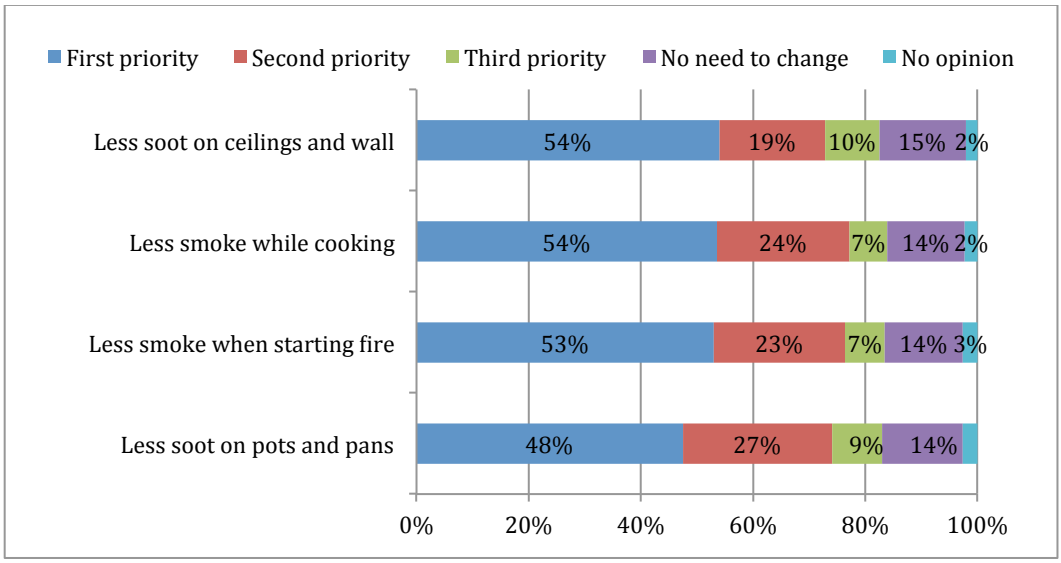
Figure 2.5 Household Interest in Changing the Physical Characteristics of the Kitchen



Source: CSI field survey in peri-urban areas of Yogyakarta City.

Specifically, approximately 50 percent of households would prioritize having "less soot on ceiling and walls," "less smoke while cooking," "less smoke when starting a fire," and "less soot on pots and pans" (figure 2.6).

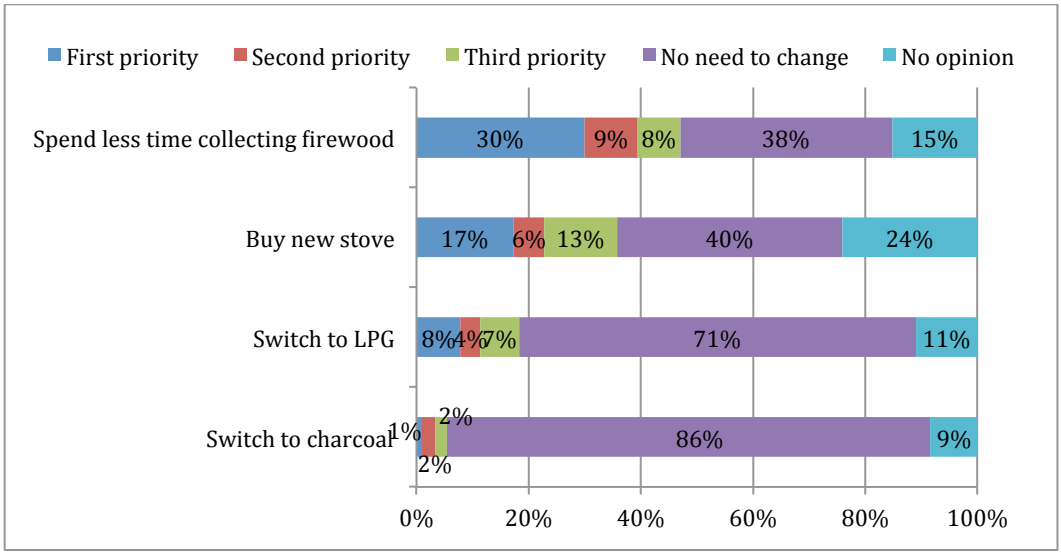
Figure 2.6 Household Views on Smoke and Soot in the Kitchen



Source: CSI field survey in peri-urban areas of Yogyakarta City.

Although one way to improve the cooking environment is to switch from using biomass to LPG, only 8 percent of the households would make this their first priority (figure 2.7). Buying a new stove is not a high priority either—only 17 percent of households would buy a new stove to improve their cooking setup. This implies that an effective public information and social marketing campaign would communicate that new, clean cookstoves emit less or no smoke and soot and thus contribute to clean-looking kitchens.

Figure 2.7 Household Priorities Regarding Stoves and Fuels



Source: CSI field survey in peri-urban areas of Yogyakarta City.

Conclusion

The physical structures of most homes in the survey area suggest that they are well built. Approximately 98 percent of the homes have baked clay tile roofs. Approximately 94 percent of the homes have a concrete, tile, or ceramic tile floor, whereas only 6 percent have an earth floor. An overwhelming majority (95 percent) of the homes have a separate room that is used exclusively as a kitchen. Approximately one-fifth of kitchens and cooking areas have no ventilation at all, and 5 percent have only one type of ventilation. A lack of or very limited ventilation means that household members have a greater risk of exposure to IAP. In addition, nearly half of the household kitchens in the survey area have an earth floor, which could exacerbate IAP. An analysis of the types and level of ventilation in the kitchens and cooking areas reinforced conventional wisdom that lower-income households are more likely to be exposed to smoke from burning fuels than are higher-income ones.

The vast majority of households in the survey area have a strong desire to change their cooking setup. This is not based on the health threats of IAP; rather, it results from concerns about soot deposits on the walls and ceilings of kitchens and on pots and pans. Significant numbers of households in the survey area are not aware of the health risks of exposure to smoke, albeit they do not like smoke and would like to have less of it in their kitchens. It is also important to note that buying a new stove ranks very low on the list of ways they want to change their cooking setups.

3. Household Cooking Fuels

Demand for cooking fuel depends on several factors, including availability, ease of use, household income, price of fuel, and price of alternative fuels. This chapter explores the cooking fuels used by households in Central Java. The main objective is to shed light on the types and quantities of fuels that households use to prepare meals at home. As discussed in this chapter, a significant number of surveyed households rely on a combination of fuels that are readily available at different price levels or at no financial cost to the households. The first section outlines the types of cooking fuel used by households. The second section discusses their costs. The final section concludes.

Types of Cooking Fuels

In general, households in Central Java rely on combinations of LPG and biomass (including wood and agricultural residue). Electricity is used only for rice cookers and rice warmers. Despite LPG promotion and price subsidy programs, biomass is still used by three-quarters (73 percent) of the surveyed households. The use of LPG, which is considered a clean cooking fuel, is as widespread as biomass: LPG is used in 74 percent of households. This means that the biomass and LPG stove markets in Central Java are of about equal size—each covers nearly three-quarters of the total population.

Electric hot plates, stoves, and other electric cooking appliances are used exclusively in less than 0.5 percent of households—but are used in combination with LPG or biomass in 53 percent of households. It is estimated that charcoal is used by only 0.8 percent of households.

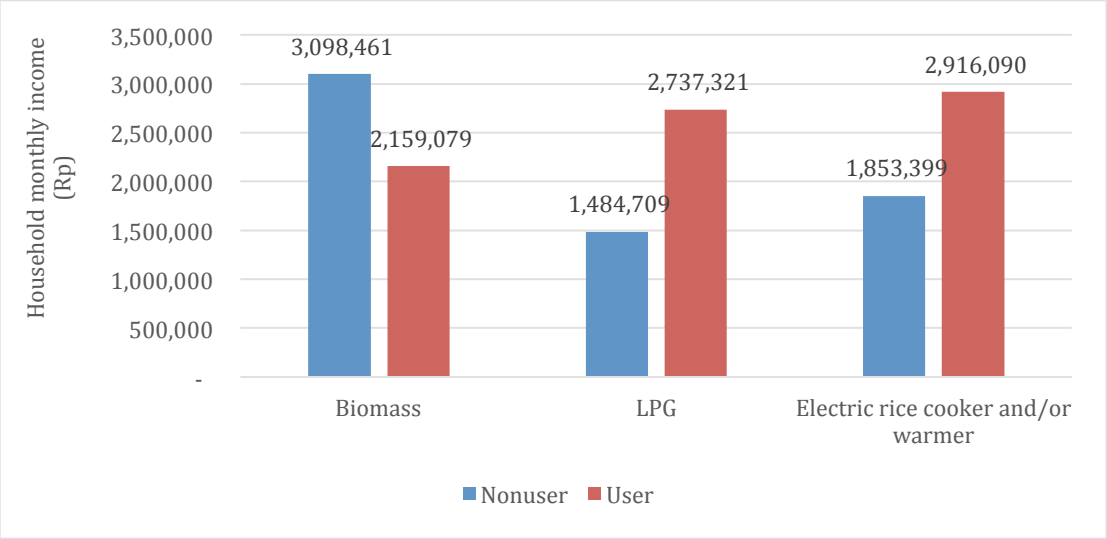
The vast majority of peri-urban households in the survey area in Central Java rely on a combination of two or three types of cooking fuel, including biomass, LPG, and electricity (again, for rice cookers and warmers). Thus, fuel stacking seems to be quite common.

Types of Cooking Fuels in Relation to Income

It seems that household income is associated with the types of cooking fuel used. The average total monthly income of households that use electric rice cookers or warmers is significantly higher than that of households that do not use these appliances (figure 3.1). Similarly, the average monthly income of those that use LPG is significantly higher than that of households that do not use LPG. The reverse trend is shown among biomass users: the average household monthly income of biomass users is significantly lower than that of households that do not use biomass. This finding confirms that biomass is the fuel of choice for lower-income households, because it can be purchased at low cost or collected for free.

The average monthly income of households that use electric rice cookers and/or warmers is estimated to be Rp 2.916 million. Among LPG users, it is approximately Rp 2.737 million. The average household monthly income of biomass users is significantly lower, at approximately Rp 2.159 million. As noted earlier in this report, this finding indicates that poor households are more vulnerable to exposure to toxic biomass smoke than are households in the higher-income brackets.

Figure 3.1 Average Household Monthly Income of Users and Non-Users of Biomass, LPG, and Electricity for Cooking



Source: CSI field survey in peri-urban areas of Yogyakarta City.
Note: LPG = liquefied petroleum gas.

Types of Cooking Fuels and Stoves, by Market Segment

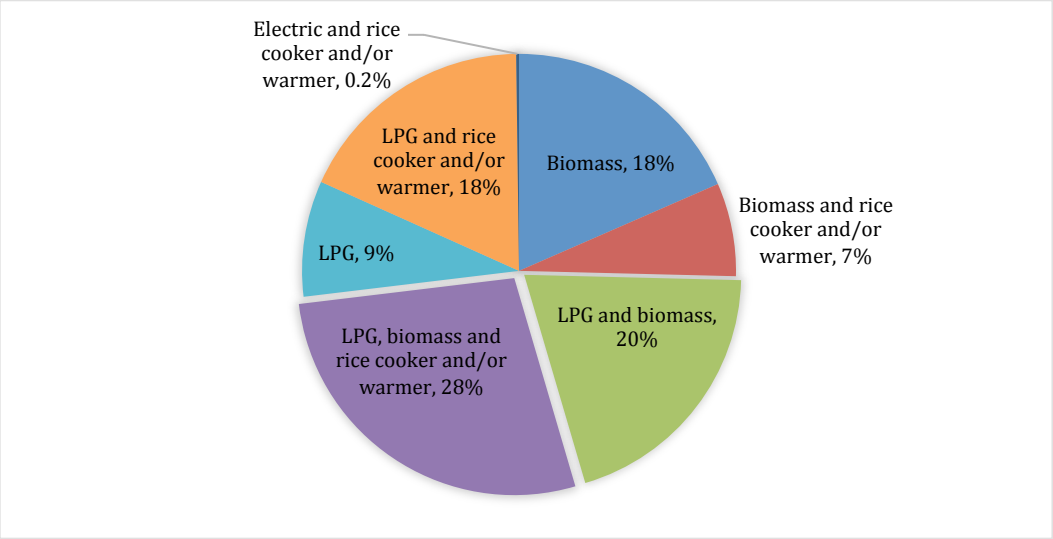
As mentioned in the previous section, most households use multiple fuels and stoves to cook and boil water. The surveyed households may be categorized in three distinct market segments: (i) biomass users, (ii) LPG users, and (iii) users of a combination of biomass and LPG. Biomass users account for 25 percent, LPG users for 27 percent, and households that use both biomass and LPG for 48 percent (figure 3.2) of surveyed households. A handful (0.2 percent) of households use only electricity.[1]

More than half (68 percent) of LPG users, and similarly more than half (58 percent) of households that use combinations of biomass and LPG, also use electric rice cookers or warmers. Meanwhile, only a small minority (27 percent) of biomass users do so. This may be because households that use only biomass tend to have lower incomes than households that use other types of fuel.

Based on results from the household survey, it is reasonable to conclude that the biomass cookstove market in Central Java is large. Currently, nearly 75 percent of peri-urban households in the survey area use biomass, despite ongoing government efforts meant to encourage households to switch to LPG.

[1] Three households surveyed use only electricity. The number of electricity users was too small to provide a meaningful statistical result, and therefore it was excluded from the analysis.

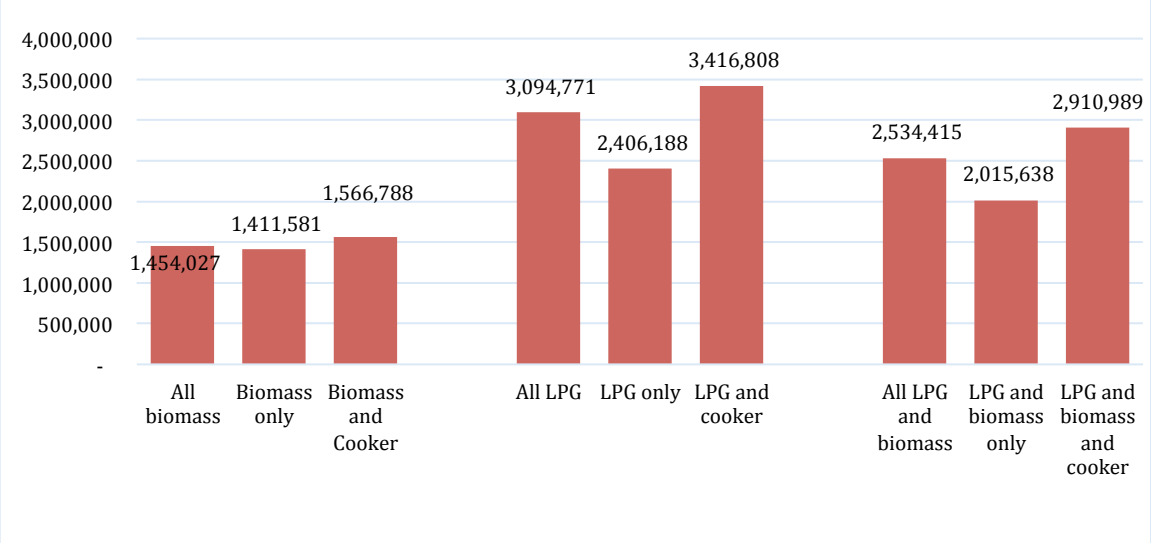
Figure 3.2 Types of Cooking Fuel, by Market Segment



Source: CSI field survey in peri-urban areas of Yogyakarta City.
Note: LPG = liquefied petroleum gas.

Figure 3.3 compares household monthly income among the three market segments. An analysis of survey results confirms that households that use only biomass are among the poorest, with a monthly income estimated at Rp 1.454 million. The average household monthly income of LPG users is the highest—at Rp 3.094 million—and this figure is Rp 2.534 million for users of both biomass and LPG. The survey also finds that the average size of households that use both LPG and biomass is slightly larger than households that use only LPG. This may be because biomass can be collected at no cost and can therefore alleviate some of a larger household's financial burden.

Figure 3.3 Household Monthly Income (in rupiah), by Market Segment

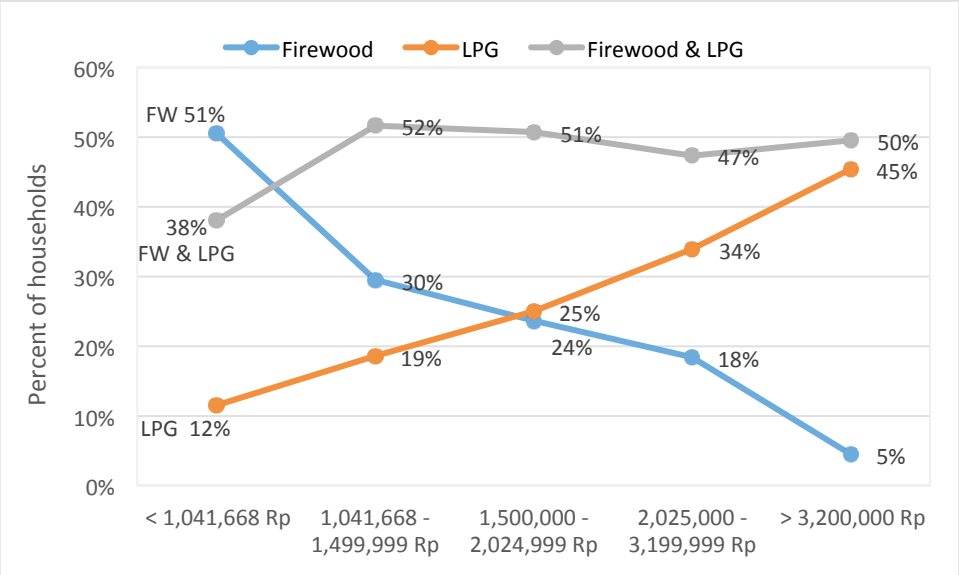


Source: CSI field survey in peri-urban areas of Yogyakarta City.
Note: FW = firewood and biomass residue; cooker = rice cookers with a rice warmer function, and rice warmers; LPG = liquefied petroleum gas.

Figure 3.4 shows a positive linear relationship between a household's monthly income quintile and the proportion of households that use LPG to cook and boil water. This finding suggests that the LPG price subsidy benefits higher-income households more than lower-income households. Of households in the bottom income quintile, 12 percent use only LPG. The proportion of households among the top income quintiles that use only LPG increases to 19 percent, 25 percent, 34 percent, and, ultimately, 45 percent. But the reverse trend is shown for households that use only biomass. Approximately 51 percent of households in the bottom income quintile use only biomass to cook and boil water. This proportion drops to 30 percent among households in the second income quintile, and to only 5 percent among households in the top income quintile. Interestingly, the proportion of households that use both biomass and LPG stays near 50 percent in all but the bottom income quintile. Approximately 38 percent of households in the bottom income quintile use both biomass and LPG.

A comparison of household monthly income among these three market segments suggests that the biomass stove market, which covers nearly three-quarters of all households in the survey area, encompasses both low- and middle-income households. The lower end of the biomass stove market consists of households that rely primarily on biomass to cook and boil water, and the higher end consists of households that use both biomass and LPG. These households are much better off financially—in fact, their average household monthly income is only slightly lower than that of households that use LPG exclusively. It is conceivable that these households may be able to afford higher-end, clean cookstoves.

Figure 3.4 Cooking Fuel Market Segments, by Monthly Household Income Quintile



Source: CSI field survey in peri-urban areas of Yogyakarta City.
Note: FW (and "firewood") includes both firewood and biomass residue; LPG = liquefied petroleum gas; Rp = Indonesian rupiah.

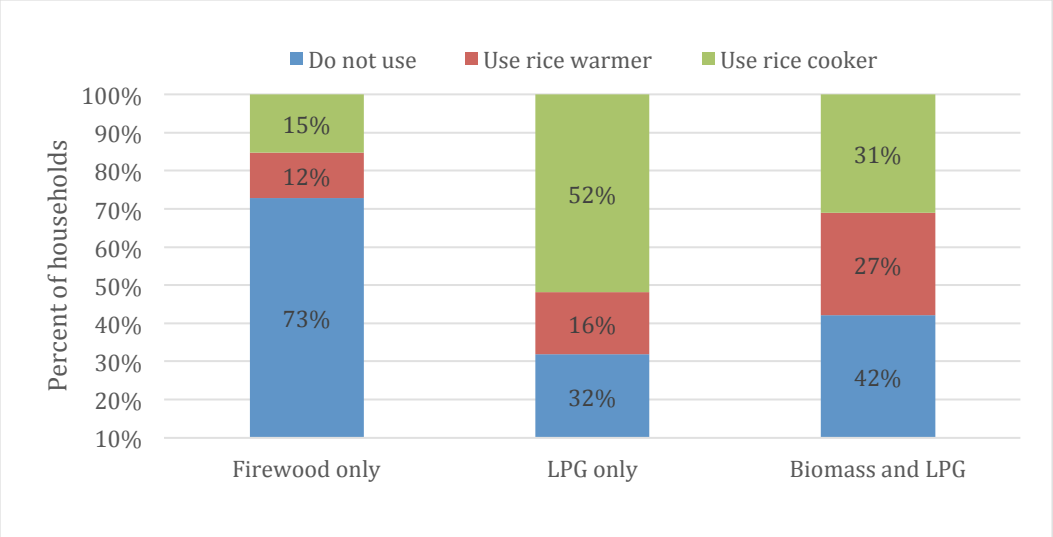
Ownership and Usage of Electric Rice Cookers and Rice Warmers

Electric rice cookers and electric rice warmers are considered to be key kitchen appliances. As discussed in the previous section, slightly more than half (53 percent) of the households in the survey area in Central Java use these appliances to cook and keep rice warm. Of these households, approximately 62

percent own and use a rice cooker, while 38 percent own and use a rice warmer and use a biomass or LPG stove to cook the rice.

Approximately 52 percent of households in the survey area use a rice cooker or warmer on a daily basis. This proportion is highest among users of only LPG, and falls to 31 percent among biomass and LPG users, and 15 percent among only biomass users (figure 3.5).

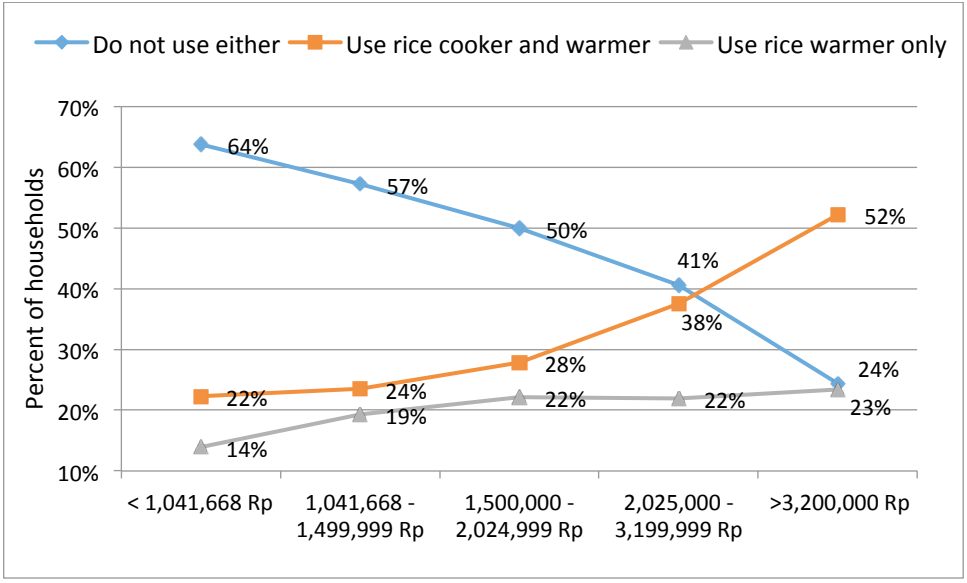
Figure 3.5 Use of Electric Rice Cookers and Warmers, by Market Segment



Source: CSI field survey in peri-urban areas of Yogyakarta City.
Note: "Firewood") includes both firewood and biomass residue; LPG = liquefied petroleum gas.

Household use of rice cookers and warmers increases as income rises—from 22 percent in the bottom income quintile to 52 percent in the top income quintile (figure 3.6).

Figure 3.6 Use of Electric Rice Cookers and Warmers, by Monthly Household Income Quintile



Source: CSI field survey in peri-urban areas of Yogyakarta City.
Note: Rp = Indonesian rupiah.

The use of electric rice cookers and warmers should be encouraged and promoted, especially among households that use biomass to cook or warm rice. Rice is the main staple of all households in Central Java. Currently, 86 percent of the households in the survey area cook rice once per day, and 11 percent cook rice at least twice per day. Approximately 43 percent of the households that cook rice daily use biomass. Switching to electric rice cookers would undoubtedly alleviate or reduce IAP and provide households with a cleaner cooking environment.

In addition, household use of electric rice cookers would reduce the time women spend preparing meals. It takes only a few minutes to cook rice using an electric cooker, which automatically shuts off when the rice is cooked. Conversely, it takes approximately 30–40 minutes to cook rice in a regular pot using a biomass stove. Traditionally, Javanese cook rice in two ways. The first is to boil the rice until the water has evaporated (and the rice is still wet), which takes approximately 25–30 minutes. Then the rice is transferred to a steamer for another 10–15 minutes. Using this method, cooks must bring biomass stoves to a high heat level two times in one cooking cycle (to boil and then steam rice), using more fuel than the second method. In this second method, rice is cooked until the water has evaporated, but is left in the same pot on low heat to allow the steam inside the pot to finish cooking the rice. This method requires some cooking skill and fire management to maintain stove heat so as to continue cooking the rice without burning it. Also, the cook needs to ensure that the heat is distributed evenly throughout the pot, and may need to move the pot around. Note that the *cooking* time saved by using an electric rice cooker amounts to 27 or 37 minutes, though it is hard to know exactly how much time in the kitchen is actually saved. Women who prepare meals for their households usually multitask while managing the cookstove fire and adjusting the heat level—they are also chopping food and mixing or grinding spices.

Since most households cook rice only once a day (usually in the morning), they keep the rice warm in a rice warmer or must reheat it. Thus, electric rice cookers and warmers can play a significant role in reducing IAP in those households that use biomass to reheat rice.

Conclusion

The study reveals that 25 percent of households in the peri-urban areas around Yogyakarta City still rely on biomass (including firewood and agricultural residue) as their only cooking fuel. Forty-eight percent of households use a combination of biomass fuels and LPG. The combined total of biomass users in the survey area may be extrapolated to cover three-quarters of the entire peri-urban population around Yogyakarta City. This finding confirms that biomass remains an important cooking fuel—despite the government's ongoing LPG price subsidy, and especially among lower-income households in Indonesia, even those in a peri-urban area of the most densely populated island. Biomass fuels are popular because they are plentiful and readily available at little or no financial cost to households. In addition, approximately 27 percent of peri-urban households rely on LPG as their primary cooking fuel, and 48 percent use a combination of biomass fuels and LPG. In contrast to biomass, LPG is more popular among higher-income households. Middle-income households use both fuels. The study also indicates that approximately one-third of peri-urban households in the survey area use an electric rice cooker or warmer. Electric rice cookers can play a significant role in reducing IAP in households that use biomass, and should therefore be promoted.

4. Household Expenditures on Cooking Fuel and Electricity

The main fuels used for cooking by peri-urban households in the survey area are biomass and LPG. Some households use only one fuel; most use a combination. This chapter provides an analysis of cooking fuels used in the survey area and their costs. Specifically, it demonstrates that biomass—that is, wood and agricultural residue—which can be collected for free, alleviate the financial burden of a large number of households.

Biomass Expenditures and Quantities Consumed

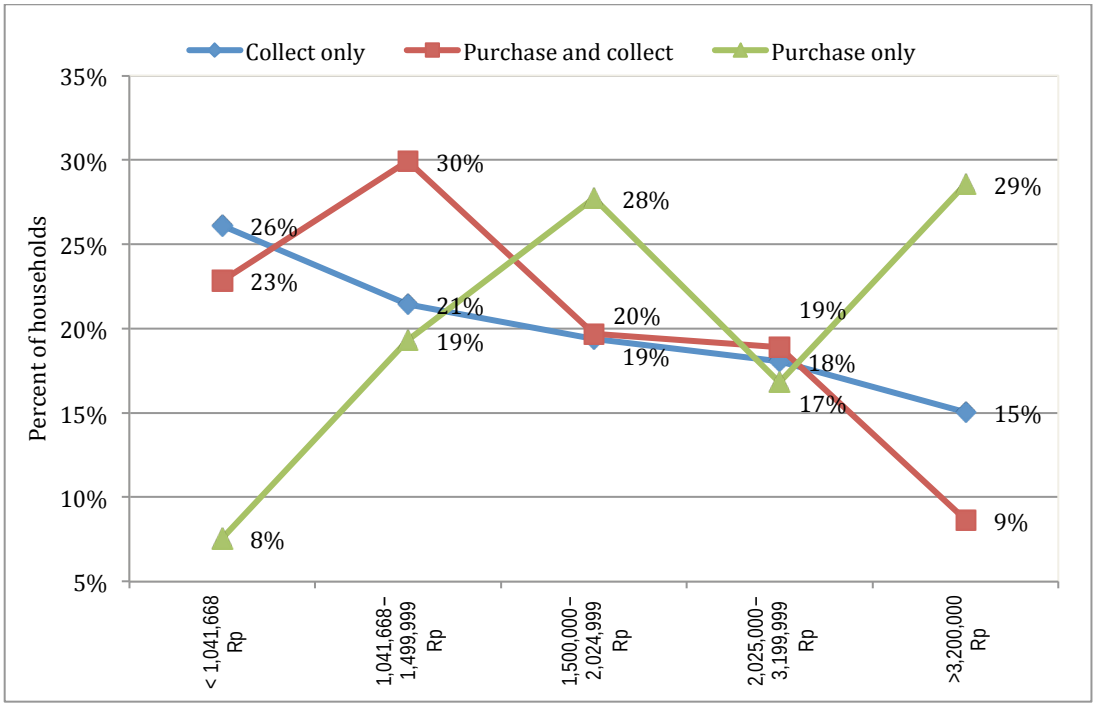
Total household cash expenditures on biomass in the survey area vary significantly, from none to more than Rp 100,000 per month. Households that do not purchase biomass at all must put aside some time to gather, collect, and prepare it on their own private property or on public land. Seventy-seven percent of the households that use a biomass stove do not purchase biomass at all, approximately 10 percent rely on purchased biomass, and the remainder both purchase and collect biomass. Households that rely on only purchased biomass spend approximately Rp 92,030 per month, whereas households that both purchase and collect biomass spend approximately Rp 61,288 per month. As expected, households that purchase biomass are slightly better off financially than the others (figure 4.1).

Figure 4.1 Biomass Acquisition in Relation to Household Monthly Income

Source: CSI field survey in peri-urban areas of Yogyakarta City.

Approximately 26 percent of households in the bottom income quintile collect biomass, but the proportion of households that collect biomass in the second, third, fourth, and fifth income quintiles drops to 21 percent, 19 percent, 18 percent, and 15 percent, respectively. Conversely, only 8 percent of households in the bottom income quintile purchase biomass, and this increases to 19 percent, 28 percent, 17 percent, and 29 percent in the second, third, fourth, and fifth income quintiles, respectively (figure 4.2).

Figure 4.2 Biomass Acquisition, by Monthly Household Income Quintile

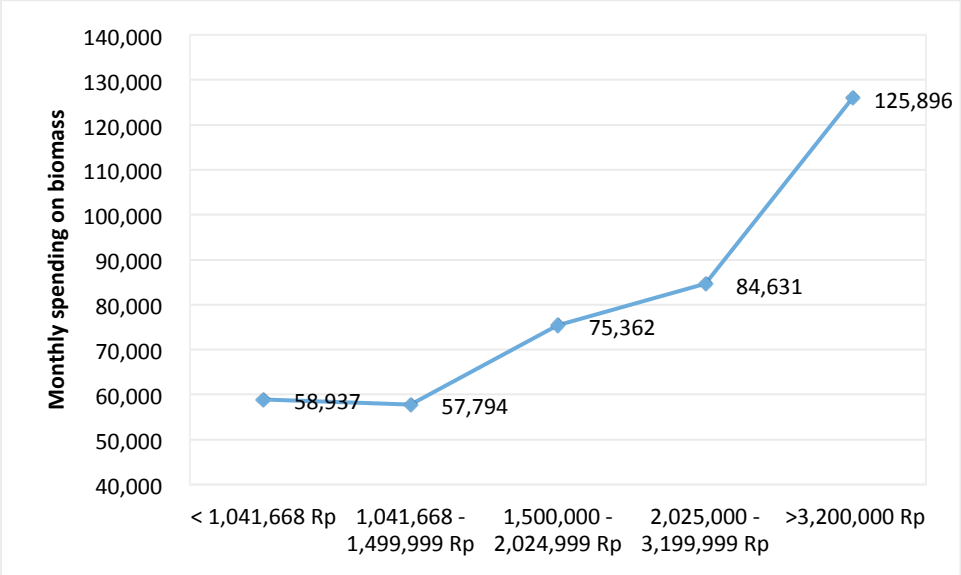


Source: CSI field survey in peri-urban areas of Yogyakarta City.
Note: Rp = Indonesian rupiah.

The average total household monthly expenditure on biomass—of all households that purchase biomass—is estimated at Rp 79,370. As expected, household monthly spending on biomass is positively associated with income. The average monthly expenditure on biomass for households in the bottom two income quintiles is close to Rp 60,000; as income increases, household monthly spending on biomass also increases, to as high as Rp 125,896 among households in the top income quintile (figure 4.3). This relationship suggests that households in the bottom two income quintiles are sensitive to the price of biomass; their total monthly expenditure on biomass is between Rp 58,000 and Rp 59,000. Conversely, households in the third and fourth income quintiles are less sensitive to price; their monthly expenditure ranges from Rp 75,000 to Rp 85,000. This larger range of expenditure indicates that their budget is also more flexible. From the point of view of a clean cookstove market, any stove that can significantly reduce biomass consumption could attract households sensitive to the price of biomass.

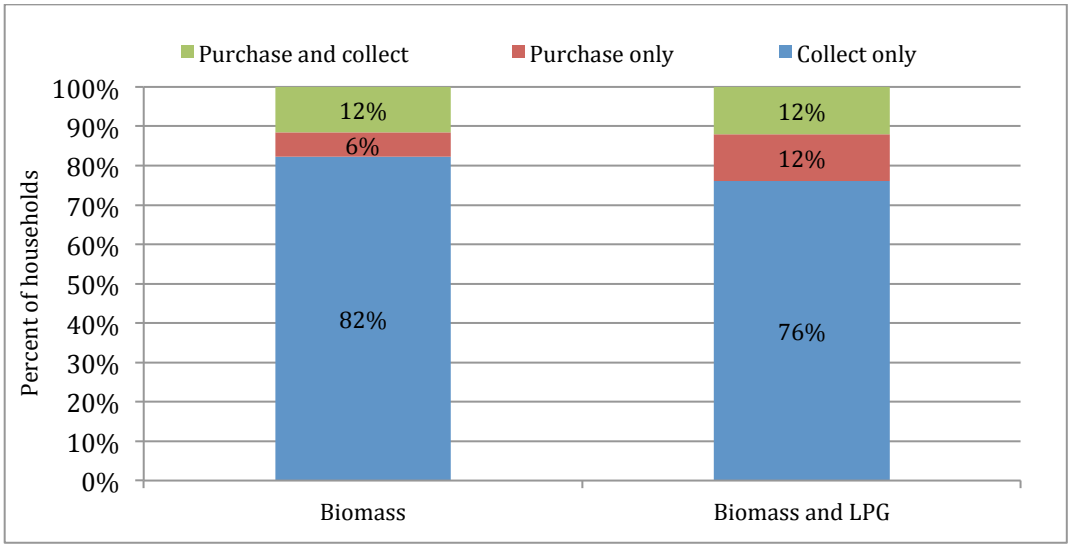
Households that rely solely on biomass spend approximately Rp 65,718 per month on fuel; those that use both biomass and LPG spend approximately Rp 72,766 on biomass alone. A slightly smaller portion (76 percent) of households that use both biomass and LPG collect biomass (figure 4.4).

Figure 4.3 Household Monthly Spending on Biomass, by Income Quintile



Source: CSI field survey in peri-urban areas of Yogyakarta City.
Note: Rp = Indonesian rupiah.

Figure 4.4 Methods of Household Biomass Acquisition



Source: CSI field survey in peri-urban areas of Yogyakarta City.

Although households that collect biomass bear a smaller financial burden for fuel than those who use both biomass and LPG, these households must spend time collecting and preparing biomass for use. On average, one adult member in each household spends approximately 2 hours per week collecting biomass. There is a small difference in the time spent collecting biomass among households that only collect biomass and households that collect and purchase it (2 hours and 10 minutes compared with 2 hours and 4 minutes, respectively). Households that both collect and purchase biomass collect less biomass (about 104 kg per month) than do households that only collect it (about 137 kg per month). These households spend slightly less time but collect significantly less biomass, which suggests that they may have more limited

access to free biomass. Also, households that collect and purchase biomass use significantly more biomass than all other households—approximately 226 kg per month, which is around 75 kg more than the average biomass usage of households in the survey area. These households may collect biomass to supplement their total demand and alleviate the financial burden of biomass expenditures.

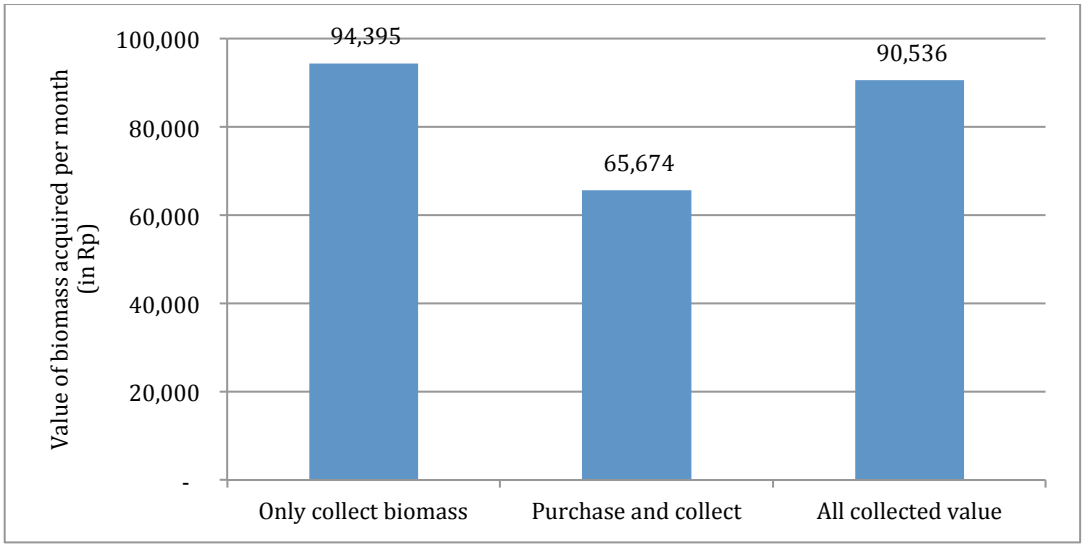
The survey finds that the burden of collecting biomass is shared equally by men and women in a household. Children participate in biomass collection in only a handful of surveyed households.

The average household uses approximately 149 kg of biomass per month. A comparison of biomass usage between two market segments—households that use biomass only and households that use both biomass and LPG—reveals that the second segment relies heavily on biomass. Biomass-only households use approximately 153 kg of biomass per month, whereas households that use both biomass and LPG use approximately 144 kg of biomass per month.

Estimated Value of Collected Biomass

The total cost and quantity of biomass reported by the responding households were used to estimate the average price of biomass, which was then used as a proxy price for collected biomass. Based on the reported quantity of acquired biomass, its average total value per month per household is approximately Rp 90,536 (figure 4.5). As discussed earlier, 77 percent of households that use biomass collect it, and 12 percent both collect and purchase it. The average total value of biomass in households that only collect it is estimated to be Rp 94,395 per month; this figure falls to Rp 65,674 in households that both purchase and collect it. Households that only purchase biomass spend about Rp 79,370.[2]

Figure 4.5 Average Total Value of Biomass Acquired per Month, by Method of Acquisition

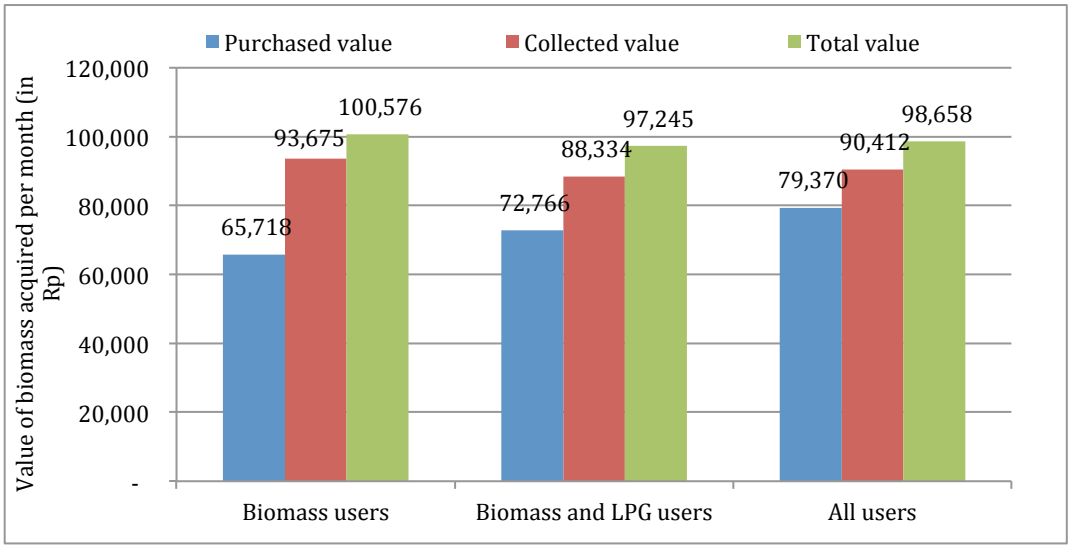


Source: CSI field survey in peri-urban areas of Yogyakarta City.
Note: IDR = Indonesian rupiah.

[2] Households that only purchase biomass (including firewood and wood residue) include households that use only biomass and households that use biomass and liquefied petroleum gas (LPG).

Because households that collect biomass cut across two market segments—users of biomass only and those who combine it with LPG—the estimated value of collected biomass may be compared across both segments. As shown in figure 4.6, the average value of collected biomass in biomass-only households is estimated to be Rp 93,675 per month, which is slightly higher than the estimate of Rp 88,334 in households that use both biomass and LPG. In both market segments the estimated value of collected biomass is significantly higher than the purchased value. This finding confirms that surveyed peri-urban households rely heavily on collected biomass. It also implies that most households that use biomass are trying to alleviate their cooking fuel expenditures. Therefore, it appears that a new, clean biomass cookstove may have a better chance of being accepted by consumers if it can use any type of biomass and reduce fuel costs.

Figure 4.6 Value of Biomass Acquired per Month, by Market Segment



Source: CSI field survey in peri-urban areas of Yogyakarta City.
Note: IDR = Indonesian rupiah.

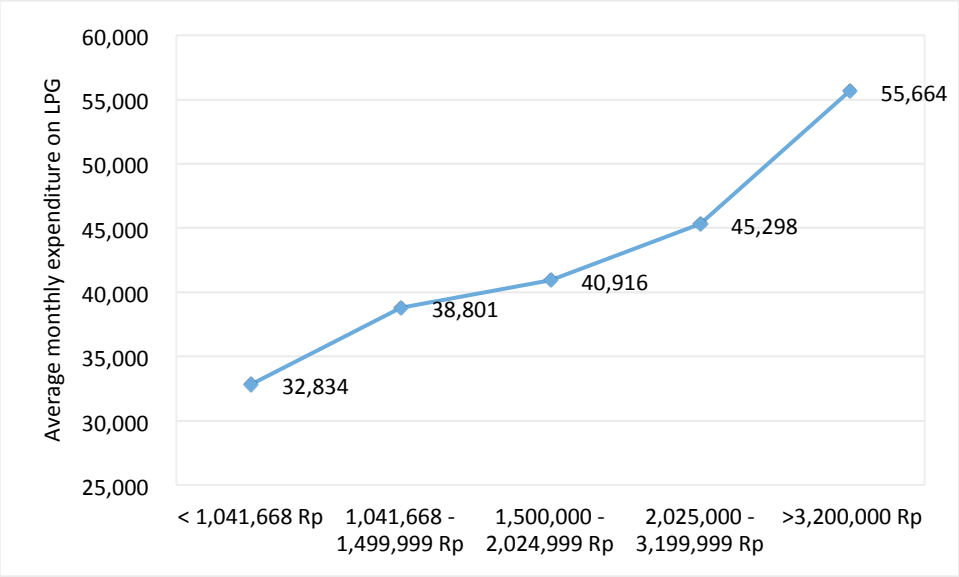
LPG Expenditures and Quantities Consumed

The average household monthly expenditure on LPG is approximately Rp 44,095, and the average monthly usage of LPG per household is 7.9 kg. As discussed in chapter 3, approximately three-quarters of the households in the survey area use LPG; however, more than half (approximately 64 percent) of LPG users also use biomass. Because households use both fuels, monthly expenditures on cooking fuels must account for both. The average monthly expenditure on LPG for households that use both biomass and LPG is Rp 39,562, compared with approximately Rp 53,307 for households that use only LPG.

As in the case of biomass, expenditures on LPG are positively associated with income—that is, low-income households spend less per month on LPG; as income increases, households spend more on LPG. The average total monthly expenditure on LPG for households in the bottom income quintile is estimated to be only Rp 32,834, and these households consume only 3.9 kg per month (figure 4.7). Total expenditure on LPG gradually increases by income quintile to approximately Rp 55,664 for 9.7 kg of LPG a month. This suggests that households from the bottom to the fourth income quintiles are sensitive to the price of LPG, and spend from Rp 33,000 per month to Rp 45,000 per month, respectively.

In Central Java biomass and LPG are substitutable fuels. Moreover, close to half (48 percent) of all households in the survey area use both biomass and LPG. This suggests that any changes in the price of LPG would have a direct effect on the demand for biomass and biomass stoves. Thus, if the price of LPG were to increase (or if there were any reduction in the LPG subsidy), households would significantly reduce LPG consumption, while the demand for biomass—and biomass stoves—would increase.

Figure 4.7 Household Monthly Spending on LPG, by Income Quintile

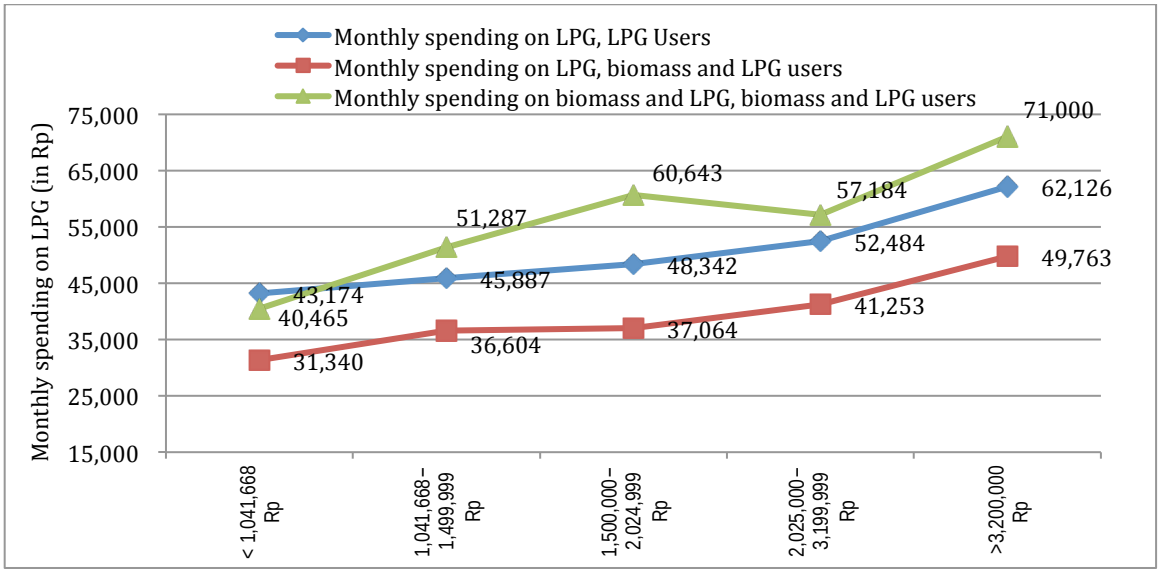


Source: CSI field survey in peri-urban areas of Yogyakarta City.
Note: LPG = liquefied petroleum gas; Rp = Indonesian rupiah.

A comparison of monthly expenditures reveals that, on average, LPG-only households spend Rp 10,000–Rp 15,000 less on LPG than do users of both biomass and LPG. Meanwhile, households that use both biomass and LPG spend a significant amount of money or time each month to purchase or collect biomass. The average total monthly expenditure on biomass and LPG among households that use both is estimated to be Rp 56,897. Monthly spending on biomass and LPG by households in these two market segments is positively associated with income (figure 4.8).

The average price of LPG paid by the households is approximately Rp 5,572 per kg. The retail price of LPG, which is government subsidized, is approximately half the market price. As noted earlier, it is expected that any price increase in LPG would increase the demand for biomass.

Figure 4.8 Household Monthly Spending on LPG and Biomass



Source: CSI field survey in peri-urban areas of Yogyakarta City.
Note: LPG = liquefied petroleum gas; Rp = Indonesian rupiah.

Electricity Expenditures Associated with Electric Rice Cookers

Another important cooking activity—with associated costs, in this case for electricity—is the use of electric rice cookers. Currently, only a handful of households in the survey area use electric stoves or hot plates, but approximately 53 percent use a rice cooker or rice warmer. Approximately 31 percent of the households in the survey area use an electric rice cooker once a day, and 1 percent use it every two or three days. A very small minority (slightly less than 1 percent) use a rice cooker more than once a day. Table 4.1 provides the estimated costs and electricity usage of cooking rice using an electric rice cooker with a capacity of 1.8 liters (L) to 2.0 L. The cost estimate is based on an electricity tariff rate of Rp 495 per kilowatt-hour (kWh) for residential customers with a 900 volt-ampere limit. Because the efficiency of electric rice cookers varies significantly—from only 350 watts to as high as 650 watts for a rice cooker of the same capacity—total electricity usage and costs can only be estimated in a large range. The total time required for one cook to boil rice is approximately 25 minutes, regardless of the rice cooker's capacity. As shown in table 4.1, the cost to cook rice ranges from Rp 72 to Rp 134.

It is not possible to reliably estimate the cost of warming rice using a rice warmer, because rice warmers turn on and off automatically. But costs are expected to be low: the power rating of rice warmers is approximately 100 watts or less.

Table 4.1 Costs of Using a Rice Cooker

Rice cooker capacity (liters)	Wattage rating	Time to cook rice (hr)	kWh consumed per cook	Tariff/kWh (Rp)	Total cost (Rp), 1 cook	Total cost (Rp), 30 cooks
1.8–2.0	350	0.417	0.146	495	72.25	2,167.36
1.8–2.0	400	0.417	0.167	495	82.57	2,476.98
1.8–2.0	450	0.417	0.188	495	92.89	2,786.60
1.8–2.0	500	0.417	0.208	495	103.21	3,096.23

Rice cooker capacity (liters)	Wattage rating	Time to cook rice (hr)	kWh consumed per cook	Tariff/kWh (Rp)	Total cost (Rp), 1 cook	Total cost (Rp), 30 cooks
1.8–2.0	550	0.417	0.229	495	113.53	3,405.85
1.8–2.0	600	0.417	0.250	495	123.85	3,715.47
1.8–2.0	650	0.417	0.271	495	134.17	4,025.09

Source: Author.
Notes: Exchange rate, Rp 10,000 = $1. The electricity tariff used to calculate the price ranges is Rp 495/kWh for residential customers with 900 volt-ampere limitations. After 25 minutes, a rice cooker will shut off automatically. At this point, the temperature inside the pot reaches the prespecified temperature, at which the water boils and begins to evaporate. After the electricity is shut off, a combination of boiling water and steam cooks the rice. This step usually takes another 7–10 minutes, but requires no electricity. kWh = kilowatt hour; Rp = Indonesian rupiah.

Total Expenditures on Cooking Fuels

Based on the market segmentation of cookstoves and fuels—which broadly includes biomass only, biomass and LPG, and LPG only—the average household's total monthly cash expenditure on cooking fuels is close to Rp 60,000. Households that use electric rice cookers incur an additional Rp 72–Rp 134 charge per use.[3] Although the average household monthly income of those who use biomass only is lower than that of the other two other groups, they spend nearly 6 percent of their total monthly income on biomass. Conversely, households that use LPG and biomass are better off financially and spend only about 3.5 percent of their monthly income on fuel. Further, more affluent households that use only LPG spend only 2.7 percent of their monthly income on fuel. Clearly, these households directly benefit from the LPG price subsidy provided by the government.

Nine surveyed households use charcoal, and all of them engage in business activities at home. Among these charcoal users, five are engaged in the cottage food industry and spend between Rp 90,000 and Rp 300,000 a month on charcoal. The four other households that use charcoal spend only Rp 2,500 to Rp 25,000. (Because charcoal is used along with other major cooking fuels, including biomass and LPG, charcoal expenditures are included in the total monthly estimates for all market segments.)

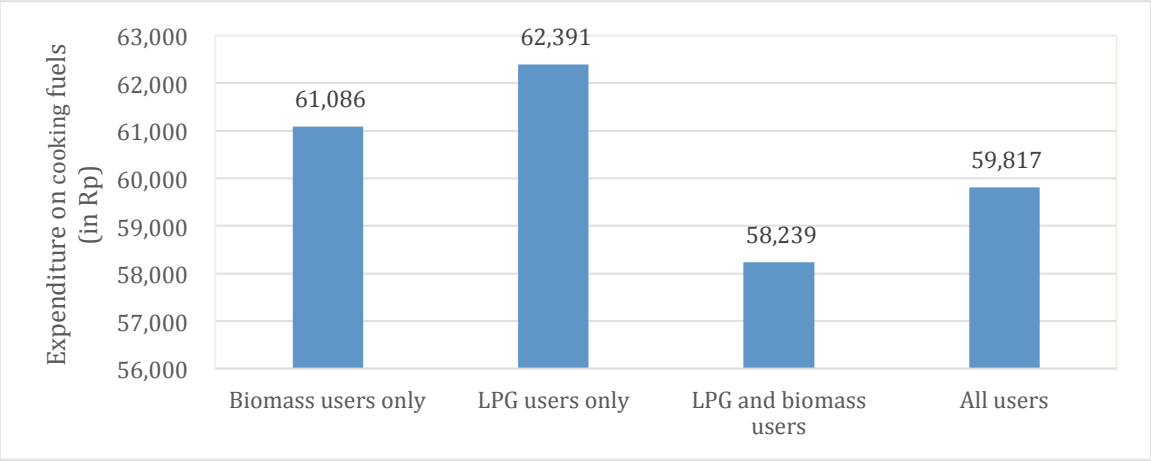
As shown in figure 4.9, there is no significant difference in total monthly cash expenditures on cooking fuels among households in the three market segments. This, and the relatively high proportion of biomass collectors, suggests that the majority of the households in the survey area are careful to spend only the minimum necessary on household cooking fuel. This finding implies that demand for cooking fuels, regardless of type, is inelastic.

A comparison of total cash spending on cooking fuels by income quintile shows a positive linear relationship—that is, as income rises, households spend more on cooking fuels (see figure 4.10). But there is a small variation in total cash spending among households in all but the top income quintile, whereas this variability ranges from Rp 42,863 to Rp 51,535 among households in the bottom two income quintiles. An analysis of total cash spent on cooking fuels in proportion to income indicates that lower-income households shoulder a higher financial burden for cooking fuels than do higher-income households. According to the survey, households in the bottom income quintile allocate approximately 7

[3] It is not possible to separate the portion of the household monthly electricity bills paid to cook rice, and therefore the total monthly expenditures on electricity used for cooking is excluded. But the estimated expenditure on electricity for rice cookers is calculated from technical specifications and current electricity tariffs and is presented separately (see section 4.4).

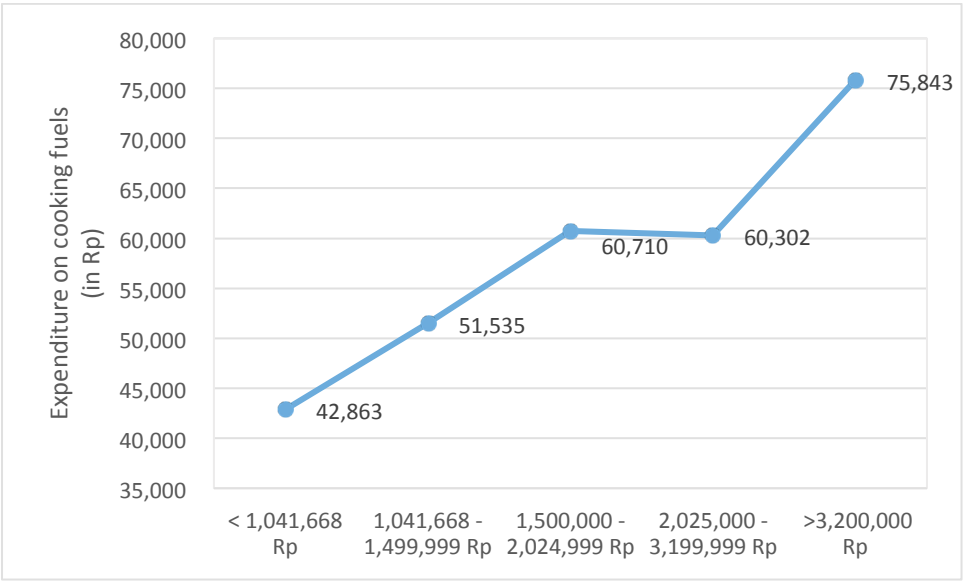
percent of their monthly income to cooking fuels, but the proportion of spending to total income declines significantly in the top income quintiles—to 4 percent and 2 percent. As discussed in chapter 3, among households in the top and fourth income quintile, approximately 50 percent and 40 percent, respectively, use LPG. Clearly, households that have higher incomes benefit more from the LPG price subsidy provided by the government than do lower-income households. Conversely, more than 50 percent of households in the bottom income quintile use biomass, which is not subsidized.

Figure 4.9 Household Monthly Spending on Cooking Fuels, by Market Segment



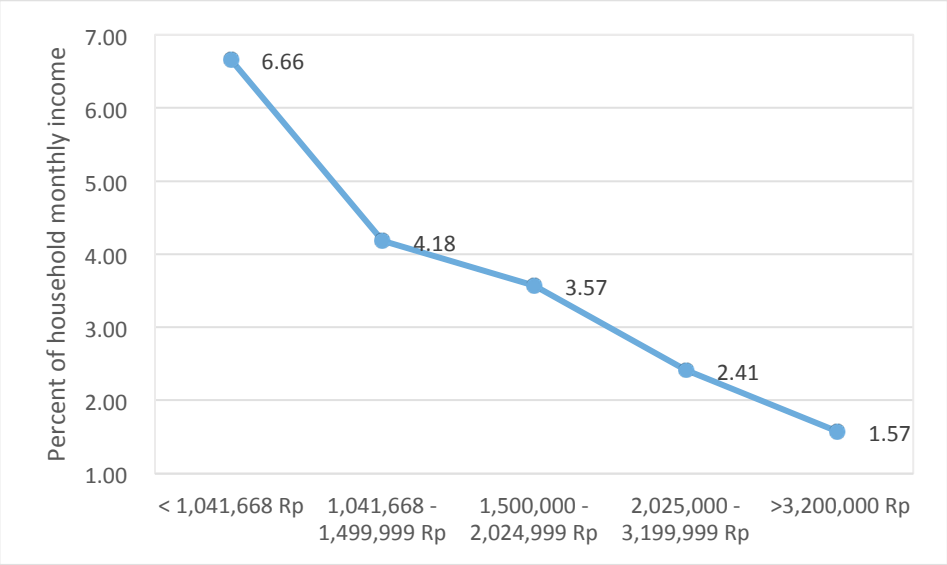
Source: CSI field survey in peri-urban areas of Yogyakarta City.
Note: LPG = liquefied petroleum gas.

Figure 4.10 Household Monthly Spending on Cooking Fuels, by Income Quintile



Source: CSI field survey in peri-urban areas of Yogyakarta City.
Note: Rp = Indonesian rupiah.

Figure 4.11 Household Monthly Spending on Cooking Fuels, by Income Quintile



Source: CSI field survey in peri-urban areas of Yogyakarta City.
Note: Rp = Indonesian rupiah.

Conclusion

Most (77 percent) of the households that use biomass do not purchase it but collect it for free. Only about 10 percent rely solely on purchased biomass, and the remainder both purchase and collect biomass. The average total value of collected biomass per month per household is estimated to be Rp 90,536. Household monthly spending on biomass is positively associated with income, as is spending on LPG—implying that higher-income households benefit more from the government's LPG price subsidy than do lower-income households. Those households that use a rice cooker spend little on electricity. Regardless of the type of cooking fuels used, households are very cautious in their monthly expenditures on fuel.

5. Household Cooking Practices and Cooking Habits

To understand the clean cookstove market, it is necessary to have a thorough understanding of not only household demographics and socioeconomic characteristics but also the characteristics and behaviors of cooks, such as how they perform cooking activities, the types of stoves and fuels they use to cook, the types of foods they cook, their preferred stove features, and their attitudes toward IAP from burning solid fuel. A better understanding of these issues will enable stove designers to develop and fine-tune stove designs to fit the needs of consumers. Stove promoters, too, could better understand their customers, be more responsive to their needs, and develop better means to communicate with them and promote the use of clean biomass cookstoves.

The first part of this chapter describes how surveyed peri-urban households utilize their stoves, and analyzes the age, gender, and educational level of cooks The main objective of this analysis is to present a better understanding of preferred stove design features and characteristics from the consumer's point of view. The second and third sections of this chapter examine attitudes toward biomass use and IAP, including reasons why households may be willing or unwilling to change their stoves and adopt cleaner models. This information can be used to assess the effectiveness of current methods of information dissemination and to inform future clean cookstove programs.

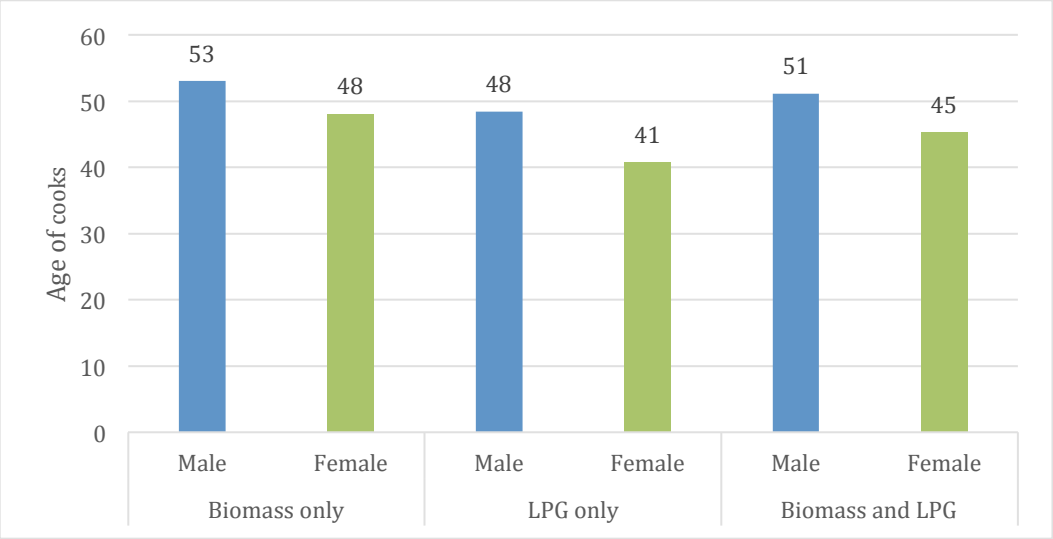
Characteristics of Household Cooks

Women account for 96 percent of cooks in surveyed households. Their average age is 45 (and the average age of men is 51). Biomass stove users tend to be older than LPG stove users (see figure 5.1). This may be because younger people are attracted to more convenient and modern fuels, whereas older generations are accustomed to traditional ways of cooking.

The age ranges of both female and male cooks are further analyzed by market segment in figures 5.2 and 5.3.

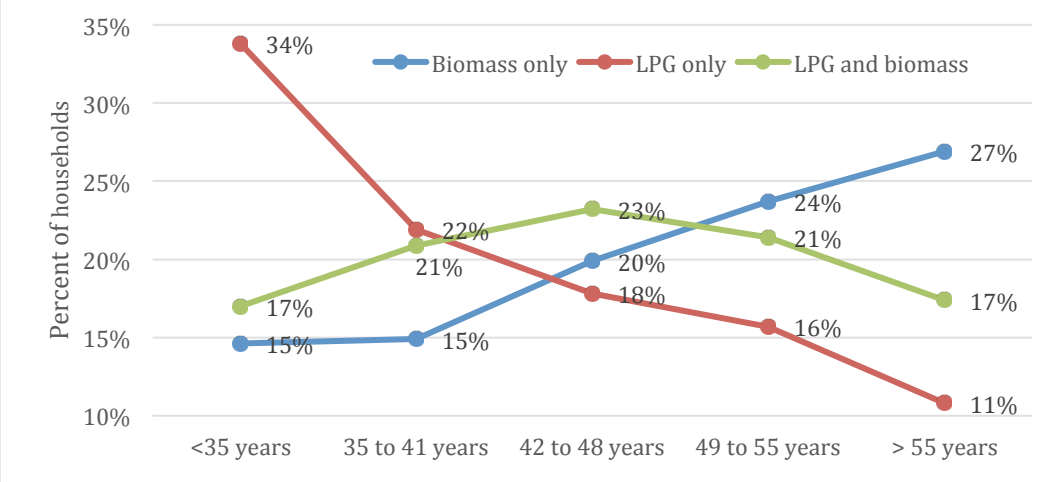
Approximately two-thirds (64 percent) of LPG users have at least a high school level of education. Conversely, only one-fifth (21 percent) of biomass users and approximately one-third (32 percent) of biomass and LPG users have at least a high school level of education. The survey indicates no association between fuel and stove preferences and women's status as income earners. Therefore, the pressure to save time may not have as much influence on fuel and stove type selection as does the cook's education level.

Figure 5.1 Average Age of Household Cooks, by Market Segment



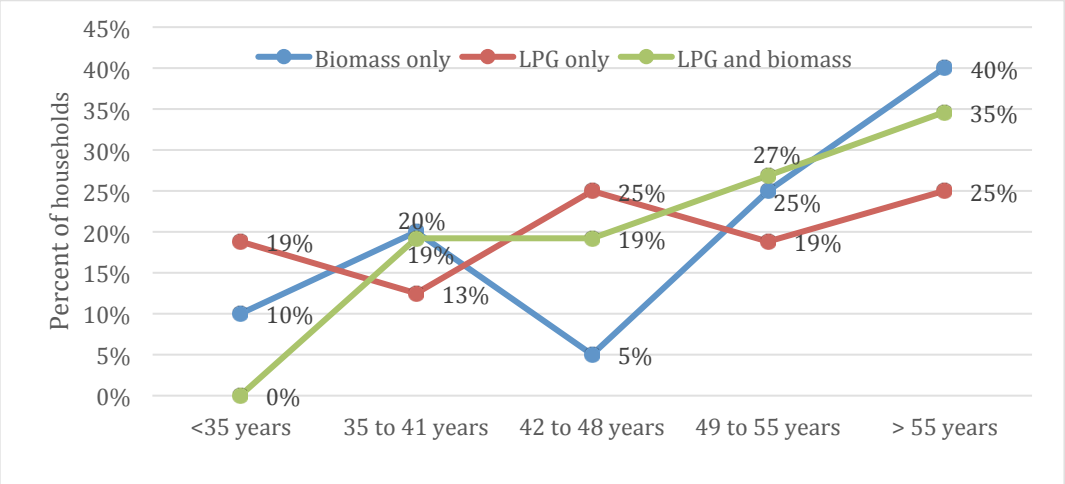
Source: CSI field survey in peri-urban areas of Yogyakarta City.
Note: LPG = liquefied petroleum gas.

Figure 5.2 Age of Female Cooks, by Market Segment



Source: CSI field survey in peri-urban areas of Yogyakarta City.
Note: LPG = liquefied petroleum gas.

Figure 5.3 Age of Male Cooks, by Market Segment



Source: CSI field survey in peri-urban areas of Yogyakarta City.
Note: LPG = liquefied petroleum gas.

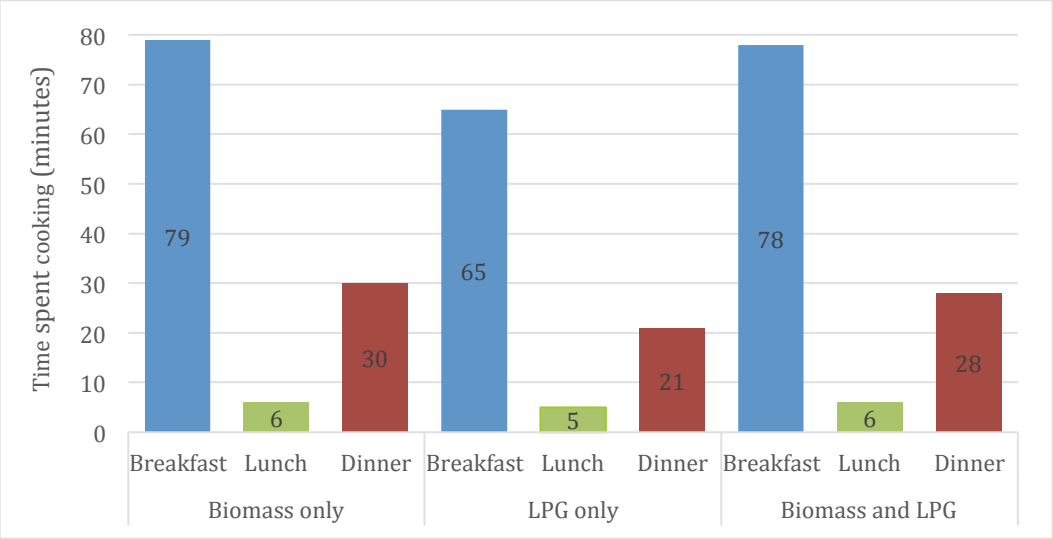
Cooking Activities

The average household meal is prepared for four people. Households that use both biomass and LPG are slightly bigger than households that rely on a single fuel. The following subsections discuss the total time each household spends cooking, and the types of foods cooked and consumed at home. These activities directly impact fuel consumption and the intensity of stove utilization.

Time Spent Cooking

Most peri-urban households in the survey area in Central Java prepare and cook most of the day's food at one time, in the morning (figure 5.4). Foods are then reheated—and possibly combined with other items—at lunch and dinner. The average time spent cooking in the morning is 75 minutes; at lunch and dinner the average time is 6 minutes and 30 minutes, respectively. Biomass users, including households that use it in combination with LPG, spend the most time cooking in the mornings: 78 minutes to 79 minutes. LPG users spend 65 minutes cooking in the morning and only 5 minutes and 21 minutes preparing lunch and dinner, respectively. This time difference may result from a few factors. First, as discussed above, LPG users tends to have smaller families that require less food and thus less time to cook. Second, a higher proportion of LPG users use rice cookers on a daily basis, which saves significant cooking time (see chapter 3). Finally, using LPG stoves does not incur time preparing fuel and starting a fire. In general, it may take at least 5 minutes to start the fire for a biomass stove. A biomass cookstove that ignites and cooks food as fast as an LPG stove may be of interest to households.

Figure 5.4 Average Time Spent Cooking, by Market Segment



Source: CSI field survey in peri-urban areas of Yogyakarta City.
Note: LPG = liquefied petroleum gas.

The vast majority of households in the survey area prepare their own food for consumption at home. Only around 1 percent buy cooked food for all three meals. Approximately 13 percent of households buy food from outside to supplement breakfast, and approximately 8 percent and 7 percent, respectively, do so for lunch and dinner.

Types of Foods Cooked at Home

Almost all surveyed households boil water to drink (97 percent) and cook rice (96 percent). About 75 percent deep-fry food, and about 58 percent make soup. The most popular deep-fried food in Indonesia is tempeh. Other foods include steamed or boiled vegetables and meat. Preparations for lunch and dinner tend to involve reheating rice and soup. Dinner preparations may also involve boiling water and deep-frying food.

Using the types of food cooked by surveyed households as a guide, it may be possible to determine what type of stove is best suited for each cooking task. For example, a stove capable of producing high heat relatively quickly and maintaining a high heat level for a short period of time is needed to boil water. Similarly, a stove that is capable of producing and maintaining high heat for a sustained period of time and producing steam is needed to steam rice, steam or boil food, and reheat rice using steam. In addition, a stove that is capable of producing high heat and adjusting to a lower heat level relatively quickly may be suitable for stir-frying, deep-frying, and, to some extent, preparing soup and rice. Stoves with these characteristics would be desirable for cooks in the surveyed households.

Boiling Water

Boiling water is one of the most important activities carried out in the kitchen. Almost all households boil water in the morning, and nearly two-thirds (60 percent) boil water again in the evening. The main purpose of boiling water is for drinking. Approximately 46 percent of surveyed households reported

boiling drinking water the day prior to the survey, and approximately 53 percent had boiled water to drink or to use for bathing/washing. The remaining 1 percent did not boil water the previous day.

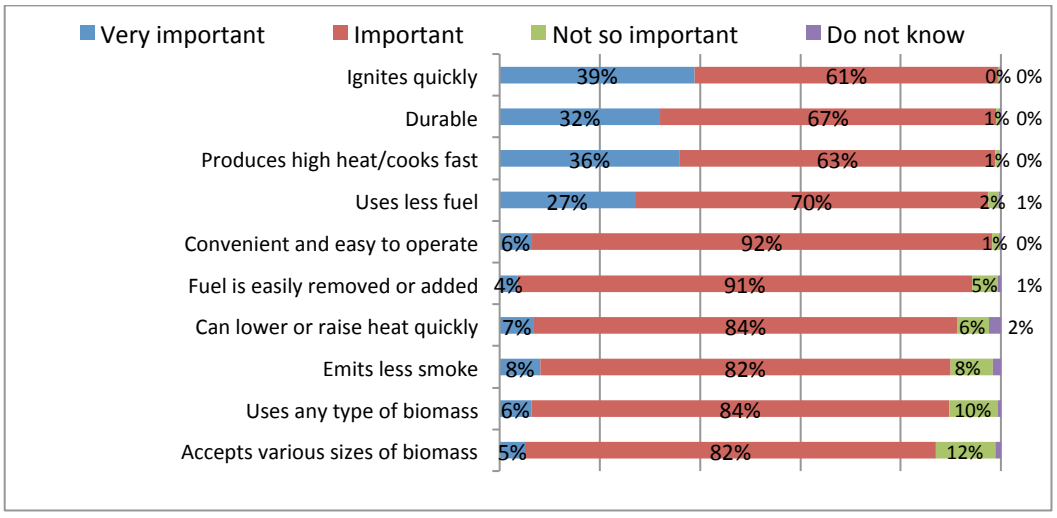
Biomass stoves are the most popular for boiling water, and are used by approximately 68 percent of households for this purpose, compared with 42 percent who use an LPG stove. The proportion of households that use a charcoal stove or electric stove to boil water is negligible—approximately 1 percent and less than 1 percent, respectively.

In general, stoves that can produce high heat in a short period of time are the most efficient for boiling water. Most biomass stove users are able to estimate the quantity of biomass needed to bring water to a boil. Because almost all households need to boil water at least once or twice every day, demand may be high for a biomass stove that can produce high heat in a short period of time. In addition to boiling water, such a stove might be suitable for steaming food. Indonesian cooks make frequent use of steam to reheat cooked rice or other food and to make desserts. Such a stove would not, however, be suitable for cooking rice, because the high heat may burn the rice at the bottom of the pot. It is conceivable that a biomass stove that is suitable for both boiling rice (but one that does not become too hot and burn the rice) and boiling water in a short period of time could be attractive to consumers.

Preferred Cookstove Characteristics and Design Features

Ten important design features of stoves are shown in figure 5.5. About 90 percent of surveyed households consider these design features very important or important. Approximately 30–40 percent of the households surveyed believe that it is "very important" for stoves to (i) use less fuel, (ii) reach high heat levels and cook fast, (iii) be durable, and (iv) ignite quickly. Thus, stove designers and manufacturers should take these features into account. Other important design features—mentioned by less than 10 percent of households—include an ability to (v) operate conveniently and easily; (vi) remove and/or add fuel easily; (vii) reduce or increase heat promptly; (viii) emit less smoke; (ix) use any type of biomass fuel, such as firewood, coconut shells, and twigs; and (x) burn various diameters and lengths of firewood.

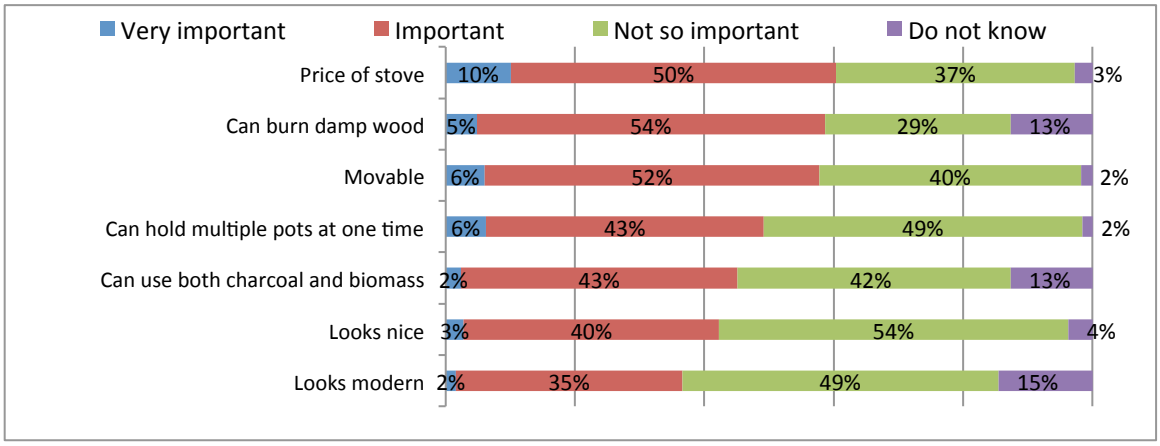
Figure 5.5 Most Highly Valued Design Features of Stoves



Source: CSI field survey in peri-urban areas of Yogyakarta City.

Other, lower-priority cookstove characteristics include (i) price, (ii) the ability to burn damp wood, and (iii) portability. Approximately 59–60 percent of the households surveyed consider these design features very important or important (figure 5.6). Additionally, characteristics such as whether a cookstove (iv) can cook multiple pots of food at one time, (v) can use charcoal and firewood, (vi) looks nice, and (vii) looks modern were considered very important or important among 50 percent of the households surveyed.

Figure 5.6 Other Design Features of Stoves

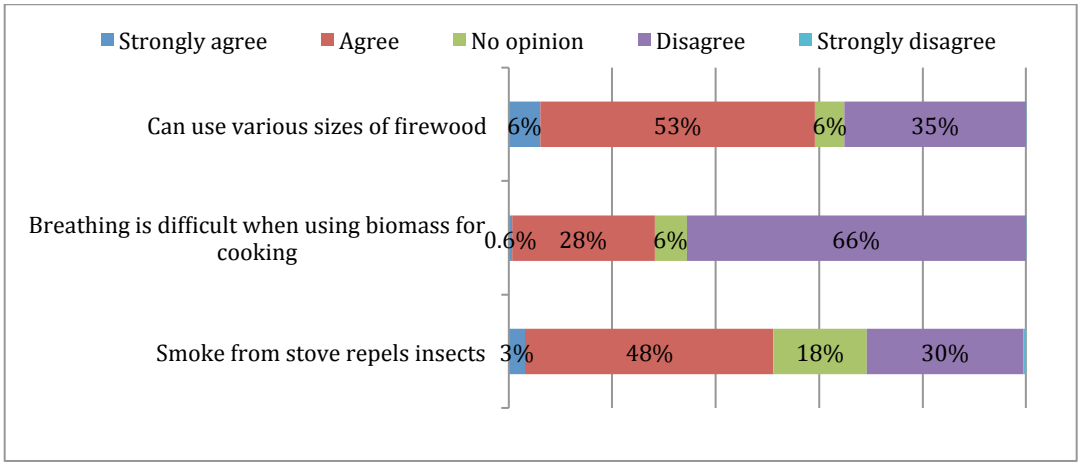


Source: CSI field survey in peri-urban areas of Yogyakarta City.

Household Opinions on Traditional Cookstoves, Fuels, and Smoke

To gain a better understanding of household attitudes toward stoves and cooking habits and potential end-users of clean cookstoves, the survey asked questions related to (i) smoke from cooking fuels, (ii) the use of biomass, (iii) traditional Keren stoves compared with open-fire three- and five-stone stoves, and (iv) the value of biomass compared with modern cooking fuels. The survey reveals that significant numbers of households are not aware of the negative health impacts of exposure to smoke from burning solid fuels, including biomass (firewood, wood, and agricultural residue). While 59 percent of households strongly agree or agree that smoke from cooking is a big health problem in their family (figure 5.7), approximately 35 percent disagree with this statement. Moreover, only 28 percent of the households agree that breathing is difficult when using firewood for cooking, while approximately 66 percent disagree.

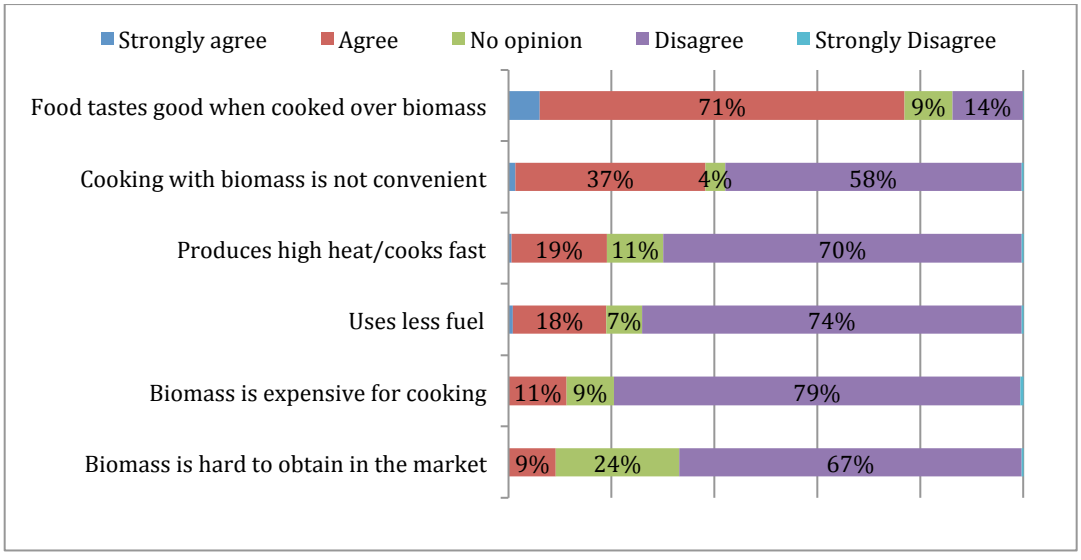
Figure 5.7 Opinions on Smoke from Cooking Fuels



Source: CSI field survey in peri-urban areas of Yogyakarta City.

Because smoke is the direct result of incomplete combustion from burning biomass, the survey asked questions pertaining to household attitudes toward firewood. Results found that the majority of the households hold favorable views of firewood. First, approximately three-quarters (75 percent) of households agree that food tastes good when cooked with firewood (figure 5.8). Second, approximately 79 percent of the households disagree that firewood is expensive to use for cooking, and, similarly, 74 percent of households disagree that firewood is getting harder to collect. This finding implies that firewood supplies are abundant and available for collection. Third, approximately 70 percent of households disagreed that preparing wood for cooking is a burden for the family. Finally, 67 percent and 58 percent of households disagreed that firewood is hard to obtain in the market and that cooking with firewood is inconvenient, respectively. These positive attitudes toward firewood confirm that biomass is still popular among peri-urban households in the survey area in Central Java.

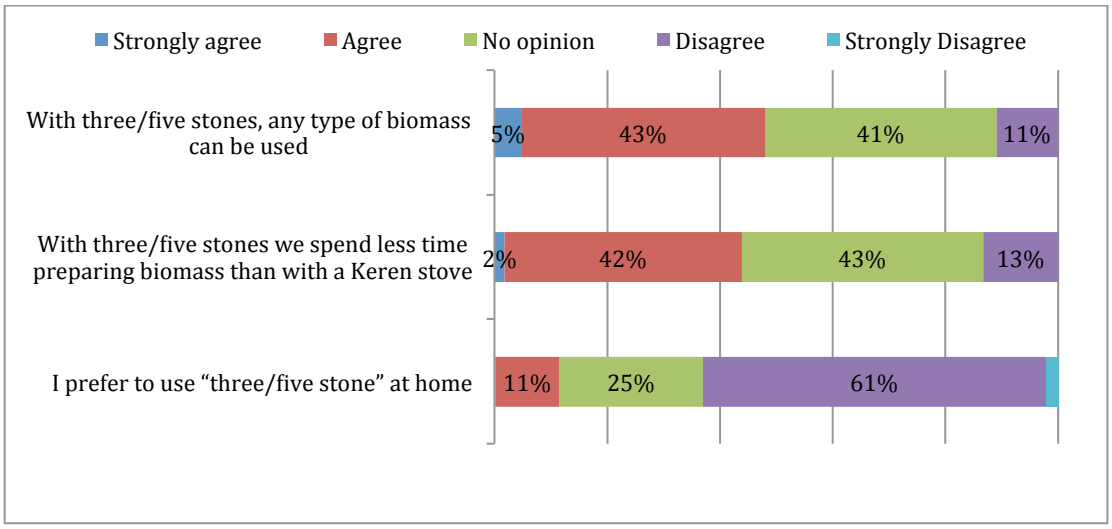
Figure 5.8 Opinions on Firewood as Fuel



Source: CSI field survey in peri-urban areas of Yogyakarta City.
Note: "Firewood" includes both firewood and biomass residue.

Nearly half of the households believe that the open-fire three- and five-stone stoves allow a variety of firewood and other biomass types to be used with ease (figure 5.9). Similar numbers agree that it takes less time to prepare firewood to use in the open-fire three- and five-stone stoves than in a Keren.

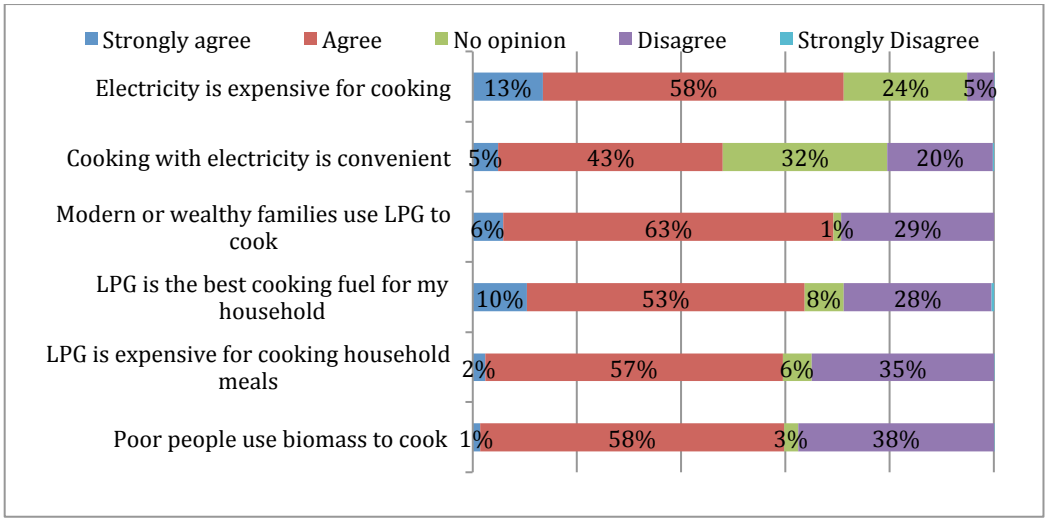
Figure 5.9 Opinions on Keren Stoves and Open-Fire Three/Five-Stone Stoves



Source: CSI field survey in peri-urban areas of Yogyakarta City.
Note: "Firewood" includes both firewood and biomass residue.

Nearly half (48 percent) of surveyed households believe that using electricity to cook is very convenient, but approximately 71 percent think that it is expensive (figure 5.10). Approximately two-thirds (63 percent) of the households believe that LPG is the best cooking fuel, but—despite the LPG price subsidy from the government—approximately 59 percent consider LPG expensive. Approximately 69 percent of the households associate the use of LPG as a cooking fuel with modern or wealthy families; similarly, approximately 59 percent of the households associate the use of firewood with poor families.

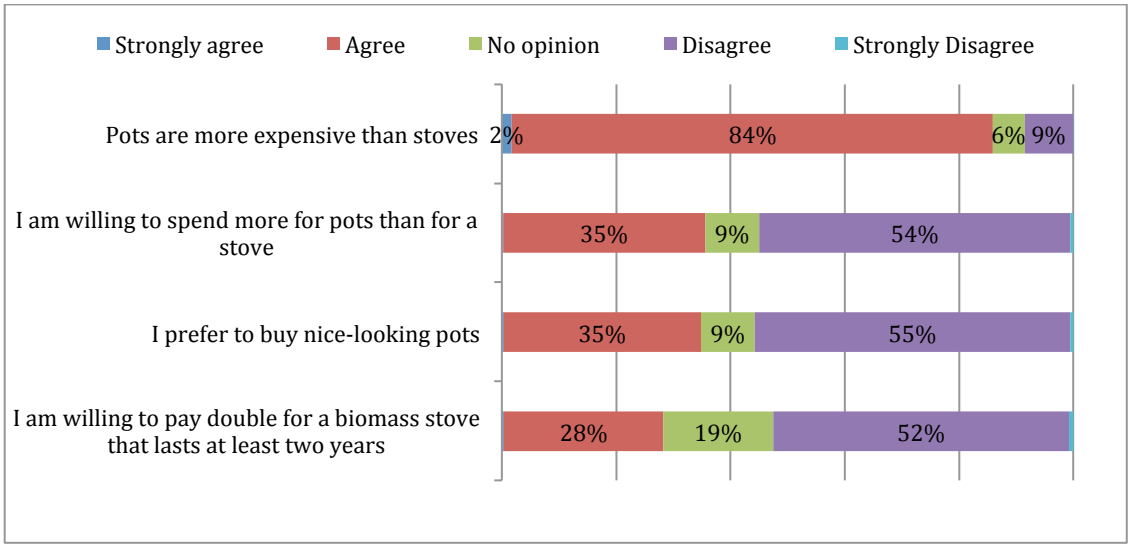
Figure 5.10 Opinions on Biomass Compared with Modern Cooking Fuels



Source: CSI field survey in peri-urban areas of Yogyakarta City.
Note: LPG = liquefied petroleum gas.

Information about household attitudes toward the price of primary cooking utensils such as pots, pans, and stoves suggests that average households could spend slightly more on cookstoves than they do. Approximately 86 percent of the surveyed households agree that pots are more expensive than stoves (figure 5.11). Almost half (44 percent) of the households agree with statements such as "I am willing to pay more on pots than stoves" and "I prefer to buy nice-looking pots." In addition, nearly half (47 percent) of the households surveyed agree that they would be willing to pay double for a biomass stove that would last at least two years.

Figure 5.11 Opinions on the Cost of Pots and Stoves



Source: CSI field survey in peri-urban areas of Yogyakarta City.

Conclusion

Biomass stoves are more popular among older cooks; LPG stoves are more popular among younger cooks. LPG users appear to have higher levels of education than those who use biomass only and those who use biomass and LPG in combination. Households that use both biomass and LPG are slightly larger than those that use only one fuel.

Most peri-urban households in the survey area in Central Java spend a significant amount of time cooking in the morning to prepare all three meals. Lunch and dinner preparations tend to include only reheating or a small amount of new cooking. Biomass users spend about 13 minutes to 14 minutes longer cooking in the morning than do LPG users.

Almost all households boil water in the morning for drinking, and nearly two-thirds of the households boil water again in the evening; the majority use a biomass stove for this purpose.

The top four most prized stove characteristics are a capacity to (i) use less fuel, (ii) reach high heat levels and cook fast, (iii) remain durable, and (iv) ignite quickly. Meanwhile, a significant number of households are not aware of the negative health impacts of exposure to smoke from burning solid fuels.

Most households believe that LPG and electricity are very convenient but expensive.

Finally, household opinions on the price of primary cooking utensils such as pots, pans, and stoves suggest that the average household could spend slightly more on a cookstove than it does now. Nearly half (47 percent) of households indicated that they would willing to pay double for a biomass stove that would last at least two years.

6. Biomass Cookstoves: Ownership, Market Size, and Purchase Decisions

This chapter discusses the existing types of biomass stoves used and owned by households in the survey area in Central Java, the size of the cookstove market, and the decision-making process used to purchase stoves.

Types of Biomass Stoves Owned

As shown in figure 6.1, the vast majority of stoves owned and used by the surveyed households can burn wood and agricultural residue, such as coconut husks and leaves. Households that use Anglo and Apollo stoves that burn charcoal and sawdust are a small minority—only 4 percent and 2 percent, respectively. Note that most households own more than one stove, and some households own a few types of stoves.

The most popular type of stove is the traditional Keren stove. Approximately 63 percent of households in the survey area own at least one or more Keren stoves; the average is two stoves per household. The second-most popular stoves, at 31 percent, are self-built, fixed, one- and two-pot stoves made from a combination of mud and brick or brick and cement. Stoves made of stone, which can last for decades, account for 7 percent; and three- and five-stone stoves account for only 4 percent. This finding confirms that Keren stoves dominate the biomass cookstove market in Central Java. One-pot Keren stoves are the most popular—approximately 60 percent of the households own a one-pot model, and only 3 percent own a two-pot model. Stoves and fuel use are inseparable, and, as discussed in chapter 3, biomass is the preferred fuel among lower-income households.

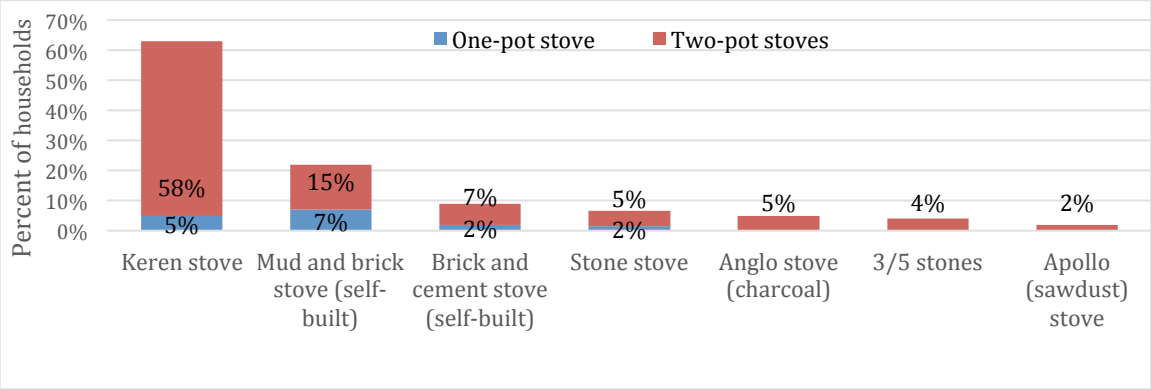
Further, households that use Keren stoves tend to be slightly poorer (with an average monthly income of Rp 2.264 million) than households that do not use Keren stoves (Rp 2.675 million). Also, cooks in households that have Keren stoves are slightly older: 47 years compared with 45 years. Household size remains the same, at an average of four members.

Among the 22 percent of households that own self-built stoves made from mud and brick, two-pot stoves account for two-thirds (15 percent) and one-pot stoves account for only one-third (7 percent). The average monthly income of households that own self-built mud-and-brick stoves is estimated to be Rp 2.140 million, compared against Rp 2.494 million for those that do not. The average age of the cooks and of household size remain the same.

Another type of self-built (fixed) stove is made from brick and cement. Though considered more durable, this stove involves the cost of cement and a need for skillful builders. Only about 9 percent of proportion of households use this type of stove.

The proportion of households that use three- and five-stone stoves is very small, at 3.5 percent (figure 6.1). The average monthly income of households that use three- and five-stone stoves is close to the income of Keren stove owners.

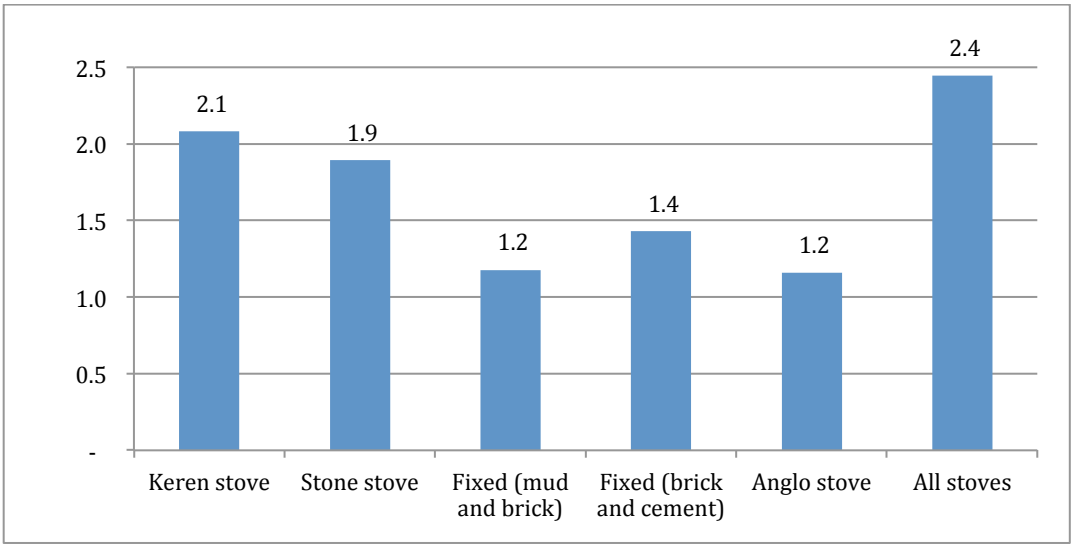
Figure 6.1 Types of Biomass Stoves Owned



Source: CSI field survey in peri-urban areas of Yogyakarta City.

Households in the survey area own at least two biomass cookstoves, and many households own two or more (patterns of ownership are shown in figure 6.2). This means that the size of the biomass cookstove market is more than double the total number of households that use biomass.

Figure 6.2 Total Number of Biomass Stoves Owned per Household



Source: CSI field survey in peri-urban areas of Yogyakarta City.

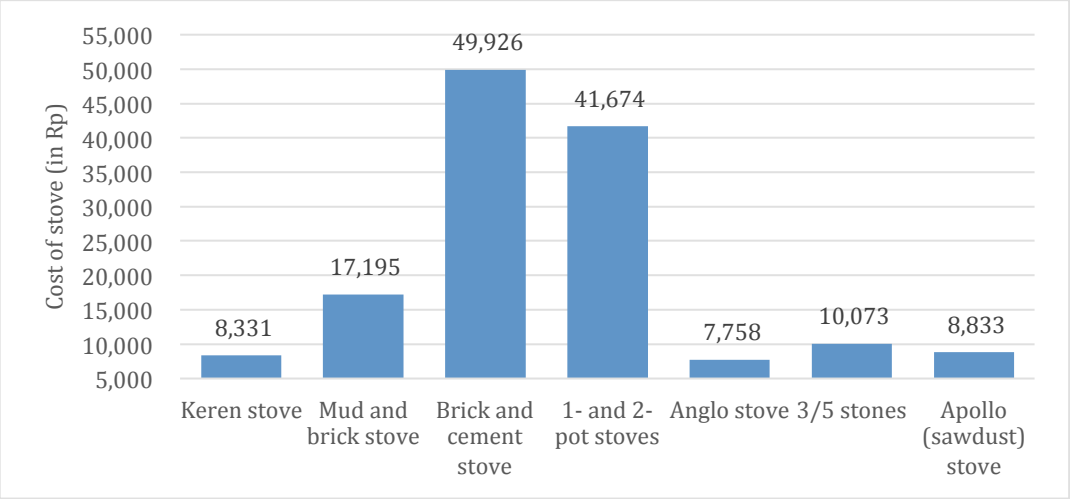
Stove Costs and Purchase Decisions

Understanding the costs of stoves and how consumers decide to purchase stoves is critical to efforts to market clean cookstoves. As shown in figure 6.3, the average cost of a biomass cookstove varies significantly by type. One- and two-pot fixed stoves made of brick and cement and stone stoves are the most expensive biomass stoves in the market—their average price ranges from Rp 42,000 to Rp 50,000. The relatively high price of these two stoves may be because of their relative durability: they can last as long as six to seven years (figure 6.4). Moreover, they require some masonry work. The second-most-expensive cookstove in the market is a fixed stove made of mud and brick, which is reported to last up to five years but usually cracks and needs constant repair. Although nearly one-third (31 percent) of

households in the survey area own these two types of fixed stoves, they are not as popular as Keren stoves, which cost only Rp 8,331 on average. But Keren stoves are not as durable as the other stoves; households reported that their previous Keren stove had lasted only one year and a few months.

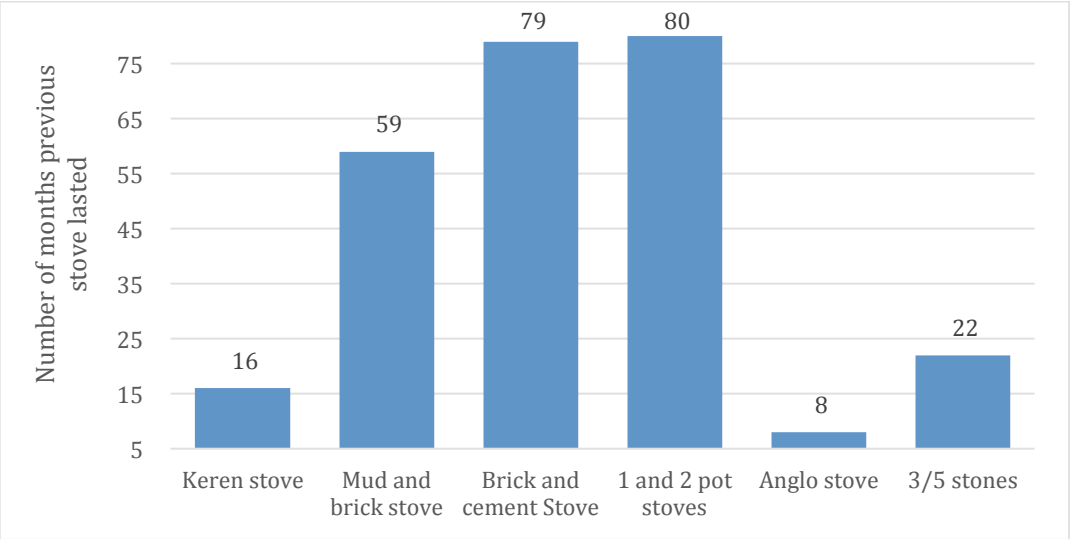
Three- and five-stone stoves, meanwhile, last up to two years and are free to those who can collect stones from public lands, rivers, or streams. But about half of the households that use such stoves must pay for these stones, bringing the average cost to Rp 10,000.

Figure 6.3 Costs of Biomass Stoves, as Reported by Users



Source: CSI field survey in peri-urban areas of Yogyakarta City.
Note: Rp = Indonesian rupiah.

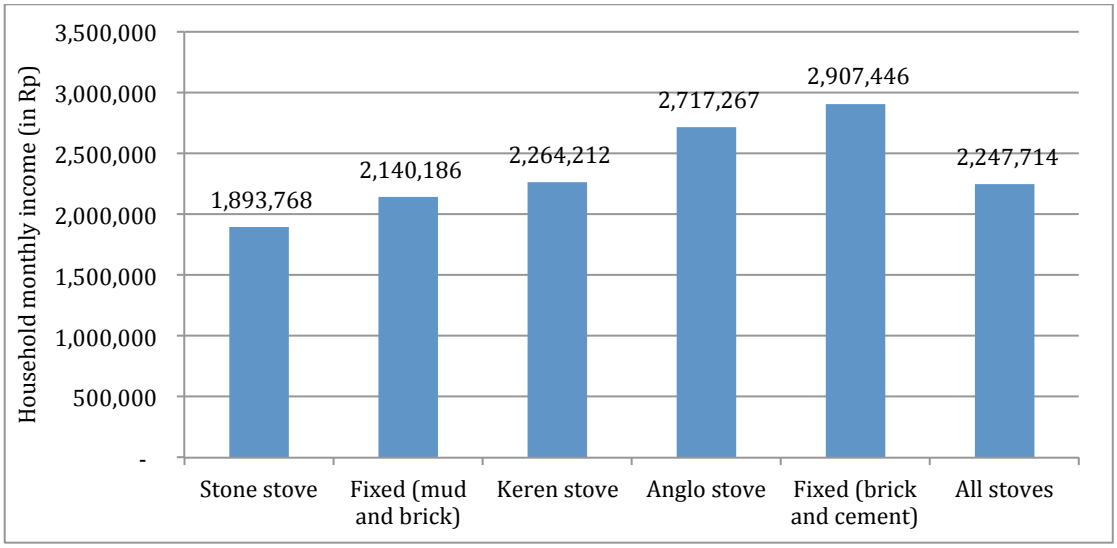
Figure 6.4 Average Lifetimes of Previous Biomass Stoves (in months), as Reported by Users



Source: CSI field survey in peri-urban areas of Yogyakarta City.
Note: The use of Anglo stoves was too low to provide a reliable result.

As would be expected, lower-cost stoves are more popular among lower-income households (figure 6.5).

Figure 6.5 Household Monthly Income, by Type of Biomass Stove Owned



Source: CSI field survey in peri-urban areas of Yogyakarta City.
Note: Rp = Indonesian rupiah.

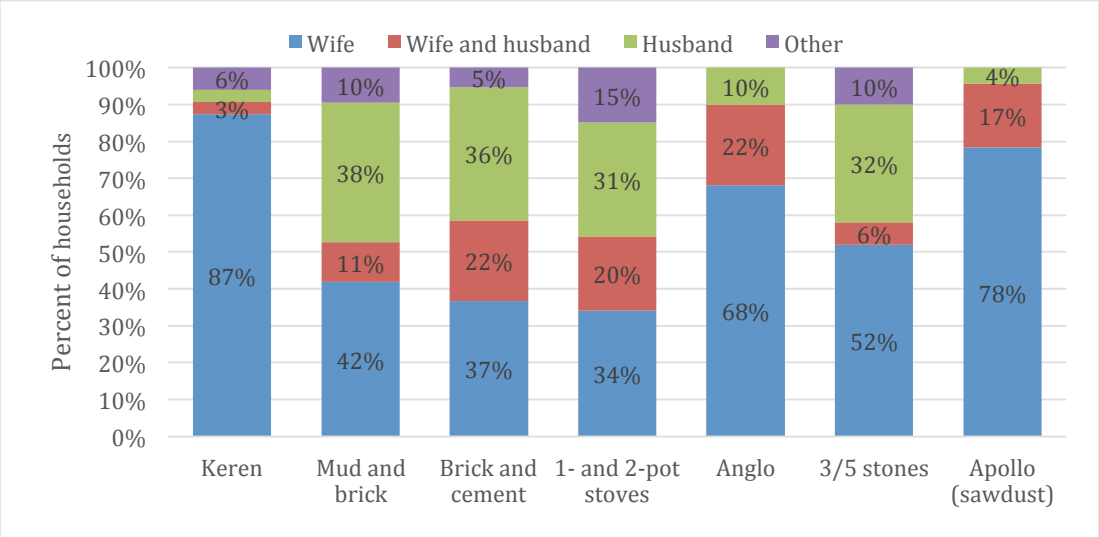
Given the existing cost of biomass cookstoves, it appears that the average household could afford to pay as much as Rp 50,000 for a new, clean cookstove. Nearly one-third of surveyed households reported paying between Rp 17,000 and Rp 50,000 for a traditional biomass stove. Even the costs of cheap stoves can add up. For example, Keren stoves—the most popular and lowest-cost biomass cookstoves currently available in the market—do not last long. If during a six-year span a household must purchase up to six stoves, this would amount to approximately Rp 50,000.

Stove Purchase Decisions

An understanding of how households decide on stove purchases helps sellers target their marketing campaigns. As shown in figure 6.6, women generally decide on stove replacements. They may do so independently for lower-cost biomass cookstoves (such as the Keren and Anglo), and in a joint decision with their husbands for high-cost stoves (such as fixed stoves made of brick and cement). Approximately 20 percent of households make a joint decision to purchase a fixed stove.

It seems that a significant proportion of men's purchase decisions are based on the physical labor involved. In approximately 38 percent and 36 percent of the households, men decided to have fixed mud and brick and brick and cement stoves installed or built (figure 6.6). Similarly, men decided to purchase or acquire stone and three- and five-stone stoves in approximately 31 percent and 32 percent of the households. Other individuals may make purchase decisions for a wedding gift. For example, a mother or mother-in-law may purchase a stove to give to a household. In particular, two-pot stone stoves and mortar and pestles made from stone are considered important traditional cooking appliances in Java Island and are usually given as gifts to young couples.

Figure 6.6 Household Roles in Stove Purchase Decisions



Source: CSI field survey in peri-urban areas of Yogyakarta City.
Note: The use of Anglo stoves was too low to provide a reliable result.

Home Appliance Purchase Decisions

To garner additional information possibly relevant to the purchase of clean cookstoves, the survey asked households how they decided on the purchase of small home appliances that cost between Rp 50,000 and Rp 200,000, and their willingness to purchase home appliances using credit. Most often women decide on small home appliances that cost less than Rp 50,000. As the price of the appliance increases—or as household income decreases—joint decisions are more likely to be required (figure 6.7).

In sum, these findings confirm that women in the survey area are an important target for the promotion of new, clean cookstoves. But it is important not to ignore the men, who make joint decisions with women on the purchase of more expensive appliances.

Regarding the use of credit, the survey reveals that households in the survey area are financially conservative and reluctant to create debts for the family. Joint decisions are required in the majority of cases, ranging from 78 percent to 85 percent among households in the second through the fifth income quintiles (figure 6.10).

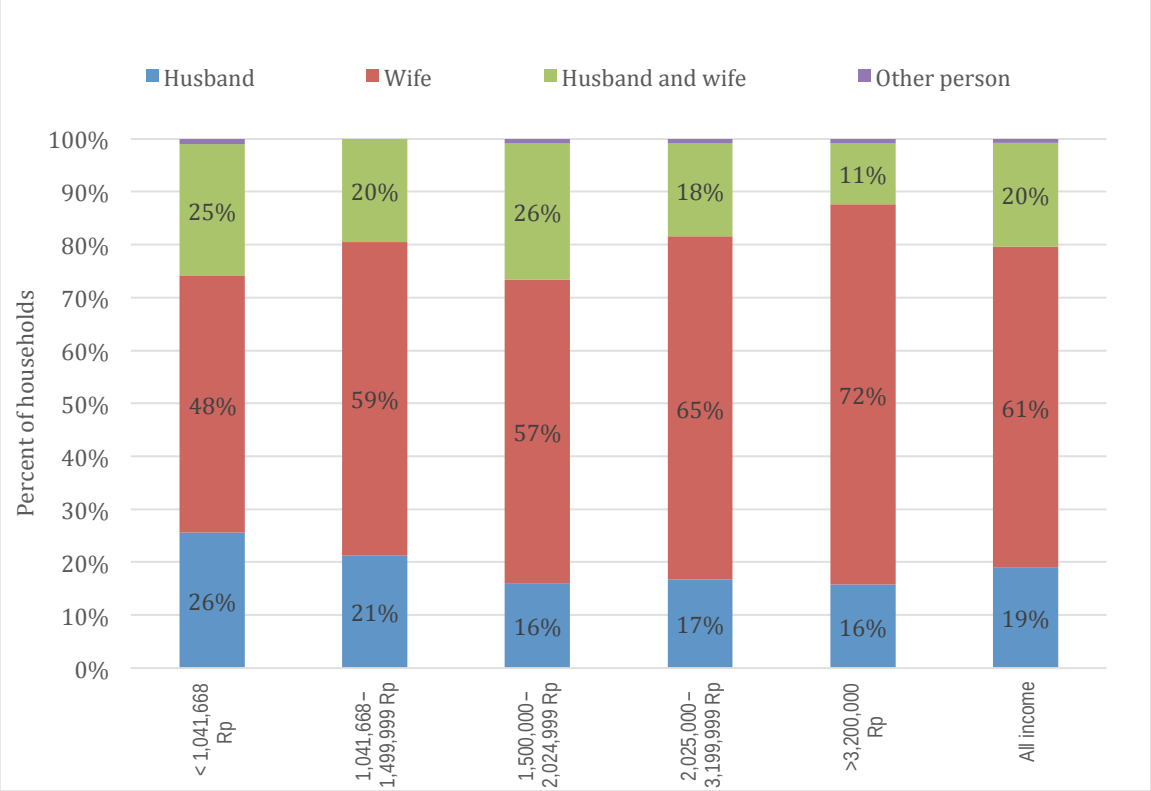
Conclusion

Surveyed biomass users own two or more biomass stoves at home. These stoves may be of the same or of different types. The most popular are the traditional Keren stoves, owned by 63 percent of households. The second-most-popular stoves, at 31 percent, are self-built, fixed, one- and two-pot stoves made from a combination of mud and brick or brick and cement. Stone stoves rank third.

The average price of a biomass cookstove varies significantly by type. One- and two-pot fixed stoves made of brick and cement and stone stoves are the most expensive. The relatively high price of these two stoves may be because of their durability—they can last as long as six to seven years. As might be expected, lower-cost stoves, such as Keren stoves, are more popular among lower-income households.

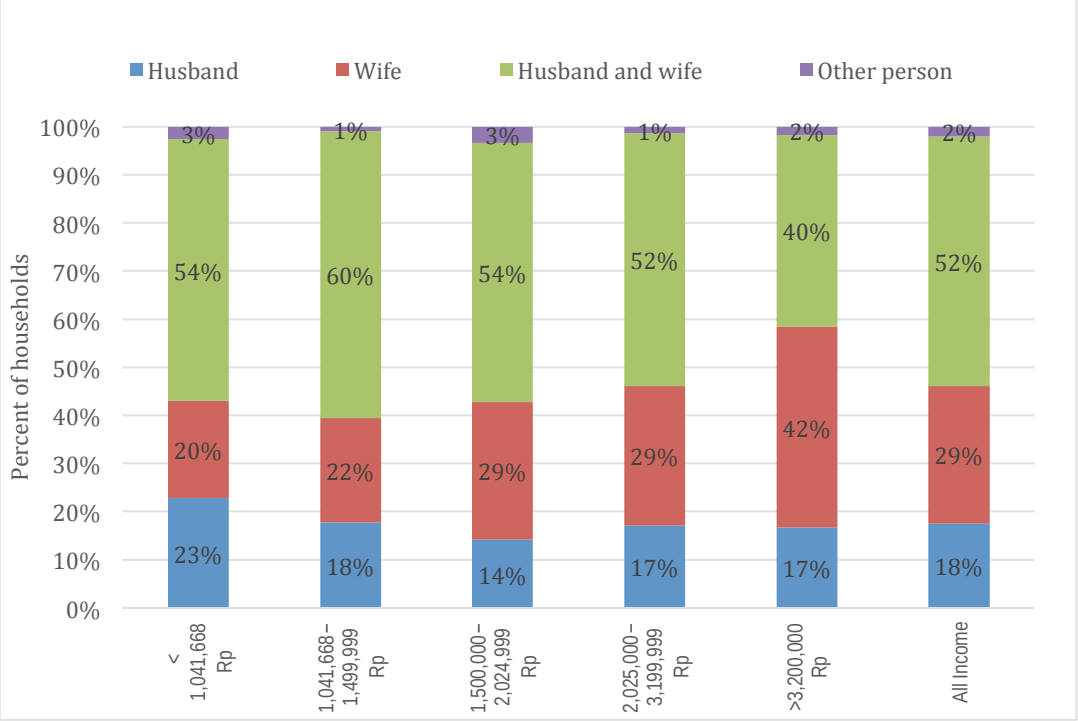
Lower-cost stoves may also be decided on solely by the women in a household. To purchase a more expensive stove, a woman must consult and make a joint decision with their husband. This reflects the decision-making process used for small home appliances. That is, women may independently decide to buy small home appliances that cost less than Rp 50,000. The higher the cost, the more likely a joint decision will be required. Buying an appliance on credit requires a joint decision in the majority of cases, indicating that most households in the survey area are financially conservative and reluctant to create debts for the family.

Figure 6.7 Gender Roles in Decisions to Purchase Small Home Appliances Costing Less Than Rp 50,000, by Monthly Household Income Quintile



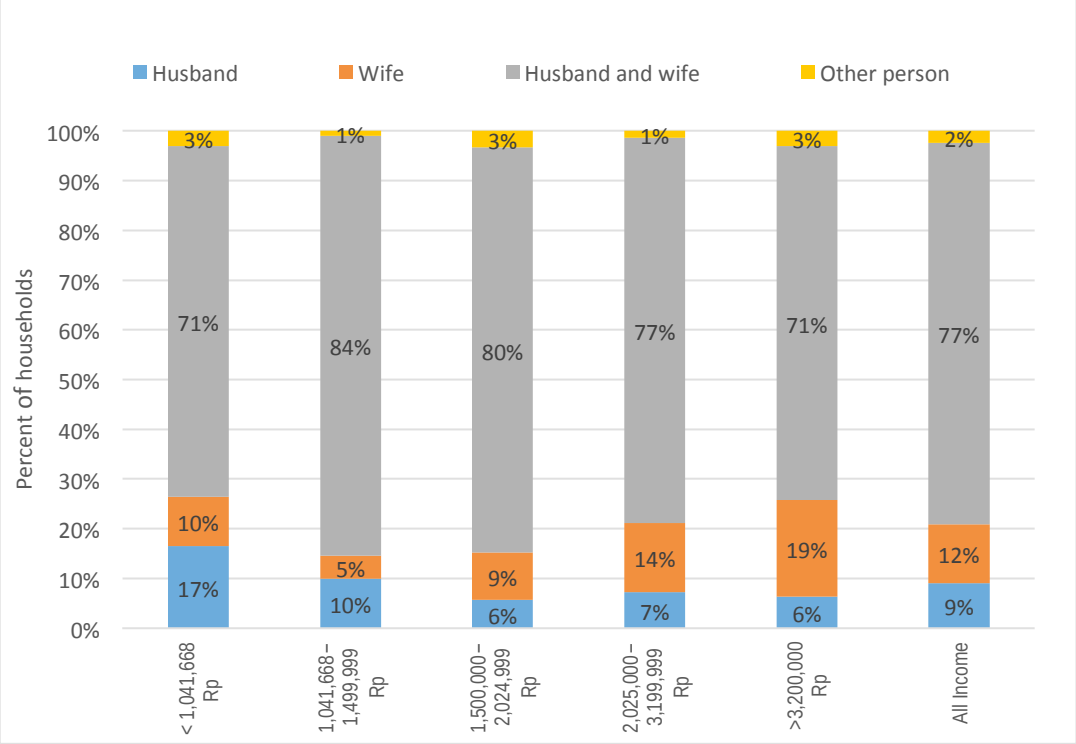
Source: CSI field survey in peri-urban areas of Yogyakarta City.
Note: Rp = Indonesian rupiah.

Figure 6.8 Gender Roles in Decisions to Purchase Small Appliances Costing between Rp 50,000 and Rp 200,000, by Monthly Household Income Quintile



Source: CSI field survey in peri-urban areas of Yogyakarta City.
Note: Rp = Indonesian rupiah.

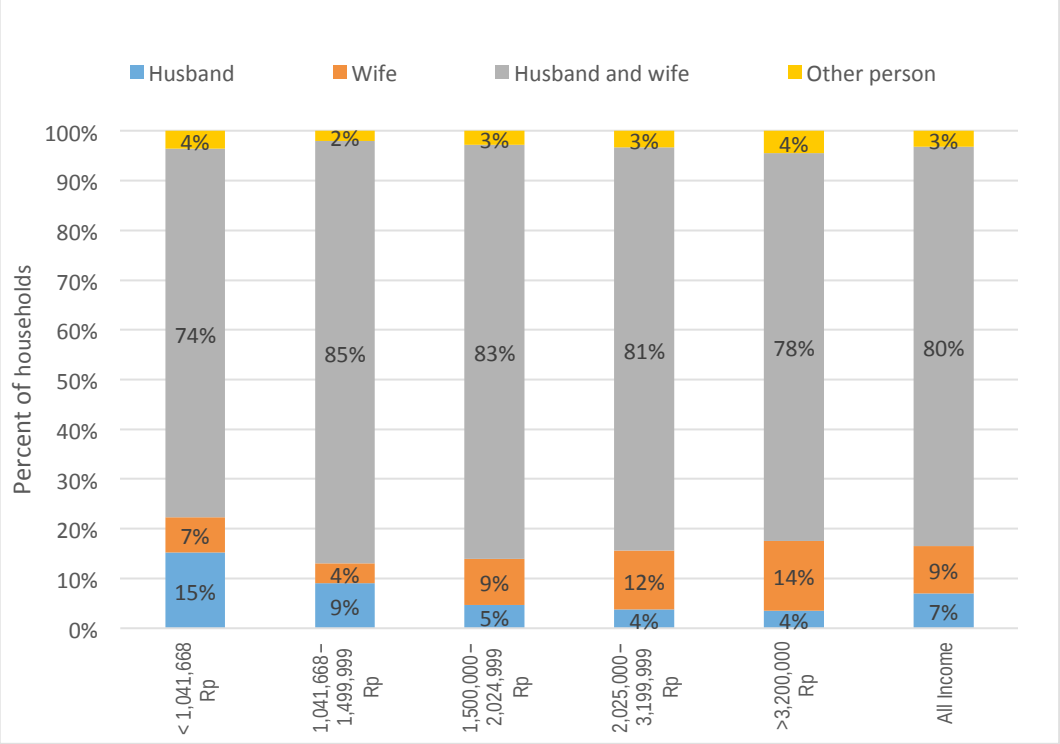
Figure 6.9 Gender Roles in Decisions to Purchase Small Appliances Costing More Than Rp 200,000, , by Monthly Household Income Quintile



Source: CSI field survey in peri-urban areas of Yogyakarta City.

Note: Rp = Indonesian rupiah.

Figure 6.10 Gender Roles in Decisions to Purchase Small Appliances Using Credit, by Monthly Household Income Quintile



Source: CSI field survey in peri-urban areas of Yogyakarta City.
Note: Rp = Indonesian rupiah.