



# Cooking Practices in Institutional Settings in Indonesia and Cambodia

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## 1. Introduction

Institutional cooking practice (ICP) is inextricably linked with cooking energy transition and supplementary feeding programs. Within the first agenda, most of the literature is concentrated on energy transition in household scale rather than in institutions, although the burden and impact are bigger in an institutional setting. On the other hand, feeding programs and cooking tend to be put in a separate conversation thus cooking energy use is often overlooked.

Traditional biomass, like firewood, generates smoke from cooking fires that contain small particles which can penetrate the lungs and blood vessels, causing health complications. Cooking practices are also a matter of gender empowerment as the burden of collecting firewood is often put on women. They can spend around 12 hours per week dedicated to gathering firewood and cooking, a considerable time which can either be used for doing income generating activities or to simply rest [1, 11].

Mapping cooking fuel usage in institutions could pave the way to increase awareness and educate those who are involved in the program about the importance of clean cooking. Hence, this baseline report aims to provide information about ICP in three locations within Indonesia (Sumba Island) and Cambodia (Phnom Penh city and Kampong Thom city). Each locus will be compared accordingly to understand the similarities and differences and thus contributing to a better understanding of modern energy transition in ICP.

## 2. Institutional cooking ecosystem in Indonesia and Cambodia

### 2.1. A rural perspective from Indonesia: study case of Sumba

Sumba is an island located in East Nusa Tenggara province, with a population density of around 72 people/km<sup>2</sup> [3], [4]. Considered to be a rural area, Sumba Island provides a unique locus for this baseline assessment due to its high contrast with the national context of Indonesia. In 2016, the biggest share of cooking fuel in East Nusa Tenggara came from firewood (77.58%), followed by kerosene (21.05%), and LPG (0.57%) [5]. Firewood is commonly gathered from a privately owned backyard or bought from a firewood seller. As noted from a personal interview with Siti Suryani<sup>1</sup>, local government in Sumba has established regulations regarding illegal logging and in fact, people are only allowed to collect firewood in their backyard. Chopping wood from the forest for cooking purposes is hence illegal, although this practice seems to be normalized, Siti Suryani commented in the personal interview, as demands in the firewood market are constant. This activity of chopping wood allegedly contributed to deforestation in Sumba [6], even if no available data has directly linked the pervasiveness of firewood cooking with deforestation rate in East Nusa Tenggara.

The prevalence of cooking with traditional biomass at the household level opened the door to study about the condition in institutional settings, especially as East Nusa Tenggara is hosting several school feeding programs. East Nusa Tenggara had the highest number of schools covered in 2017 (194 schools) during Progas (Program Gizi Anak Sekolah), a collaborative school feeding program between World Food Programme (WFP) and the Government of Indonesia (GoI) [7]. This program correlates with the findings that East Nusa Tenggara is the province in Indonesia with the highest stunting rate (42.7% in 2018) [8]. School feeding program then became the avenue for nutrition improvement, which highlights the importance for institutional cooking in Sumba. To date, the Indonesian government has not made any further commitment to the school feeding program,

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<sup>1</sup> Siti Suryani is the lead field researcher who coordinated the data collection in Sumba, Indonesia.

focusing instead on a more holistic approach to health and nutritional education through the GERMAS (Healthy Living Movement).

Cooking in institutional settings such as schools is not a part of the policy program in energy transition, as the focus is mostly on the household. Even so, East Nusa Tenggara was not included in the 2007 Zero Kero program, where it is aimed to shift household usage of kerosene to LPG [9]. The GoI renewable energy trajectory for NZE 2060 provides an opportunity for modern energy cooking services to be introduced and mainstreamed as an attempt towards meeting the Sustainable Development Goals (SDGs).

As GoI monopolizes resources and energy management, the transition scheme tends to follow a top-down approach, where the national government provides regulatory framework and policy targets, and the local government is the implementer. To date, the GoI has not proposed any major energy transition scheme for cooking, like the past Zero Kero program [9]. This gap can be feasibly addressed by local or international NGOs to mainstream electric cooking, whether at household or institutional level. Joint collaboration with national or multinational institutions could amass the necessary financial support. On the other hand, the private sector has the role to build a market where there is a sustainable demand and supply for clean energy for cooking.

## 2.2. Urban-rural dynamics of Cambodia: study cases of Phnom Penh and Kampong Thom

In Cambodia, the two cities of Phnom Penh and Kampong Thom provide a perspective of urban-rural dynamics. All the 948 villages in Phnom Penh are classified as urban while around 93% of the 780 villages in Kampong Thom are considered as rural. The two areas also present a contrasting condition in terms of socioeconomic status. In 2019, the average of the total monthly income in Phnom Penh reached 3,735 thousand riels (US\$920), the number is twice higher than of those in rural areas with the amount of 1,818 thousand riels (US\$446) [10].

Cooking in Cambodia is largely fuelled by biomass, with almost 90% of its population using biomass as their primary cooking fuel. Similar to the national condition, the majority of Kampong Thom population also use fuelwood for cooking i.e. 97.3%, the other 2.4% use kerosene, and only 0.3% use liquefied petroleum gas (LPG) [11]. The cooking fuel composition in Phnom Penh is somewhat lacking with the latest data found compiled by the FAO on 1997 [12], however all the institutions surveyed in this research use LPG as their main cooking fuel.

The transition towards clean cooking has been one of the country's agendas, with several programs has been initiated such as the Cambodia's National Biodigester Programme (NBP). Looking beyond domestic cooking interventions, a different perspective is taken within this baseline assessment by exploring the realm of ICP. Within diverse settings such as in schools, clinics, prisons, or shelter, institutional cooking is closely correlated with the country's rural development i.e., energy distribution and nutrition improvement. Broadly represented by the school feeding program in Cambodia, there has been a progressive development of the country's school feeding program. A future commitment has also been made, as reflected in the Home Grown School Feeding Program (HGSF) [13]. As seen from the program evaluation [13]– [15], the positive impacts of institutional cooking programs have been proven and it could be the entrance for an institutional clean cooking transition.

## Kampong Thom deforestation history

Kampong Thom has been the study case for many studies regarding its forest resource conservation [11], [16]– [20]. The province has over 0.63 million ha of forests, 51% of the provincial area [11]. While the number of forest coverage in Cambodia keeps decreasing [17], deforestation should be seen in a scope broader than simply caused by unsustainable wood fuel collection [19]. As a discussion about sustainability, fuelwood consumption only accounts for 2% of the entire province's wood increment [20]. Others also found that 29% of the used firewood is sourced from dead wood [11].

Another perspective is that the rural population is negatively impacted by deforestation. Forest resources are the supporting ecosystem for their income sources such as plantation and non-timber forest product collection [16], [17]. The shortage of wood will place a burden on those who do not have abundant sources of firewood from non-forest sources [11]. Measures to limit the fuelwood consumption should provide alternatives for the people to mitigate the impacts arising from increased price or scarcity of their main cooking fuel source. In a personal interview, Yoshua Bonar Nugroho<sup>2</sup>, explained that the price estimate of charcoal has increased by twice the previous price, from 1000 Riel to 2000 Riel for a bag of charcoal.

Faced by the emerging problems of biomass extraction for cooking fuel, there were already several initiatives to transform the cooking practices in Kampong Thom and Phnom Penh. Some notable initiatives in Kampong Thom are The National Improved Cook Stove Program [22] and the previously mentioned Cambodia's NBP [21]. The interventions found mostly still rely on firewood that underscores the need for massive dissemination of feasible and practical clean cooking alternatives. Yoshua stated in a personal interview that biogas is indeed one of the found alternatives, however the procurement is still centralised, and the instalment price (US\$30/month) was even higher than the regular price of gas in Phnom Penh (US\$20/12.5 kg gas tube). It also requires complex behavioural change demanded from the users. Although gas could be an alternative, there are no policies regulating LPG market operations which leads to several problems hindering the improvement of the safety and adoption of LPG—high number of smuggled LPG, underpayment of VAT, and cylinder misuses [23]. These initiatives highlight the need for an integrated collaboration of key enablers i.e. the Cambodian government, INGO, NGO, and the community to establish the contextual study, the supply chain, and the financing mechanism.

To provide information about ICP through the study cases in Cambodia and Indonesia, the findings will be explained in the results and discussion section according to the developed categories. Based on those findings, the limitations found during the research and the potential for future assessment will be discussed after the conclusion.

## 3. Method

### 3.1. Data collection

A brief content analysis of literature and reports was done to construct the interview tools and to provide contextual information of the three loci in support of the findings. We conducted a series of semi-structured interviews to 61 institutions mainly in Sumba Island, Phnom Penh city, and Kampong Thom city. Around half of the total institutions are education institutions ranging from kindergarten to university. The details of the interviewed institutions are listed in Table 1 below.

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<sup>2</sup> Yoshua Bonar Nugroho is the lead field researcher who coordinated the data collection in Phnom Penh and Kampong Thom, Cambodia.

<b>Locus</b>	<b>Location details</b>	<b>Number of institutions</b>	<b>Institution type</b>
<i>Sumba Island, Indonesia</i>	East Sumba regency	29 institutions	14 schools and/or student dormitories, 3 churches, 4 orphanages, 3 health centres, 2 governmental institutions, 2 shelter, and 1 INGO office
	West Sumba regency	1 institution	1 student dormitory
	Central Sumba regency	1 institution	1 governmental institution
	Southwest Sumba regency	1 institution	1 student dormitory
<i>Cambodia</i>	Phnom Penh city	16 institutions	6 schools, 5 orphanages, 2 woman rescue centres, 1 church, 1 student centre, and 1 social enterprise
	Kampong Thom city	10 institutions	9 schools, 1 clinic
	Kampong Speu city	1 institution	1 orphanage
	Siem Reap city	1 institution	1 children vocational centre
	Kampong Cham city	1 institution	1 district hospital

**Table 1.** Institution types in data collection locus

### 3.2. Data analysis

Quantitative data were analysed using Microsoft Excel 2013. The results were described using descriptive statistics using tables and figures, which provide simple summaries about the sample and measures. Meanwhile, the qualitative data were analysed in a comparative analysis according to Fachelli et al. (2021) [25].

The main concept of the comparative analysis is to provide understanding of the current ICP. To achieve such understanding, 7 meta-categories obtained from the preliminary literature study are formulated to cover the variation of the concept, whether in terms of similarities or differences, within the different contextual patterns in Sumba Island, Phnom Penh city, and Kampong Thom city. The 8 categories are as defined; (1) institutional structure; (2) cooking practices; (3) institutional resources; (4) institutional cooking space and appliances; (5) institutional cooking fuel; (6) health impact of current cooking practices; (7) perception on shifting to modern cooking energy.

## 4. Results and Discussion

The ICP setting in each locus will be explained first before the findings are elaborated in this section. In Sumba Island, most schools do not cook meals for their students, instead the students usually buy their food from food stalls or retailers provided by the local people. However, some schools have a dormitory in which food is provided daily, though not all of the students live in dormitories, for instance, from 200 students within the school, only 80-100 students stay in the dormitory. The majority of schools, dormitories, and orphanages in Sumba are Christian- or Catholic-institutions as 66% of the population in Sumba Island are Christians and 29% are Catholics [24].

In Phnom Penh, institutional cooking is mostly supported by Christian organizations or individual donors although the funding support is not specified for food provision only. On the other hand,

Kampong Thom provides a perspective of ICP in rural areas which is mostly conducted under a food aid program given by NGO/INGO. The two institutions in Kampong Cham and Siem Reap are included in the findings of institutions in Phnom Penh, while the one institution in Kampong Speu is included in Kampong Thom findings. The classification is considering the similarity of the fuel characteristics to the datasets of Phnom Penh and Kampong Thom.

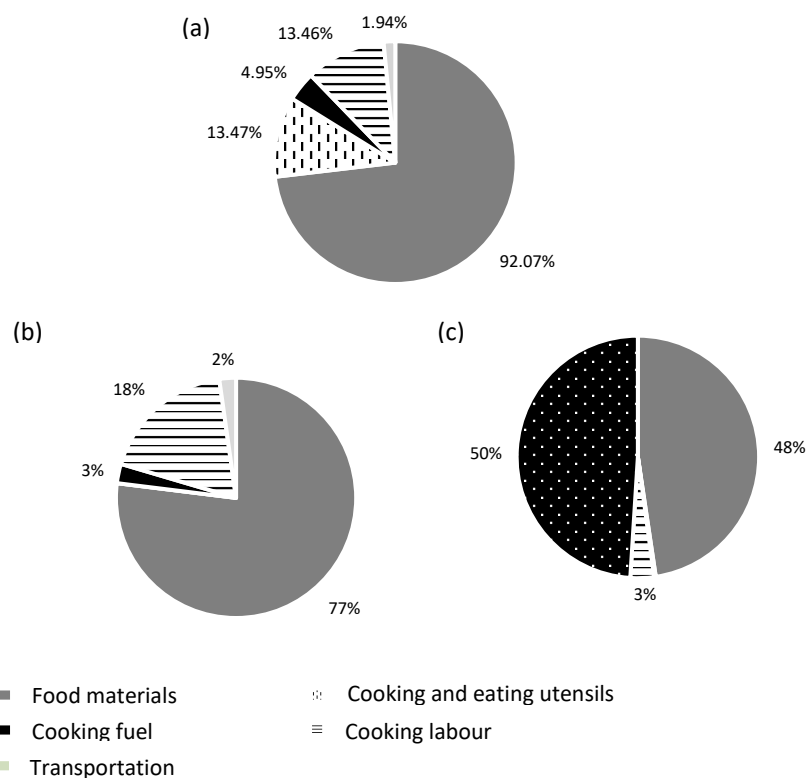
#### 4.1. Institutional structure

##### Financing structure

Funding is nevertheless an important aspect in the continuity of ICP, especially when around 50% and 66% of the institutions surveyed in Sumba and Cambodia are non-profit institutions. Therefore, this section tries to provide information of the sources of income and to know the share of cooking fuel from the total current costs associated with cooking practices.

A majority (66%) or as many as 20 out of 32 institutions in Sumba ever received donations or aid programs. The Government of Indonesia (GoI) contributes the most (40%) while NGO and INGO have equal share as seen in Figure 1. From those receiving donations, 60% of the programs give money, ranging from US\$4,000 to nearly US\$36,000 in a year. The rest receive goods in the form of foods, milk, rice, and daily necessities.

More than half of the aid is given annually. If donations are not paid on a regular basis, cooking practices will stop when funds are not available. The dependence upon funding aids was also shown in government-aided institutions, for example, Siti Suryani said in a personal interview that previously in Sumba there was a Social Safety Net program which enabled some of the schools to cook every one or two weeks, but the program has not been continued and so does the cooking.



**Figure 1.** The components of institutional cooking expense in (a) Sumba, (b) Phnom Penh, and (c) Kampong Thom



In Phnom Penh, most aid programs were not related to supplementary feeding or clean cooking, in fact, only 2 of them received such programs. The source of funding for the institutions mostly comes from donors either from Christian organizations or individuals. All of the donors give assistance in the form of cash. This finding is very different compared to the findings in Kampong Thom. All of the institutions there received a food aid program named “School Feeding Program” by WFP. The program is currently ongoing and executed by a local NGO called World Vision.

The components of the institutional cooking expense are shown in Figure 2. Cooking fuel only accounts for 4.95% in institutions in Sumba. Food materials account for almost 92% of the expense and the total cooking expense makes up 50.40% of the total institution expense<sup>3</sup>, thus savings would be prioritized through changing the menu to the lower priced food ingredients. The allocation of cooking appliances funds was practiced in 88% of the institutions in which the institution proposes monthly budget plan and afterwards, the expense will be reported back to the donor. In several institutions, the donor is mediated by a third-party institution that handles the procurement of the ingredients, in that case the institution proposes goods instead of money to the vendor. Usually, the donor already has an annual budget plan despite the monthly disbursement. If the institution wants to propose for cooking appliances, it has to propose in the beginning of the annual budget planning and specify in what month the purchase will be made. If granted, the budget for the cooking appliances will be allocated separately from the monthly budget given for food ingredients.

In Phnom Penh, the share of food materials accounts for 77% (Figure 2b) of the total cooking expense on average, while cooking fuel expense only makes up 3%. In comparison, the total cooking expense only makes up 6% of the total institution expenditure. In Kampong Thom, the share of total cooking expense to the total institution expenditure is higher (10%), with the components as shown in Figure 2c. In both loci, the cost for cooking and eating utensils are only disbursed one time and many cannot recall the associated cost, therefore the component is not shown.

As aforementioned, the source of ICP funding in Kampong Thom is mostly provided by NGO/INGO. This finding is observed exclusively from the 9 schools that received support from WFP. In these schools, the food aid program gives food donations instead of cash, therefore the cost of raw food only takes 6% of the total cooking expense. The cost is only to pay for foods to occasionally substitute for the food aid menu. A large share (78%) of the cooking expense is used to pay the stock keeper whose job is to monitor and give reports to the donor on the food stock status and usage. The cooking fuels are sourced from the community and by having the students bring firewood to the institutions, thus it does not contribute any share to the cost.

### **Identified actors**

Overall, the actors of ICP in Sumba are the donor, institution, management, head of the cooking team, and the cooking team. The involvement of the donor is relatively limited. The institution's role is represented by the head of the institution which in Sumba, 59% of them are female. As many as 75% of the heads of institutions are university-graduates, while another 22% are senior-high-school graduates. While the head of the cooking team is mostly undifferentiated from the cooking team. There are also other actors found exclusively in certain institutions e.g. the cadre of the Integrated Healthcare Center, the caregiver in an special needs school dorm, and third party institutions in prisons. On the other hand, in Cambodia, the actors are relatively limited to the donor, committee,

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<sup>3</sup> The average total institution expense does not include the data from Umbu Rara Meha Public Regional Hospital in Waingapu. The data is deliberately omitted due to its outlier nature with a much higher amount than the other institutions.

cooking team (cooks & cooking assistants), and institution members. The head of the institutions are 52% female, mostly aged 31 to 40. The percentage of the heads of institutions who are university-graduates (73%) are more or less the same as in Sumba while the other 23% had vocational training education.

**Decision making structure**

A particular aspect of ICP lies in the complexity of the institutional structure which influences how decisions are made. These decision-making structures are different from one institution which explained in detail in Table 2, however, to provide a general dynamics of it, the ICP roles may be divided into those who execute, make choice, and pay. The activities within ICP are also assigned to three categories, namely energy provision, cooking practices, and kitchen operations. Energy provision includes the act to determine which cooking fuel used, and to pay and purchase the fuels. Cooking practices activities include determining the menu, pay for the ingredients, purchase them in the market, and cooking the meals in the kitchen. Last, the kitchen operations activities cover making decision to buy kitchen appliances, managing the cooking team, and to pay for the appliances and the cooks’ salary. Each role is played by different identified actors, depending on the kind of activities.

In Sumba, energy source procurement is paid mostly by the institution, chosen either by the management or the cooking team, and purchased by the cooking team. Within the cooking practice, the payment is made by the institution with the help of the management, determined by the cooking team or the institution, and done mostly by the cooking team. Last, in managing the kitchen operations, the institution and the management make the payment, the choice, and run the execution. On how the actors in lower- and higher-structure interconnected in making a decision, 78% of the institutions adopt a mechanism in which the lower-structure actors can voice their opinion, mostly through a proposal.

<i><b>Institution type</b></i>	<i><b>Institutions</b></i>	<i><b>Decision making structure</b></i>
<i>School and/or student dormitory</i>	Early Childhood Education and kindergarten	The institution consists of less than 100 members with relatively lean organizational structure. Cooking is done by the management, who are also the teachers, or the head of the institution. Considering their short schooling period, the cooking is held weekly only for breakfast with mung bean porridge as the menu.
	Elementary, middle, high, university, Academy	The schools that receive donations and have more cooking expense allocation tend to have management who handles the payment and choosing, some of them also have a cooking team to do the execution. While the institutions with relatively lower total cooking expenses give all the tasks to the cooking team or the members of the institutions.
	Special needs school	In the school with fewer students, the caregiver acts as the management, who manages the determination and does the payment of the cooking energy, cooking practice, and kitchen operations. While in another school with more students, the institution's role is more prominent in managing the cooking energy. It also makes the payment. The cooking team handles

<i>Institution type</i>	<i>Institutions</i>	<i>Decision making structure</i>
		almost all activities in the cooking practice, including making the choices.
<i>Stay-house</i>	Shelter, orphanage	The role of the institution is strong in all activities, which could be represented by the management staff. The cooking team only determines the food choices and does the cooking. In one institution, the cooking is done by the members of the institution.
<i>Health centre</i>	Integrated Healthcare Centre, hospital	In the integrated healthcare centre, almost all activities are conducted by the cadre, while in managing the cadre itself and to arrange the payment of the kitchen operational, there is a coordination mechanism with the donor. The hospital with less capacity has the management to handle everything. In the regional public hospital, the cooking is handled fully by the third-party institution.
<i>Religious centre</i>	Church, Child Development Centre	In the child development centre, the staff tends to make the choice, the institution makes the payment, and the cooking team does the execution. In the church's Sunday school, the cooking practice is managed by the head of the institution with the help of the volunteering member during the execution.
<i>Prison</i>	Open prison	The cooking is managed by the government and the vendor, mediated by the management. The member participates only in cooking.
<i>Officials</i>	Government institutions and INGO	The officials have specially appointed staff that handle all the activities without a certain cooking team.

**Table 2.** Details of decision-making structure of ICP in Sumba

In Cambodia, the roles of the identified actors in ICP tend to be generally similar across institutions. The role of the cooking team dominates the cooking practice activities, although the institutions are still responsible for the payment as well as for paying the other cooking-related activities. The committees are running the energy provision and in operating the kitchen while also becoming the decision maker. Specifically in kitchen operations, the cooking team also shares the role of decision maker along with the committee. In the decision-making structure, the cooking team tends to be accountable for their voice, they freely discuss the matter with their peers or with the institution's members and make a decision according to their preference. In most cases when the matter to be determined is a big-scaled one, the decision still needs to be confirmed by the management as the final decision maker, otherwise it would not need any approvals.

The decision-making structure in Kampong Thom is more concentrated on the role of the donors, in which they make decisions on the type of fuels, food ingredients, the cooking method, and the cooking appliances. Although in doing so, other actors such as the committee, the local community, and the cooking team are involved as well. For example, in choosing the type of fuels, the committee

and the local community are also accountable although the installation cost is paid by the donors. The cooking team is also involved in selecting the cooking ingredients and cooking method.

### **Cooking team profiling**

In brief, institutions in Sumba with higher cooking expenses tend to hire cooking teams, considering labour makes up 13.46% of the total cooking expense. Volunteers are found in all institutions that only conduct cooking on occasions. Different gender composition is found in Sumba, in which hired cooking team tends to be female, while volunteers could either be female or male. The cooking team in Sumba mostly do not have to go through the selection process and are not given training. Some institutions who do have requirements only demand basic knowledge in cooking, nutritional knowledge, or simply belong to the nearby community.

Unlike in Sumba, the cooking team in Cambodia is dominated by females. As many as 88% of the hired cooking team and 95% of the volunteering cooking team are female. The cooking team is mostly coming from the institutions' inner circle such as from the local community or a member of the church. Most of the cooking team (79%) received training, either through on the job training, training given by WFP, or formal training in vocational training school for several months. The content of the trainings include knowledge on hygiene, menu options, and certain cooking requirement. The on-the-job training is given either by the head of the institution/department or by the senior cook. As labour makes up a high percentage (18%) of total cooking expenses in Phnom Penh compared to only 3% in Kampong Thom, amidst the Covid-19 school activity restriction, some institutions had to lay off their cooking team.

## **4.2. Cooking Practices**

### **Cooking schedule and menu**

Most institutions in Sumba cook regularly although three institutions conduct cooking only for certain occasions. The institutions cook 2 to 3 times daily, serving breakfast, lunch, and dinner with the menu shown in Table 2. Those only serving snacks or weekly meals usually cook mung bean porridge. As many as 66% of the institutions cook in batches with an average total cooking duration, starting from the preparation until finished and ready to be served, of 280 minutes for the whole portions in one batch. While those who cook all the daily portions at once need on average 162 minutes. The institutions that only serve meals once in a day will cook at once. The menu is mostly just mung bean porridge for breakfast which requires much less amount of time to cook, thus the shorter duration. In a day, the kitchen that uses firewood as the cooking fuel is running for 10.6 hours on average, a considerable exposure time to household air pollution for those in the cooking team.

Although the average time spent per day dedicated to food preparation and cooking in Phnom Penh is considerably lower (44.5 minutes), they have longer preparation time for dinner and lunch, which can take around 100-120 minutes. In one cooking shift, the people involved are up to 4 people, despite the range of institution size. All of the institutions surveyed in Cambodia have a regular cooking schedule and all of them always cook the food at once, rather than in batch. The cooking schedule in all of the institutions in Kampong Thom is limited to breakfast with the same menu according to what is given by the donors.

For the matter of cultural or religious effects, the survey conducted in Sumba found no cultural or religious prohibition regarding the type of food cooked or served in the institution. Cooking-related standards are only found in healthcare institutions. In an elementary school, the children are given

cooking practice lessons. They usually use a kerosene stove except when the menu is grilled fish then they will use charcoal.

Still regarding cultural and religious values in the food provision, one institution in Phnom Penh, reported that they are prohibited to include blood in their diet. An orphanage in Sen Sok mentioned that once a month, members of the institution are ‘meat-fasting’ as part of their belief. Other than that, culture and religious aspects only influence the changes of cooking volume as will be mentioned later.

Menu rotations occur every day at the maximum and once to twice a month at the minimum. The menu changes can also be affected by availability of food, depending on what kind of food is currently in season in Sumba. Food availability ranks first in the list of considerations in choosing a menu, the second and third are nutritional fulfilment and familiarity to local cuisine. Cost of the food and workload of the cooking team are the least important considerations.

In Phnom Penh, menu changes are not as often as found in Sumba, the menu rotates mostly per week. The menu considerations are being determined through different considerations as well, which are institution members preferences, total cost, and nutritional fulfilment are the three main considerations. Despite these considerations, some institutions in Phnom Penh set menu standards to comply with the nutritional requirement along with hygiene standards.

Conversely, the menu almost never changes in Kampong Thom considering the foods and the equipment are procured by the donors. The menu is standardized and there is a rule in which the food should not contain MSG. In that case, requirement from donor and nutritional requirement being the two main considerations about the menu. As the institutions are not deciding the menu, they only vary the vegetables occasionally to be eaten alongside the canned fish.

The summary of the types of food regularly served in Sumba, Phnom Penh, and Kampong Thom can be seen in Table 3 below. Other than the menus listed below, several institutions also provide snacks occasionally such as milk, cookies, or desserts.

<b>Location</b>	<b>Common Menu</b>		
	<b>Breakfast</b>	<b>Lunch</b>	<b>Dinner</b>
<i>Sumba</i>	Mung bean porridge, fried rice, porridge	Rice, fish, chicken, eggs, tofu, tempeh, vegetables, fruits (banana, snake fruit, orange)	
<i>Phnom Penh</i>	Fried eggs, fried chicken, fried meat (pork/chicken/fish), porridge	Soup, cha meals (fried meat), vegetables, fermented meat pie, fried fish	Soup, cha meals, vegetables, and <i>mjue kreng</i>
<i>Kampong Thom</i>	Canned fish soup, mixed vegetables, fried rice	Stew, soup, vegetables stir-fry, fried salted fish, salted egg	Stir-fried meat & vegetables, fried salted fish, salted egg

**Table 3.** Menu variance

## Capacity

The total portions served in institutions in Sumba are 86, ranging from 6 to 298 (for those that cook regularly). The great variance of the portions may pose a challenge in designing clean cooking appliances although nearly 70% of the institutions do not experience change of cooking volume. Holiday seasons and annual institutional events are the reasons for changes in cooking volume. Apart from these, occasional menu and volume changes also happen when there are guests staying at the institution. Notably in hospitals, the cooking volume changes daily due to the fluctuation of the patients staying in the hospital.

Similarly, institutions in Kampong Thom do not experience a lot of cooking volume changes. It usually only happens once when the teachers and students celebrate the end of the school year. Otherwise, on the usual days, the amount of the foods are standardized by the donor. In the case of Phnom Penh, flexibility of the cooking appliances to accommodate the large serving portions in institutional settings becomes one of the considerations to shift towards modern energy. Changes in cooking volume occur more often than Sumba by approximately 4 times in a year due to holidays, religious events, and celebrations.

### 4.3. Institutional resources

#### Access to electricity

The 2019 data on electrification rate (84%) showed that East Nusa Tenggara has the lowest rate in Indonesia, where other provinces have exceeded 90% [27]. Due to the low population density, villages are dispersed and isolated from each other. This geographical condition presents a challenge to the electrification program and energy supply in East Nusa Tenggara.

This number also corresponds to the 20% poverty rate of East Nusa Tenggara [28]. As per 2019, there are still 323 villages (9.63%) that have no electricity access in East Nusa Tenggara [27]. The 90.37% of villages who have access to electricity are connected to both the national grid (80.38%) and the rest (9.99%) are connected to the non-PLN (Perusahaan Listrik Negara, translated to State Electricity Enterprise) grid. This data corresponds with the survey on the field, where 99% of the institutions obtained their electricity access from the national grid, with the average maximum capacity of approximately 8,800 Watts. Among 32 institutions, 4 of them mixed their electricity supply from diesel generators and micro hydro power plants. On average, the electricity is available for 24 hours a day, with blackout frequency around 1 - 2 times a month. The monthly average cost for the electricity is around Rp3.835.020 (US\$268), making up around 0.25% of the total institution expenditures.

As the province with the lowest electricity rates in Indonesia, the GoI has several plans for electrification programs in East Nusa Tenggara that also includes renewable energy into the mix. However, most of the electrification programs are run by the government through PLN. Siti Suryani noted in a personal interview that private institutions contribute to the electrification program on a limited capacity, since PLN set the buying price of Rp600/kWh (US\$0.04) while the production cost could reach Rp1400/kWh (US\$0.1). This business scheme is considered unfeasible by the private sector and results in the continuation of monopoly by the PLN. The National Electricity Supply Business Plan (RUPTL) 2021-2030 in Sumba also focuses on supply from renewable energy, such as solar, hydropower, and geothermal. Solar and biomass are the largest contributors to the energy mix, 42.8% and 44.7% respectively [29]. Solar energy for electricity has certain appeal for the

communities in Sumba since the climate is considered to be suitable, as noted by Siti Suryani in a personal interview.

In Cambodia, 97.6% of Cambodian households have access to at least one source of electricity, although only 13% of them have access to 23 hours of supply a day. The unequal distribution of energy access is stark between urban-rural settings, for instance, households in rural areas often use off-grid electricity, faced by the problem of distance from the grid and the scattered house-to-house setting, according to a personal interview with Yoshua Bonar Nugroho. Most off-grid sources are solar home systems, which only give around 4 hours access to electricity in a day [30].

The data gathered from the survey in Phnom Penh shows that all of the institutions are connected to the national grid with 24 hours access. Four of the institutions use other sources as well, three own a diesel generator and another has a solar panel. The generator is used to generate electricity during blackouts. As though many are burdened by the high electricity cost, the one institution that uses solar panels reports that it can reduce half of their electricity bills. The high cost of electricity makes up on average 3% of the institution's expenses.

Many institutions complain about the frequency and duration of the blackouts in Phnom Penh, which can happen 2 to 7 times in a month and for 1 to 3 hours. The blackouts also become more frequent during the dry seasons. According to the personal interview with Yoshua Bonar Nugroho, the temperature in Phnom Penh during the dry weather could reach 40-41oC compared to the average 18-19oC during the wet season, causing people to turn on their air conditioners and fans and thus pumping up the load.

The institutions in Kampong Thom are all (except the one institution in Kampong Speu) connected to a mini-grid system by the Rural Electricity Enterprise (REE). REE is a private electricity provider contractor, who is in contract with the EDC (Electricity Du Cambodge, a government body who manages electricity in Cambodia) in providing electricity for certain remote areas. They need to sell the electricity by the defined price and a subsidy is given to pay for the uncovered production cost. The schools in Kampong Thom only consume very little electricity, as shown from the monthly electricity cost with an average of only US\$7. In comparison, the average electricity cost in Phnom Penh is US\$723. Other than the schools, the electricity usage is much higher in the one clinic surveyed in Kampong Thom. The clinic is also connected to a mini-grid system with electricity bill reaching US\$1,100 per month.

### **Water supply**

The availability of clean water supply is important in the conduct of ICP. In 2019 data from the Central Bureau of Statistics showed that only 75.01% of households in East Nusa Tenggara have access to clean and sustainable drinking water [31]. From the same source of data, the largest share of water supply in Sumba Island came from protected springs [32], [33]. More than half (56%) of the institutions in Sumba sourced their water supply from a well, and the rest obtained the supply from the national water tap company. Accessibility and proximity to the water supply can affect the duration of cooking, as boiling water for cooking and drinking takes up around 38 minutes per day. Using a water tap company as the source of water supply can also contribute to the operational cost of the institution. For the 41% of institutions in Sumba Island who are consumers of the national water tap company, 38% of them consider the cost of the water supply is affordable.

In the context of Cambodia, based on the data from 2011, only 5.1% of the villages in Kampong Thom had access to a clean water supply system in the province [34]. In comparison, the water tariff

was also relatively lower in Phnom Penh i.e. 1,030 Riel/m<sup>3</sup> for institutions and communities while in Kampong Thom the price was 1,500 Riel/m<sup>3</sup> [35].

From the survey, 83% of the institutions in Phnom Penh sourced their water supply from state-owned water tap companies, while the rest obtained their water supply from wells. For drinking water, 78% of the institutions have installed water filtration systems. The rest (11%) boiled water from the water tap for drinking purposes and bought water in gallons. Two of the institutions surveyed admitted that they have problems with the water supply, namely broken pumps, low water pressure, and the expensive cost of the state-owned water tap bills (up to almost US\$200 for 2 months).

The institutions in Kampong Thom sourced their water from wells instead from the state-owned water tap company. The well water quality is varying, some NGOs have tested it and found arsenic in the water, although in some other wells the quality is good. For drinking water, they filtered or boiled the well water. Other than well water, some use water gallons provided by the donors for their consumption purposes. Those who neither own a water filtration nor receive water gallons will boil the well water using firewood.

#### 4.4. Institutional cooking space and appliances

##### **Kitchen condition**

Most institutions in Sumba have a permanent kitchen building to prepare the food, although they usually have an outdoor space as well for cooking with firewood. The majority of the kitchen has decent walls, roof, ventilation, air circulation and electricity connection. While only 5 of the institutions have their kitchen outside of the institution's building. Many do not have a designated place to eat. In most of the school dormitories and orphanages, the children are involved in the cooking practices. Thus where biomass stoves are in use, the urgency to limit the children's exposure to harmful pollutants are more pronounced.

The average kitchen area<sup>4</sup> in Sumba is 21.39 m<sup>2</sup>. After accounting for the number of people involved in the ICP, the area per person ranges from 1 m<sup>2</sup> to 30 m<sup>2</sup> or 7.1 m<sup>2</sup> on average. Most institutions state their willingness to improve the kitchen if there is any funding, with the majority prioritizing to expand the kitchen, only one prioritizing to fix the walls.

Majority of the institutions in Phnom Penh also have permanent buildings with more than twice (50.74 m<sup>2</sup>) the average kitchen area of the surveyed institutions in Sumba. The kitchen area per person is also considerably bigger, i.e. 21.40 m<sup>2</sup>. As many as 69% of the institutions have plans to improve the kitchen. As maybe the kitchen area tends to be sufficient, the improvement is more directed to improve the furniture, the tiles, the roof, and to add more cooking equipment.

The kitchen buildings of the institutions in Kampong Thom are mostly semi-permanent. The average kitchen area (27.73 m<sup>2</sup>) is similar compared to Sumba, although after being divided by the cooking team, the average number of kitchen areas per person (16.59 m<sup>2</sup>) is much bigger. The plans for kitchen improvement tend to be to construct a new room or room feature e.g. to build a storage room, dining area, or chimney.

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<sup>4</sup> The average total institution expense does not include the data from Public Regional Hospital Umbu Rara Meha in Waingapu. The data is deliberately omitted due to its outlier nature with a much higher amount than the other institutions.



## **Cooking appliances**

Institutions in Sumba have on average 2 electric cooking devices. The three most found electric devices are blender, rice cooker/magic jar, and refrigerator/freezer, respectively. For the non-electric appliances, the majority have wok, cooking pot, and steamer pot. The stoves owned are mostly kerosene stove and wood stove, only 6 of the institutions use gas stove. On average they have up to 4 stoves, with the exception of the Family Empowerment and Welfare (Pemberdayaan Kesejahteraan Keluarga) team that cook in a large volume for an occasion. Almost everyone feels satisfied with the stoves they use.

In Phnom Penh, all of the institutions use gas stoves, with each institution having 1 to 2 gas stoves along with non-electrical appliances such as grill stools, frying pan, and pots. On average, each institution owns 3 electric devices. The most found devices being rice cookers and refrigerators. In rural areas of Kampong Thom, the off-grid systems are underused because only 2 institutions have electric appliances. In an institution where there is no refrigerator, the meat would be preserved by adding salt and it would be rinsed prior to cooking. Promoting energy-efficient appliances and affordable schemes for purchasing them would allow households to enjoy more benefits from their off-grid electricity sources.

### 4.5. Institutional cooking fuel

#### **Cooking fuel**

The current cooking fuels used in institutions in Sumba are kerosene, wood, and Liquefied Petroleum Gas (LPG) with the number of institutions using the fuel types i.e. 23, 18, and 6 respectively. One institution uses corn cob for a portion of their cooking fuel needs. Those numbers are not exclusive from each other as half of the institutions practice fuel stacking in which 9 of them stack firewood and kerosene.

The details of the cooking fuel use and its associated costs can be seen in Table 4. The costs can be in the form of money, labour, and/or time spent to fulfil the needed quantity. It can be expected that the quantity and the costs increase proportional to the institution size. Such a trend can be observed in kerosene use but not in firewood consumption. It seems to be most effective in institutions sized 100-200. Another finding is that LPG use seems to incur the least cost either in terms of money, labour, or time on average basis.

<b>Associated Cost</b>	<b>Institution Size</b>	<b>Firewood</b>	<b>Kerosene</b>	<b>LPG</b>
<i>Quantity needed (kg/day) (litre/day)</i>	<20	10.00	1.75	0.17
	20-50	21.88	3.60	0.40
	50-100	38.33	4.60	-
	100-200	30.00	7.50	0.50
	>200	20.00	14.38	0.10
	<b>Average</b>	22.94	5.87	0.33
<i>Cost (IDR/day)</i>	<20	IDR 3,333.33	IDR 7,000.00	IDR 2,500.00
	20-50	IDR 13,125.00	IDR 15,200.00	IDR 6,666.67
	50-100	IDR 26,666.67	IDR 18,400.00	-
	100-200	IDR 15,000.00	IDR 30,000.00	IDR 8,000.00
	>200	IDR 45,000.00	IDR 57,500.00	IDR 2,000.00
	<b>Average</b>	IDR 17,500.00	IDR 23,826.09	IDR 5,416.67
<i>Labour to collect (people/day)</i>	<20	2.00	2.00	1.00
	20-50	5.25	3.80	1.00
	50-100	5.00	1.67	-
	100-200	2.00	-	-
	>200	1.50	2.50	1.00
	<b>Average</b>	4.00	3.06	1.00
<i>Time to collect (hour/day)</i>	<20	120.00	150.00	30.00
	20-50	142.50	213.75	120.00
	50-100	260.00	216.00	30.00
	100-200	60.00	360.00	240.00
	>200	90.00	180.00	-
	<b>Average</b>	148.24	180.00	125.00

**Table 4.** Sumba institutional cooking fuel daily consumption and the associated costs

Urban and rural settings of Cambodia affect the type of cooking fuel used in the institution. In urban settings represented by institutions in Phnom Penh, all the institutions use LPG with an average consumption of 11.23 kg/month or almost equal to one 12.5kg-sized LPG tube. The average cost per month to buy the LPG is US\$27.28. As many as 39% of the institutions in Phnom Penh practice fuel stacking in which they mostly use LPG and charcoal. However, charcoal is only used for occasional purposes like having a BBQ. Thus, the consumption of charcoal is low (7.85 kg/month) and the cost is only US\$3.09. In Kampong Thom, all the institutions use firewood. The average consumption is 144.6 kg/month. Almost all the institutions located in Kampong Thom obtained the firewood as donations from the local community and the students, therefore the institutions do not need to allocate any associated costs, either in the form of money, time, or labour.

#### **Strategy to reduce fuel consumption**

Most institution representatives in Sumba agree on the strategy to do upfront preparation before starting the fire and to use the fire efficiently. One noted that the institution has ever used an energy-saving stove before but stopped short since it required longer cooking time. As aforementioned, one institution uses agricultural waste (corn cobs) to cook as a strategy to substitute the cooking fuels. Others noted that he/she uses the remaining firewood to cook again

later. In Sumba, firewood is often mentioned to be used to boil water or for large volume cooking while in Cambodia, half of the institutions (52%) own a water filtration, thereby they can source their potable water from filtered tap water. Only some institutions in Cambodia mentioned their measures to reduce fuel use, such as preparing the materials before using the fuel, unplugging cables after using electric cooking devices, putting on the lid to make the cooking faster, and to cook foods right before serving time to avoid having to reheat the food.

#### 4.6. Health impact of current cooking practices

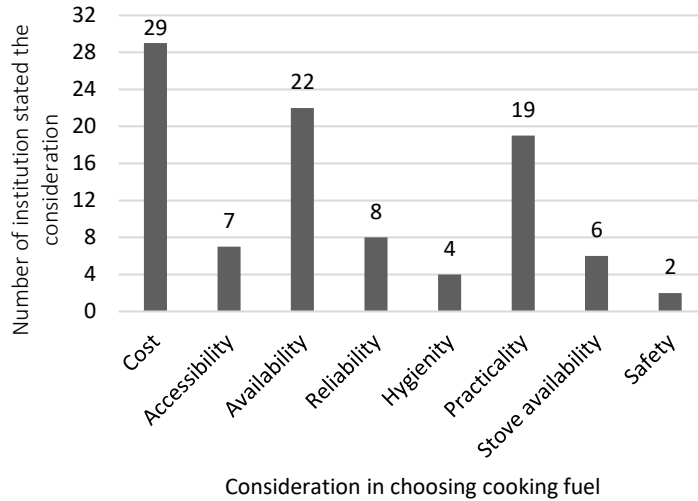
The health impact incurred from cooking practices are closely related to the choice of fuel. In Sumba and Kampong Thom, where firewood is still the dominant cooking fuel, health problems experienced by members of the institutions include eye infection, red eye, and breathing difficulties. The respondents from Kampong Thom noted cooking practices as the cause of those health problems. However, in Sumba, the respondents have mixed responses regarding the cause of the health complaints. Some attributed this to the cooking practices, while others in the survey responded that the health complaints that they experienced are not the side effects of cooking with firewood. From the interviews, the respondents mentioned that they feel these health concerns are only temporary. Once they are finished with cooking, they no longer suffer from the red eye, heat, or coughs.

Where the cooking fuel is sourced from LPG, such as the case in Phnom Penh, the line connecting health concerns and the choice of fuel have become quite blurry, as the survey has shown that no direct health impacts are incurred from cooking practices. The health concerns are mostly attributed to the changing weather. Solutions to most of the ailments are medicine, in both instances of Phnom Penh and Sumba. Only several respondents from Kampong Thom who answered that their health complaints are due to cooking activity perceive changing the fuel as part of the solution. In analysing the health impact from the cooking practices, choice of fuel is only one part of the equation. The condition of the kitchen also plays as a determinant in exacerbating or minimizing the health concerns.

#### 4.7. Perception on shifting to modern cooking energy

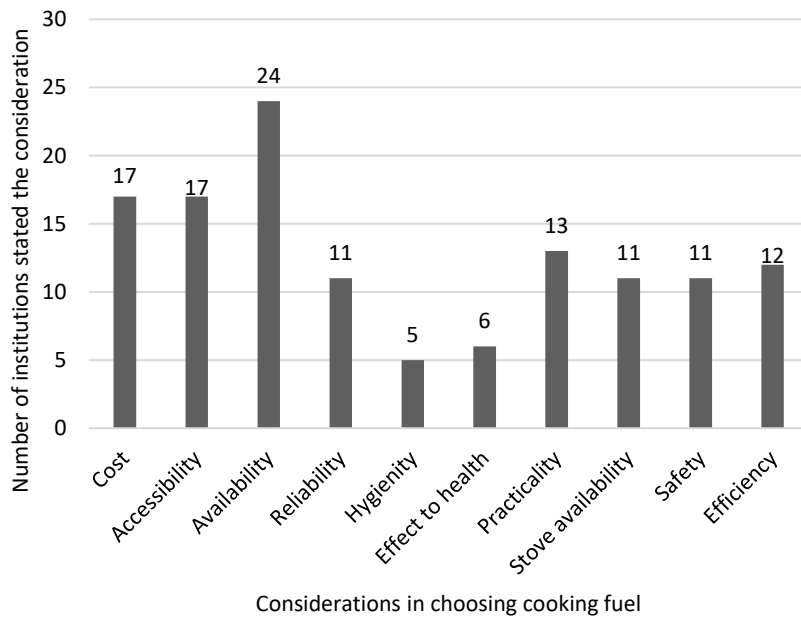
##### **Consideration in choosing the cooking fuel**

In Figure 3, it can be seen that the institutions in Sumba consider affordability, availability, and practicality as the main considerations in determining the cooking fuels. Affordability and availability are related to each other in which when the availability of the fuel is low, the low supply increases the price. When there is scarcity, institutions tend to shift to firewood as it is always available around. Availability is an important factor especially for the institutions located far away from the city centre. Other than the two factors, many also mentioned ease of use.



**Figure 2.** Considerations of types of cooking fuel use in Sumba

In Phnom Penh and Kampong Thom, the three main considerations are availability, accessibility, and cost as seen in Figure 3. Notably in Kampong Thom, many institutions mentioned stove availability as one of the reasons for using the current cooking fuel.

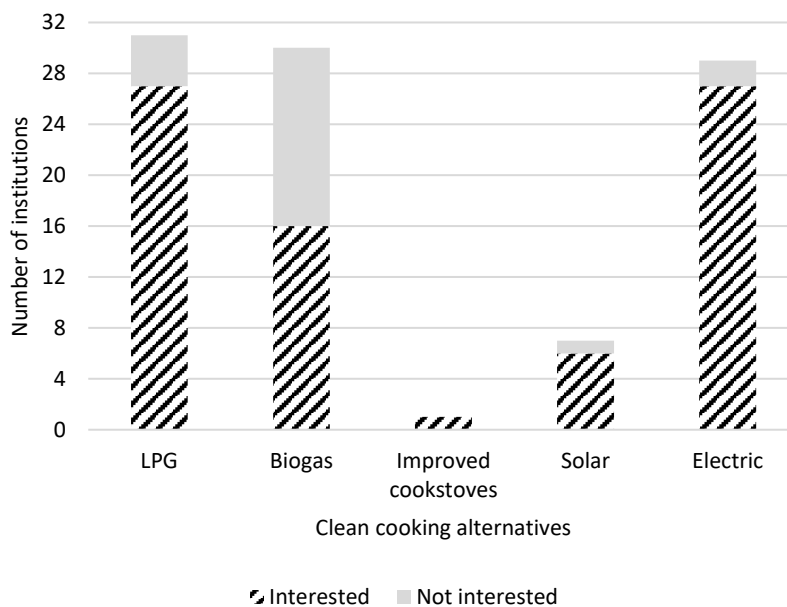


**Figure 3.** Considerations of types of cooking fuel use in Cambodia

## Perception of clean cooking alternatives

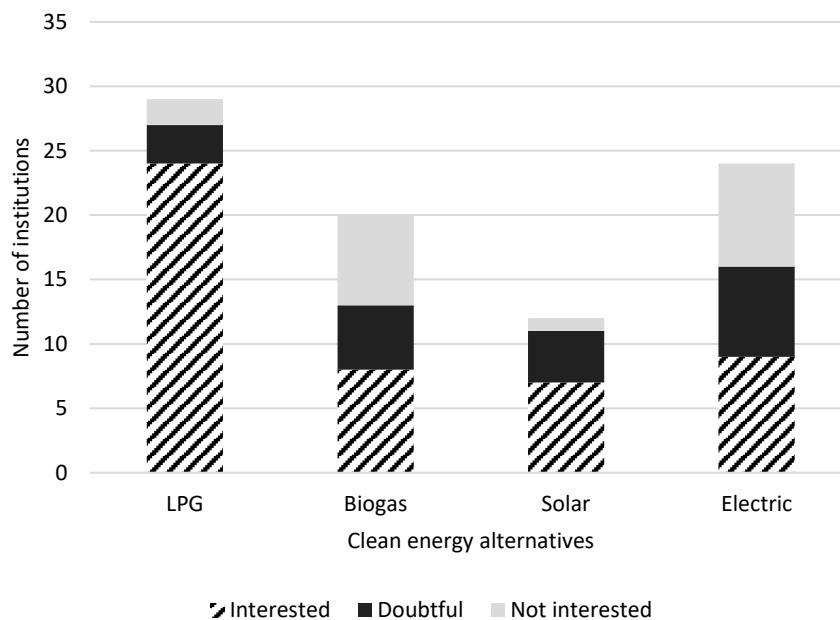
The institutions in Sumba were also asked for their perception on several clean cooking alternatives, LPG, biogas, improved cook stoves, solar cooker, and electric cooker. The solar cooker is mostly perceived as a stove connected to solar panel as no uses of direct solar cooker has been reported in the surveyed area. From Figure 4, the height of the bar shows the number of institutions with awareness of the clean cooking alternatives. From the three alternatives with highest awareness (LPG, electric cooker, and biogas), electric cooker has the highest percentage of those interested to use i.e. 87% while biogas is split into approximately half between those who are interested (53%) and those who are not (47%). Media and relatives being the most notable source of awareness for LPG and biogas, while for electric cookers, the State Electricity Enterprise plays a fairly big role in the awareness raising. Siti Suryani mentioned in a personal interview that PLN is involved in the adoption of electric cooking through the “Gerakan Berpindah Peralatan Masak Listrik” scheme or Transition to Electric Cooking Movement. This program aims to raise awareness about clean cooking and lowering carbon emission through a cooking competition with a prize of induction stove. This program could explain the high interest for electric cookers, highlighting the importance of involvement from PLN as the sole electricity provider in Indonesia.

Perception towards LPG is dominated by the potential of cost savings as it says to be more economical. The barriers are mostly due to the limited budget. Other barriers are surrounding the operation e.g. worries of wrong use, cannot be used for large volume cooking and worries of explosion. Biogas faces varying barriers with most institutions noting the insufficient manure. There are two institutions who have had the biogas digester, both stopped to use it because the fire produced was small and lack of knowledge on how to operate it. While solar may only be known by several institutions, most of them are interested although they worry about the cost and accessibility of the appliances. Lastly, electric cookers are relatively well known for being economical and practical considering one does not need to gather the fuel anymore. However almost all mentioned budget limitation as their main constraint.



**Figure 4.** Perceptions of clean cooking alternatives in Sumba

Affordability of LPG is also the main constraint that hinders the transition of the institutions to use LPG in Kampong Thom and Kampong Speu. Perception about biogas and electric cookers are mixed in Cambodia as seen in Figure 6. Most people highlight the complexity in installing and operating the biogas as reason of being not interested. Similarly with electric cooker, many mentioned about the barriers instead of the opportunities e.g. high cost, not efficient, low capacity, and safety concerns. For solar cooker, the concern is about the high installation cost, although some noted about the potential cost saving. There are mixed perceptions about the type of solar cooker, some institutions that have solar panel for lighting tend to perceive it as a stove connected to solar panel while the rest might perceive it as a direct solar cooker. The variability of the perceptions surrounding the operability of solar cooker and electric stove highlights the needs for awareness raising about the two alternatives. The perception about improved cook stoves were only asked to those that used firewood, therefore the institution samples are smallest and thus not included in Figure 5. All of those who were asked are not aware of an improved cook stove. The source of awareness of these clean cooking alternatives are mostly coming from relatives or friends.



**Figure 5.** Perceptions of clean cooking alternatives in Cambodia

### Perception of inter-linkages to household cooking practices

In Sumba, if the cooking fuel used in the person’s host institution is the same as the cooking fuel used in their household, the cooking team tends to bring their household cooking experience to the ICP. However, the ICP provides a learning practice for using a clean cooking alternative. For example, in those institutions using LPG, the cooking team who initially had safety concerns over wrongful use of the LPG or had never used LPG before are encouraged to use it according to the institutions’ procedure. In Cambodia, the perception is equally separated into those who stated that cooking experiences in institution and in household does not influence each other and those who stated that there is an influence. Many mentioned that both settings are different thus the experience would not affect each other.

## 5. Conclusion

The institutional cooking practices (ICP) is a complex setting for a transition towards clean cooking alternatives but it also provides a bigger positive impacts. In exploring both the complexity and the potential impacts, the report compares the different characteristics of ICP in the two countries, Cambodia and Indonesia, to gain a more comprehensive understanding. In both countries, cost is undoubtedly one of the biggest factors that could be a barrier or an opportunity. It is one of the main considerations in determining the types of fuel used, although it may be not a strong-enough one to drive the transition as it only makes up a small portion of the total cooking expense. Looking beyond cost saving potential, transition towards clean cooking alternatives holds an important opportunity in increasing the health of those involved in the kitchen, who mostly are women. They are often not the one who gets to decide the cooking fuel to use, even though they are the most impacted one. The low awareness of the health impact associated with cooking alleviated the problem as children are also involved in cooking practices. Prolonged exposure to the pollutant may impact their future wellbeing. Even so, designing an ideal clean cooking alternatives for ICP is a complex challenge. Institutions have to provide meals for a large number of people in a set schedule with only a small team. Therefore, aside from cost, availability, accessibility, and efficiency are among the most important considerations. External factors like utility service and supply chain also inevitably affect the ICP, which might require an even more complex intervention.

In spite of the complexity, the transition could be made possible through the participation from the identified actors, for example, the role of governmental institution is found to be crucial in increasing of positive awareness about certain cooking alternatives. Moreover, the strong role of the donor in ICP may also be an opportunity to drive the transition.

## 6. Study limitation and future research.

To support further research in ICP, the study limitation and recommendations for future research are explained in this section. The related discussions will be separated based on the location of the survey. In the case of Sumba, the information scarcity about ICP is found in the field, where many respondents including the enumerators have just introduced into the topic, causing difficulties in explaining the objectives of the research and hesitation from the institutions, especially from those with strict procedures from the government. Enumerators have to come at an unspecified eating time, to avoid the institutions to lavish up their menus. The ICP in Sumba may provide a unique perspective about renewable energy transition in the area in terms of how to provide alternatives if firewood prohibition enforcement should be made strict. Furthermore, the clean cooking alternatives tend to be heavily dependent on the State Electricity Enterprise as the sole energy provider in Indonesia.

People are also not too familiar with ICP in Cambodia. Another constraint is the possible conflict of interest with the running feeding programs from several NGOs. The institutions are hesitant towards the survey as they perceive it as an audit for such a program. Moreover, in Cambodia, technical problems are often the underlying reason for modern energy cooking within ICP. It is difficult to ask for the people's perception about clean cooking alternatives as the real implementation needs to be more mainstream. This is especially true considering LPG is still not addressed by proper policies and electricity access is still constrained by the decentralization strategy.

In both loci, firewood is also highly used in the commercial small- and medium-sized enterprises, therefore to address the implication of firewood consumption, the research could be expanded to survey these institutions as well.

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