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Clean Cooking and the Rice Cooker Programme: An Evaluation and Policy Perspective

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Abstract

Clean cooking is a critical agenda for enhancing access to clean energy in developing nations. In 2023–2024, the Indonesian government implemented a programme to distribute free rice cookers to underprivileged communities, yet this initiative has not previously been evaluated. This study addresses that gap by examining the impact of the rice cooker distribution on household energy consumption and LPG dependency. While several studies have assessed clean cooking programmes—such as biogas, induction, solar-powered stoves, and electric pressure cookers—this research is among the first to evaluate a rice cooker programme in a large-scale field setting, thereby offering novel insights and contributing to the literature on the clean energy transition. A Slovin sampling strategy selected 600 respondents from among 342,621 households across 36 provinces with a margin of error of approximately 4.1%. Primary data were analysed using descriptive statistics, including frequency distributions and cross-tabulations, alongside inferential methods such as ordered logistic regression to investigate the determinants of satisfaction of this program and also t-tests to compare electricity consumption and LPG usage before and after receiving the rice cooker. In addition, secondary data comprising 5,814,476 records on monthly electricity consumption from January 2023 to May 2024 were utilised. Our evaluation reveals that the free rice cooker programme has led to a significant increase in per capita electricity consumption and a corresponding reduction in LPG consumption and subsidies. Although household electricity bills have risen, most respondents report that the efficiency and convenience of the rice cooker offset these additional costs. These findings support the further expansion and continual evaluation of such clean cooking initiatives, enhancing energy resilience in Indonesia and other developing countries.

Keywords:
clean cooking, energy consumption, LPG subsidy reduction, rice cooker programme

1. Introduction

Electric cooking appliances are technologies that can contribute significantly to achieving the Sustainable Development Goals (SDGs) (Rosati & Faria, 2019). For example, the use of rice cookers supports SDG 1—aimed at eradicating poverty—by reducing economic burdens. In this context, highly efficient electric cooking appliances can lower household expenditures on cooking fuels, thereby aiding in poverty alleviation. Compared with microwave ovens and pressure cookers, electric appliances such as rice cookers are more energy efficient for cooking rice (Murray et al., 2018). Consequently, the use of rice cookers aligns with SDG 13, which focuses on climate action and the reduction of carbon emissions (Daioglou et al., 2012).

Furthermore, the use of electric cooking appliances also supports SDG 3, which promotes good health and well-being, while simultaneously addressing deforestation issues associated with traditional cooking methods (Akpalu et al., 2011; Batchelor et al., 2019). The shift from liquefied petroleum gas (LPG) or biomass to electric cooking appliances is expected to reduce the emissions of smoke and harmful particulate matter that are often generated by the combustion of LPG or wood. In addition to environmental benefits, electric cooking appliances play a crucial role in enhancing the nutritional quality of food. For instance, cooking rice in a rice cooker can help preserve higher levels of phenolic compounds and antioxidants than other cooking methods (Fracassetti et al., 2020). Moreover, electric cooking tends to maintain nutritional content, particularly proteins and zinc, more effectively than alternative methods (Stephanie & Widowati, 2022). By reducing the workload on women—a task traditionally associated with time-consuming and strenuous cooking using conventional stoves—these appliances support SDG 5 on gender equality. More efficient electric cooking not only minimises the time and energy spent on meal preparation but also affords women additional time for education, work, or other activities.

However, not all communities—especially in developing countries—have access to rice cookers. Countries such as Nepal, Tanzania, Bangladesh, and Uganda have endeavoured to reform their cooking energy policies by actively promoting the use of more environmentally friendly electric stoves (Clements et al., 2020; Kafle et al., 2019). In Indonesia, a government programme has been implemented to distribute free rice cookers to poor households, with 342,621 units distributed in 2023 and 127,628 units in 2024. This initiative is fully aligned with SDG 7, which seeks to ensure universal access to modern, clean, and affordable energy – including electricity for cooking purposes (Poblete-Cazenave et al., 2021).

There is a substantial body of research on rice cooker policies and programmes spanning technological, social, and policy perspectives. From a social and policy perspective, Cang (2022) has reviewed the evolution of rice cooker adoption and technology in Japan, tracing its roots back to the prewar era when rice cookers became essential not only for cooking rice but also for preparing soups, bread, pasta, and other foods. Similar studies have been conducted in Taiwan (Wang, 2013). Moreover, a survey of 69 households in Nepal indicated that the adoption of rice cookers positively affected women's conditions and even encouraged men to participate in cooking, compared with households that do not own a rice cooker (Matinga et al., 2019). Additionally, Huh et al. (2019) analysed the impact of rebate programmes on technology selection in the rice cooker market in South Korea.

To date, no study has thoroughly evaluated the effectiveness and impact of the free rice cooker distribution programme in Indonesia. This study thus seeks to fill that gap in the literature. Research on rice cookers in Indonesia remains limited primarily to investigations of cooking practices and surveys examining perceptions of switching to electric cooking appliances such as rice cookers (Atmowidjojo et al., 2022). Other studies have compared the benefits and costs of rice cookers with those of induction stoves and LPG-fuelled stoves (Al Irsyad et al., 2022; Anggono et al., 2022). There is increasing evidence that the widespread use of electric cooking appliances holds the potential to reduce dependence on LPG (Saha et al., 2021) and to lower LPG demand (Kizilcec et al., 2022). Moreover, broad adoption of these appliances is likely to drive up electricity demand, thereby spurring investment in the development of generation and distribution infrastructure (Sánchez-Jacob et al., 2021). Therefore,

the primary objective of this study is to assess the utilisation patterns of the distributed rice cookers and to estimate the programme's impact on per capita electricity consumption, as well as its effect on reducing LPG consumption and subsidies.

2. Methods and Materials

The study employed a combined sampling technique involving both simple random sampling and stratified random sampling. In total, there were 342,621 households that received the rice cooker across 36 provinces in 2023. Village-level samples were selected at random to adequately represent the provinces where the rice cooker distribution programme had previously been implemented. Within each selected village, households receiving the rice cooker were proportionately sampled according to their power connection category (i.e., 450 VA, 900 VA, and 1300 VA) through a stratified approach. The sample size was determined using Slovin's formula (Equation 1) in which *n* represents the number of rice cooker recipient samples, *N* is the total population of rice cooker recipients, and *e* is the margin of error (fixed at 4%). An initial margin of error set at 4% yielded a sample size of 623.95. However, due to resource limitations, this figure was rounded to 600 respondents, resulting in an adjusted margin of error of 4.1%. The 600 respondents were surveyed through face-to-face interviews using a paper-based questionnaire, administered by 20 trained enumerators during the period from June to July 2024 across 36 provinces (see Table 1).

$$n = \frac{N}{1 + N(e)^2} \tag{1}$$

Primary data analysis comprises both descriptive and inferential statistical techniques. Descriptive statistics are used to portray the characteristics of the survey data by quantifying and summarising the information collected from rice cooker recipients. In this study, two main descriptive techniques were applied: frequency distribution and cross-tabulation. Frequency distribution is used to demonstrate how the data are spread across specific categories or intervals, typically presented in the form of tables or diagrams (e.g., histograms or bar charts). Frequency tables display both the count and percentage of respondents within each category. Conversely, cross-tabulation is a method used to examine the relationship between two or more categorical variables. In this context, it is employed to investigate how one measured variable among rice cooker recipients relates to other factors—such as levels of electricity consumption, LPG usage, and additional variables. This cross-tabulation is constructed as a matrix with rows and columns representing different variable categories, thereby highlighting the interactions among them. Descriptive analysis further includes the calculation of the mean, as well as the maximum and minimum values of the analysed variables.

We also conducted inferential statistical analyses to evaluate the impact of the free rice cooker programme on household electricity consumption and LPG usage. Two principal inferential methods were applied: difference tests and regression analysis. Difference tests, which compare two or more groups for significant differences, typically use the t-test (for two samples) and ANOVA (Analysis of Variance) for more than two groups. In this case, the t-test (Equation 2) was used to compare electricity consumption before and after the rice cooker programme was implemented. $\bar{X}_1$ and $\bar{X}_2$ denote the mean values of the two groups that were referred to before and after the rice cooker programme was implemented; s_1^2 and s_2^2 represent the variances of each group; and n_1 and n_2 are the respective sample sizes.

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \tag{2}$$

Furthermore, Equation 3 was employed in an ordered logistic regression analysis to estimate the determinants of rice cooker quality as perceived by recipients. In this model, *Y* is the dependent variable

namely the level of quality satisfaction of the rice cookers; α is the intercept; β_1, β_2, β_3 are the regression coefficient estimates for each independent variable X_1, X_2, X_3 resprectively the ease of use, the ease of cleaning, and the safety of use; and ϵ represents the error term. Both the independent and dependent variables utilise a 5-point Likert scale, ranging from 1 ("very dissatisfied") to 5 ("very satisfied").

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \epsilon \quad (3)$$

Table 1. A breakdown of the rice cooker recipients and respondents across each province.

No	Province	Recipients (people)	Respondent (people)
1	Aceh	8,527	15
2	Sumatera Utara	28,288	38
3	Sumatera Barat	2,815	9
4	Riau	3,112	9
5	Bengkulu	1,490	7
6	Jambi	1,134	7
7	Sumatera Selatan	7,873	15
8	Kepulauan Riau	925	7
9	Lampung	1,970	8
10	Bangka Belitung	4,906	11
11	Jakarta	4,578	11
12	Banten	14,704	23
13	Jawa Barat	43,109	56
14	Jawa Tengah	43,286	56
15	DIY	6,435	13
16	Jawa Timur	79,461	98
17	Bali	1,317	7
18	NTB	3,731	10
19	NTT	3,728	10
20	Kalimantan Barat	21,379	30
21	Kalimantan Tengah	9,153	16
22	Kalimantan Selatan	236	6
23	Kalimantan Utara	2,164	8
24	Kalimantan Timur	2,375	9
25	Sulawesi Barat	3,863	10
26	Sulawesi Tengah	2,408	8
27	Sulawesi Selatan	15,873	24
28	Sulawesi Tenggara	6,127	13
29	Gorontalo	5,468	12
30	Sulawesi Utara	2,909	9
31	Maluku Utara	2,670	9
32	Maluku	2,970	9
33	Papua Barat	30	6
34	Papua Barat Daya	1,657	7
35	Papua Tengah	1,784	8
36	Papua	166	6
Total		**342,621**	**600**

The survey findings are subsequently enriched by an analysis of secondary data obtained from Perusahaan Listrik Negara (PLN – the State Electricity Company of Indonesia), which consists of electricity consumption records from 342,621 households that received rice cookers under the programme, covering the period from January 2023 to May 2024. The total dataset comprises 5,814,476 records, encompassing detailed information on the monthly electricity consumption of households, installed electricity capacity, as well as the administrative regions in which they reside, including

villages, sub-districts, cities/districts, and provinces. This secondary data is used to examine the impact of the rice cooker programme on changes in electricity consumption and the reduction of LPG usage, while also serving to validate and complement the findings from the primary survey to enhance the robustness of the analysis.

3. Results and Discussions

In Table 2, most respondents who received a rice cooker came from households with lower-middle income brackets. Approximately 46.50% of respondents earn between USD60 to USD182 per month. Furthermore, 39.83% of respondents reported earning less than USD60 per month, with most living below the poverty line, indicating that the rice cooker programme has effectively reached lower-income segments. Additionally, 12.17% of respondents have a monthly income between USD182 to USD303, while only 1.50% earn more than USD303 per month. These data suggest that the rice cooker programme effectively targets those most in need, thereby yielding a positive impact on the economic welfare of lower-middle-income households.

Table 2. Income categories of rice cooker recipients.

Monthly Income Category	Frequency	Percentage
Less than USD60	239	39.83%
USD60–USD182	279	46.50%
USD182–USD303	73	12.17%
Over USD303	9	1.50%
Total	600	100.00%

Exchange rate: 1USD = IDR16,515

3.1 Utilisation Patterns of the Distributed Rice Cookers

Figure 1 demonstrates that the majority of respondents (87.41%) consider the rice cooker extremely easy to use for everyday cooking. Moreover, 75.54% of respondents reported that the rice cooker speeds up the cooking process at home, meaning it saves time, a feature particularly beneficial for households with busy schedules. Regarding quality, 30.4% of respondents rated the rice cooker as "good," while 65.65% rated it as "very good." These positive evaluations underscore that the provided rice cookers are of reliable quality. In addition, 71.04% of respondents felt that the features offered by the rice cooker are more than adequate for daily cooking needs, with another 25.64% considering them adequate. This indicates that the available features have largely met users' requirements. Furthermore, 78.42% of respondents felt very safe when using the rice cooker every day, and 20.32% reported feeling safe, which confirms that the appliance is designed to high safety standards. A high level of satisfaction is also reflected in user recommendations: 58.27% of respondents are very likely to recommend the rice cooker to friends and family, while a further 30.22% would recommend it. Across various islands, most rice cooker recipients expressed that the quality of the distributed rice cookers is very good, with 65.65% providing this rating.

The results presented in Table 3 predict the level of satisfaction with the quality of the rice cookers among recipients using an ordered logistic regression model. This regression used independent variables comprising ease of use (X_1), ease of cleaning (X_2), and safety of use (X_3). An LR chi^2(3) value of 106.37 with a probability (Prob > chi^2) of 0.0000 indicates that the ordinal regression model is statistically significant at the 95% confidence level. This result suggests that the independent variables collectively have a significant impact on the recipients' perceptions of rice cooker quality.

Each independent variable shows a P-value (P > |z|) smaller than 0.05, implying that the null hypothesis (that there is no effect) is rejected for each factor, and the alternative hypothesis is accepted. Safety of use (X_3) exhibits the strongest influence on the perception of rice cooker quality. This finding is reasonable given that safety is a critical aspect for electrical appliances; users tend to feel more satisfied

and assign higher quality ratings when an appliance is safe to use. Ease of cleaning (X_2) also has a significant impact, as users are more likely to rate the quality positively if the device is easy to clean—thereby reducing the maintenance effort and time required on a daily basis. Although ease of use (X_1) is also significant, its influence is comparatively lower than the other two variables. This suggests that while ease of use remains important, users tend to prioritise safety and ease of cleaning when evaluating the quality of the rice cooker.

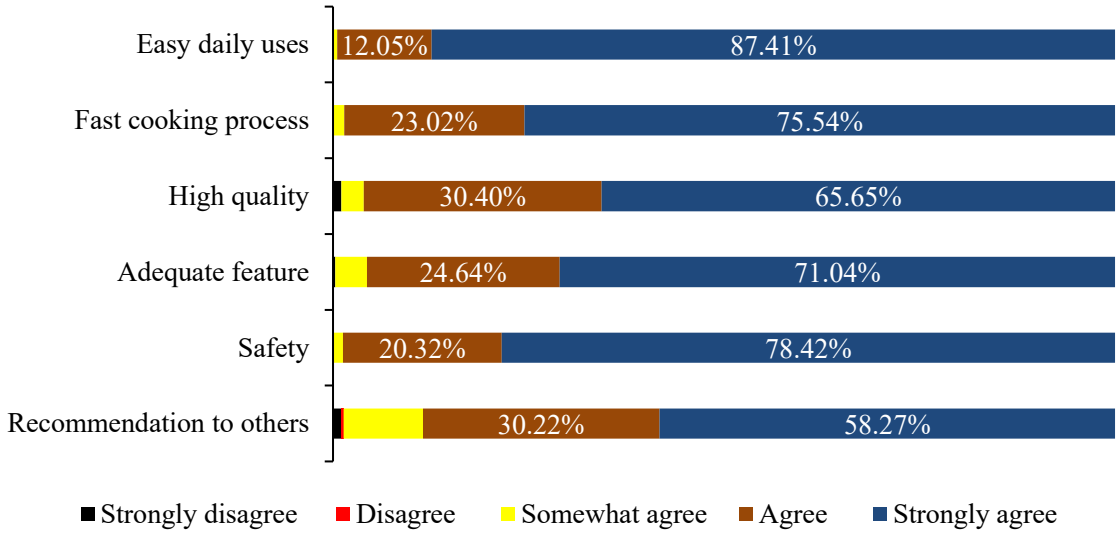


Figure 1. Respondents' evaluations on the utilisation of rice cookers.

Table 3. Ordered logistic regression results for determinants of rice cooker quality as perceived by recipients.

		LR chi² (3) =		106.37
		Prob > chi² =		0.0000
Log likelihood = -386,5067		Pseudo R² =		0.1210
Variable	Coefficient	Standard Error	z	P> |z|
Ease of use (X1)	0.5378	0.2613	2.06	0.040
Ease of cleaning (X2)	0.8903	0.2214	4.02	0.000
Safety of use (X3)	1.1057	0.2097	5.27	0.000
/cut1	7.1342	1.3504		
/cut2	8.3730	1.3186		
/cut3	11.3606	1.3742		

3.2 Impact on per Capita Electricity Consumption

Approximately 69.6% of respondents use the rice cooker for both cooking and warming rice. The dual functionality of the rice cooker is the primary requirement for most users. Specifically, 28.42% of respondents use the rice cooker solely for cooking rice, while 1.62% employ it only for warming rice. A further 0.36% use the rice cooker for other purposes. Additionally, around 55.04% of respondents use the rice cooker for more than three hours per day, indicating intensive use. Meanwhile, 26.98% use it for less than one hour per day—possibly for quick meal preparation or food warming—whereas 17.99% use it between one and two hours per day, which may suggest moderate use for preparing main meals. The amount of rice cooked with the rice cooker ranges from 0.147 kg to 4 kg daily, with an average of approximately 1 kg per day.

On average, respondents across all regions experienced an increase in their monthly electricity expenditure after receiving the rice cooker. Those in the Nusa Tenggara, Maluku, and Papua (Nusmap)

regions saw the largest increase, at approximately USD1.20 per month, while respondents in the Java-Bali area recorded the smallest rise of USD0.79 per month. Overall, the average monthly electricity bill increased from USD7.37 before the programme to USD8.31 afterwards. However, this increase in electricity bills does not seem to concern the respondents. Only about 23.74% reported checking their electricity meter more frequently after acquiring the rice cooker, while approximately 66% felt that the rice cooker's use did not noticeably burden their electricity bill. Moreover, about 50% of respondents believed that the increase in the electricity bill was very commensurate with the benefits they received from using the rice cooker, 30.22% felt it was commensurate, and 17.99% considered it somewhat commensurate. A mere 0.09% regarded the increase in their electricity bill as not commensurate or very unbalanced compared to the benefits obtained. Additionally, around 86.87% of respondents reported that using the rice cooker did not cause the mini circuit breaker (MCB) in their homes to trip, whereas 13.13% did experience tripping of the MCB.

Table 4 presents the outcomes of a paired sample t-test on 600 rice cooker recipients. The results indicate a significant difference between the average monthly electricity bills before and after rice cooker usage. Prior to using the rice cooker, the average electricity bill was USD7.37 per month, which increased to USD8.31 per month after its adoption. With a t value of –11.3543 and a probability (α) of 0.0000 ($p < 0.05$), the null hypothesis is rejected in favour of the alternative hypothesis. This means that the rice cooker programme has a significant impact on increasing electricity consumption. The average difference of USD0.94 indicates a substantial increase in electricity consumption once households began using the rice cooker.

Table 4. Differences in monthly electricity bills before and after the use of the rice cooker.

Variable	Mean	Standard Error	Standard Deviation
Monthly electricity bill before receiving the rice cooker	121,708.60	4,497.86	106,057.90
Monthly electricity bill after receiving the rice cooker	137,156.50	4,871.71	114,873.30
Difference	-15,447.84	1,360.53	32,080.80
Mean (diff) = Mean (Before – After) Ho: mean (diff) = 0 Ha: mean (diff) ≠ 0 Pr (|T| > |t|) = 0.0000		t =	-11.35

The box plot in Figure 2 reinforces the paired sample t-test findings. The distribution of electricity bills before rice cooker use (depicted in blue) is noticeably lower than that after its use (shown in red). The higher median and interquartile range in the red box plot indicate that both the average and the spread of electricity bills have increased following the adoption of the rice cooker. This visualisation clearly illustrates the rise in electricity consumption among the majority of households, as evidenced by the shift of the distribution towards higher bill amounts after the rice cooker distribution programme.

Based on the statistical analysis and the visual interpretation provided by the box plot, it can be concluded that during the period of the rice cooker distribution programme, there was a significant increase in electricity consumption. This is reflected by the rise in the average monthly electricity bill after the adoption of the rice cooker compared to prior use. The increase is statistically significant, indicating that the programme successfully stimulated higher electricity consumption.

Figure 3 illustrates the average electricity consumption of recipients of the rice cooker programme, disaggregated by their installed capacity. Prior to receiving the rice cooker in March, the overall average consumption among all recipients ranged from 99.62 to 108.99 kWh. After receiving the rice cooker, average consumption increased to between 110.89 and 115.85 kWh. When examined by installed capacity, households with a 450 VA connection consumed, on average, between 86.68 and 96.73 kWh per month before the programme; following the intervention, this rose to between 94.94 and

101.23 kWh. For households with a 900 VA connection, average consumption increased from approximately 100.18–114.49 kWh before the rice cooker was received to between 114.3 and 119.26 kWh thereafter. Among recipients with a 1,300 VA connection, average consumption ranged from 148.81 to 171.36 kWh before the programme and increased to between 168.52 and 175.08 kWh after receiving the rice cooker. In summary, the rice cooker programme resulted in a general increase in electricity consumption among its beneficiaries.

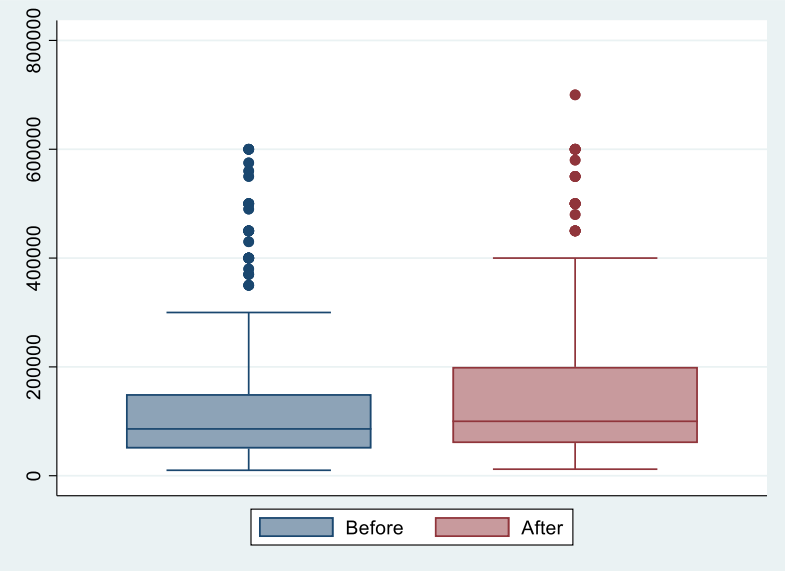


Figure 2. Box plot of monthly electricity bills before and after rice cooker use.

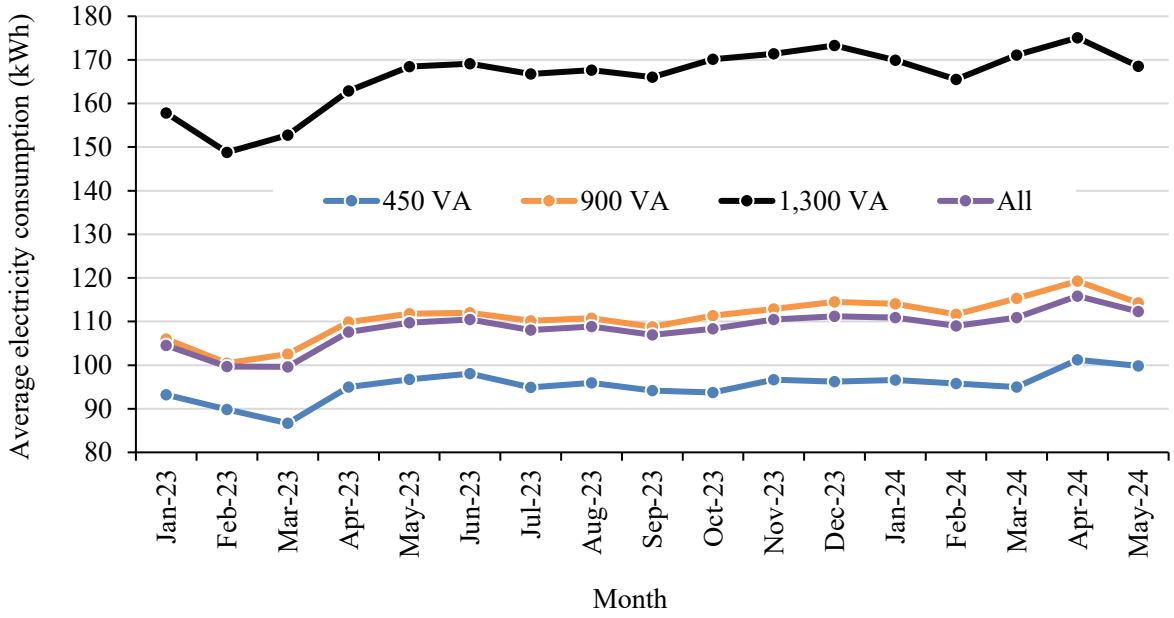


Figure 3. Average electricity consumption of household recipients in the rice cooker programme.

3.3 Impacts on LPG Consumption and Subsidies

Approximately 44.49% of respondents reported a decrease in their spending on 3-kg LPG after using the rice cooker. Before the rice cooker program, many respondents consumed a 3-kg LPG cylinder in less than one week. Following the program, there was a significant reduction in this category, indicating that the rice cooker has diminished the frequency of LPG usage. Moreover, the usage category that

previously spanned 1–2 weeks shifted to a longer duration, such as 3–4 weeks, suggesting a reduced overall dependency on LPG.

Figure 4a illustrates that after the rice cooker programme, the average monthly usage of 3-kg LPG cylinders decreased significantly across several regions. The largest decrease occurred in the Nusmap region with a reduction of 1.82 kg, followed by Java-Bali with a reduction of 1.48 kg, and Sumatra with a reduction of 1.12 kg. The Kalimantan and Sulawesi regions also experienced reductions, albeit smaller, at 0.92 kg and 0.84 kg respectively. Overall, the average LPG usage decreased by 1.23 kg across all regions.

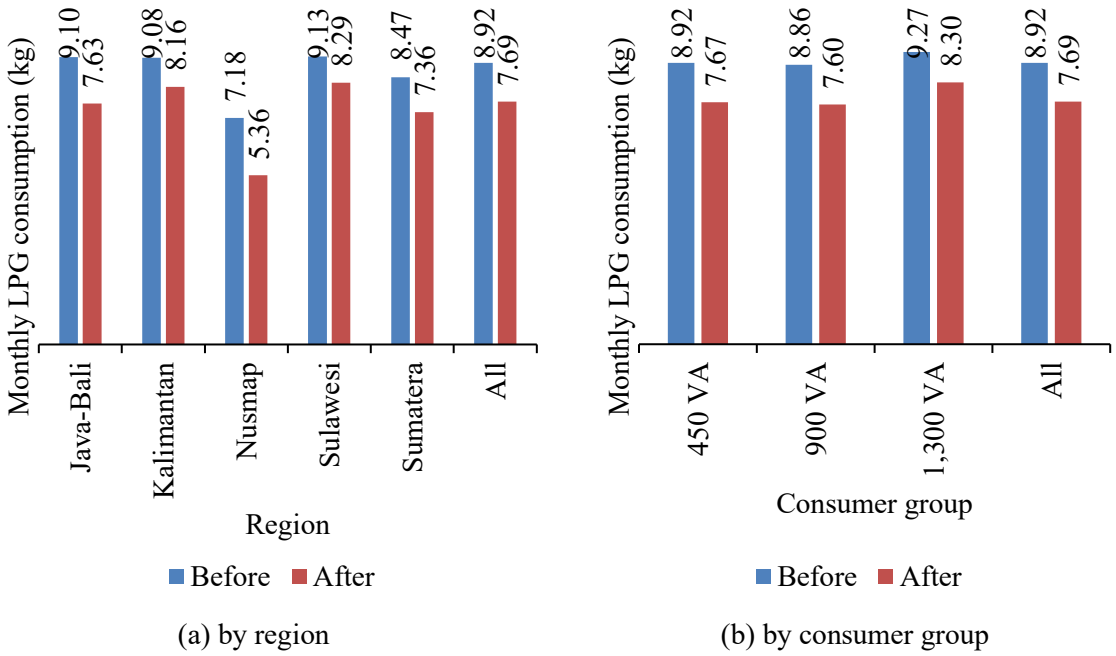


Figure 4. Average monthly usage of 3-kg LPG cylinders (kg) before and after the rice cooker programme.

In Figure 4b, following the rice cooker programme, the average monthly usage of 3-kg LPG cylinders decreased across different electricity tariff groups. For the 450 VA group, the reduction was 1.24 kg—from 8.92 kg to 7.67 kg per month. The 900 VA group recorded the most significant reduction, decreasing by 1.26 kg from 8.86 kg to 7.60 kg per month, while the 1300 VA group experienced a reduction of 0.98 kg, from 9.27 kg to 8.30 kg per month. Overall, the average reduction across all tariff groups was 1.23 kg per month after receiving the rice cooker programme. Consequently, about 58.72% of respondents stated that using the rice cooker lessened the frequency of purchasing 3-kg LPG cylinders. Most respondents rated the rice cooker as very helpful (39.48%), fairly helpful (32.67%), or helpful (22.67%), totalling more than 90%. This suggests that the rice cooker is perceived as highly effective in reducing overall household energy costs. Only a small proportion of respondents found it unhelpful (4.21%) or very unhelpful (1%).

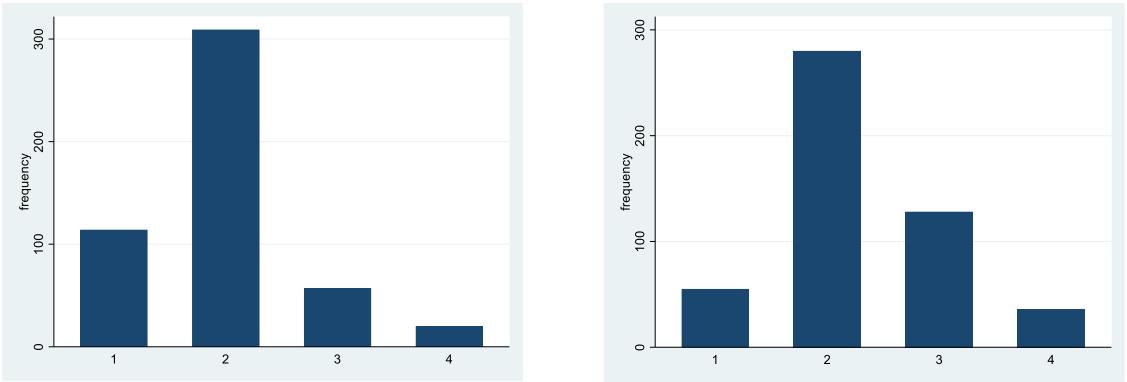
We employed the Wilcoxon Signed Rank Test to assess the impact of the rice cooker programme on reducing LPG subsidies among 600 rice cooker recipients, as presented in Table 5. This analysis compared the duration for which a 3-kg LPG cylinder was used before and after receiving the rice cooker. The results demonstrate that after receiving the rice cooker, respondents tended to use LPG less frequently—or, in other words, a cylinder lasted longer—compared with before the intervention. Specifically, 169 observations exhibited an increased duration of LPG usage (negative ranks), compared with only 13 observations showing a decreased duration (positive ranks). A Z-score of –11.569 and a very low p-value (0.0000) indicate a significant difference between the durations of LPG usage pre- and post-intervention. These findings suggest that the rice cooker programme has a significant impact

on reducing LPG consumption in households. The extended duration of LPG usage after receiving the rice cooker implies that households have reduced their dependence on LPG, potentially decreasing the necessity for LPG subsidies by the government.

The histogram in Figure 5 reinforces these findings by showing the positive effect of the rice cooker programme on LPG usage. There are notably fewer instances in the first (usage duration < 1 week) and second (usage duration 1–2 weeks) categories, with corresponding increases in the third (usage duration 3–4 weeks) and fourth (usage duration 1–2 months) categories. The shift in the distribution towards a longer LPG usage duration following the rice cooker programme indicates that households are extending the life of their LPG cylinders. In effect, rice cooker recipients are able to conserve LPG and prolong its usage, thereby supporting the conclusion that the programme is effective in reducing LPG consumption and, consequently, the need for LPG subsidies.

Table 5. Results of the Wilcoxon signed rank test on the duration of 3-kg LPG usage before and after receiving the rice cooker.

Sign	Sum Ranks	Expected
Positive	5,265	37,173.5
Negative	69,082	37,173.5
Zero	50,403	50,403.0
All	124,750	124,750.0
Unadjusted variance	10,385,438	
Adjustment for ties	-111,657	
Adjustment for zeros	-2,667,158.8	
Adjusted variance	7,606,621.8	
Ho: Before = After		
z = -11.569	-11.569	
Prob > |z| = 0.0000	0.0000	



Before receving the rice cooker

After receving the rice cooker

1 = LPG Usage Duration < 1 week
2 = LPG Usage Duration 1 – 2 weeks
3 = LPG Usage Duration 3–4 Weeks
4 LPG Usage Duration 1-2 months

Figure 5. Histogram of LPG usage duration before and after receiving AML.

3.4 Discussions

Safety is the most critical factor in assessing the quality of rice cookers, as demonstrated by the ordered logistic regression analysis. Consequently, the selection of rice cooker models for future distribution should guarantee even higher safety standards. The addition of features such as automatic power cut-off in response to electrical surges or usage exceeding capacity may also be considered. Although the majority of recipients use their rice cookers at least five times a week, about 7.33% have yet to use them

at all. Further monitoring and evaluation are required to understand the challenges faced by these non-users and to provide solutions such as additional education or technical support. Given the limited electrical capacity in some households—especially those with 450 VA connections—the programme must pay particular attention to promoting the use of energy-efficient rice cookers. In future iterations, distributing brochures outlining optimal usage patterns tailored to the electrical conditions of 450 VA users would help prevent circuit breaker trips during operation.

Analysis indicates that the rice cooker programme has resulted in a significant increase in average monthly electricity consumption per household, rising by between 4.67 and 5.49 kWh after programme implementation. Although this increase is noteworthy, it is still essential to further boost electricity consumption, as Indonesia's per capita electricity usage remains below that of other Southeast Asian countries such as Vietnam and Thailand. This gap could be narrowed through initiatives promoting devices like induction stoves, which inherently consume more electricity. While rice cookers are generally used only for cooking rice, induction stoves offer a wider range of functions (for example, frying and boiling), thereby driving higher electricity usage.

The durability of electric rice cookers generally depends on usage intensity, build quality, and the availability of repair services (Huh et al., 2019). In lower-income and rural areas, households often continue using damaged units due to financial constraints or rely on informal repair services. Furthermore, electric rice cookers are a staple in many Asian households and account for a significant share of residential electricity consumption (Chen, 2017; Foran et al., 2010). Given their routine daily use for preparing staple foods, rice cookers play an important role in shaping a household's energy consumption profile. Moreover, as electric rice cookers become more widely adopted, their role in driving electricity consumption will become increasingly important for forecasting national energy demand.

The use of rice cookers also holds the potential to reduce subsidies for 3-kg LPG cylinders by shifting household energy reliance from LPG to electricity. This study shows that the rice cooker programme reduced LPG consumption by approximately 1.43–2.74 kg per month per household. Consequently, LPG subsidies decreased by IDR6,079 to IDR11,659 per household per month, which is approximately USD0.37 to USD0.71. However, the increased use of electricity has concurrently raised electricity subsidy costs for households with 450 VA and 900 VA connections. On balance, the rice cooker programme is estimated to reduce overall energy subsidies by between IDR2.2–3 billion per month, equivalent to roughly USD133,000 to USD182,000. In addition, around 55.51% of respondents reported a reduction in their LPG expenses after adopting the rice cooker, which confirms that the programme is effective in reducing LPG consumption and gradually lowering the government's LPG subsidy expenditure. Electric cooking offers several strategic advantages over LPG-based cooking. First, it supports the decarbonisation of household energy use, particularly as the national grid becomes increasingly powered by renewable sources. Second, electric appliances such as rice cookers exhibit high end-use efficiency due to new features, which help minimise energy waste. Electric cooking presents a trade-off: while not always more efficient in the short term, it paves the way for a clean energy transition when supported by a greener grid.

Energy savings achieved through the use of rice cookers are poised to bolster various energy conservation initiatives in Indonesia. These initiatives include energy efficiency measures in public street lighting, industrial applications, and the labelling of home appliances (Ahadi et al., 2018; Al Irsyad et al., 2019; Anggono et al., 2021; Berlian et al., 2014). Furthermore, Indonesia is endowed with abundant renewable energy resources (Hesty et al., 2021; Nurliyanti et al., 2021), and it is anticipated that renewable energy generation capacity will increase substantially in the future (Pramudya et al., 2024). Consequently, the electrification of cooking technology is expected to contribute to significant emission reductions. Thus, we recommend encouraging a greater number of households to transition to using rice cookers—and even induction stoves—through various policy measures such as incentive schemes. To ensure that the rice cooker programme remains effective and meets the goal of reducing LPG subsidies, the government should implement continuous monitoring and evaluation of both rice cooker usage and LPG consumption among recipient households.

Although this study confirms an increase in electricity consumption and a reduction in LPG usage, the corresponding emission impacts remain conditional on the energy mix that powers the national grid. To assess this systematically, we recommend future research using a system dynamics modelling framework that can simulate electricity demand, energy mix trajectories, and emission outcomes under different policy scenarios. Four key scenarios to model include: (1) current mix, (2) RUEN targets (23% or revised 19%), (3) RUPTL 2034 target (35%), and (4) RUEN long-term goal (50% in 2050). This approach would provide valuable insights into the environmental implications of large-scale electric cooking adoption, thereby supporting more evidence-based energy and subsidy policies.

4. Conclusions

Clean cooking is a primary agenda for increasing access to clean energy in developing countries. The Indonesian government has launched a programme to distribute free rice cookers to underprivileged communities during 2023–2024. This initiative has not yet been evaluated, and our study aims to address this gap in the existing literature. Several studies have evaluated other clean cooking programmes such as biogas stoves, induction stoves, solar-powered stoves, and electric pressure cookers. Based on our findings, we hope to contribute to improving the effectiveness of similar programmes in the future, both in Indonesia and across other developing nations.

Our evaluation concludes that the free rice cooker programme has contributed to an increase in per capita electricity consumption, a reduction in LPG subsidies, and the adoption of cleaner cooking technologies. The analysis of both primary and secondary data confirms that there is a significant increase in electricity consumption among households receiving the rice cookers. Overall, the programme has successfully reduced dependence on 3-kg LPG cylinders, although some recipients continue to use LPG for certain cooking activities. The use of the rice cooker has led to higher monthly electricity bills for its users; however, most respondents believe that the benefits—such as improved cooking efficiency and enhanced user convenience—justify these additional costs. Despite the increase in electricity expenses, this perception indicates that the rice cooker can be regarded as an investment that adds value to daily cooking practices.

In terms of subsidy reduction, the rice cooker programme has demonstrated significant potential savings. The reduction in 3-kg LPG consumption per household has contributed to lowering the government's subsidy burden, notwithstanding the observed variations in LPG usage reduction among recipients. Most beneficiaries have experienced a decrease in household energy costs. Overall, the programme has achieved most of its intended objectives and shows promise for further reducing LPG consumption while enhancing the use of clean electricity.

Recommendations for future iterations of the programme include expanding the distribution of rice cookers in regions with high potential and undertaking ongoing evaluations to ensure the continued delivery of maximum benefits to recipient households. Additionally, such evaluations should support national clean energy policies. With continuous monitoring and improvements in implementation, the rice cooker programme is expected to become even more effective and exert a broader impact on enhancing energy resilience in Indonesia.

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