

Services to Collect a Portfolio of Data Adding Evidence to Research on Fuel Stacking

NUDGING EXPERIMENT REPORT

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AI has been used in the production of this output to improve grammar and the English wording of the text. All decisions regarding research design, analysis, interpretation, and presentation of the findings were made solely by the authors

List of abbreviations

CC	Clean Cooking
e-bag	Energy saving bag for cooking also known as Wonderbag
e-RC	Electric Rice Cooker
HH	Household(s)
KPT	Kitchen Performance Test
LPG	Liquefied Petroleum Gas
LU	Loughborough University
MECS	Modern Energy Cooking Services
R&D	Research and Development
SL	Sierra Leone
ToRs	Terms of reference
TSOF	Three Stone Open Fire

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1. Introduction

This report describes and analyses the results of the nudging experiment. The objective of this experiment is to test the effect of two low-cost nudges on the share of meals/events cooked with modern fuels (LPG, and/or e-cooking) within stacked households. The selected nudges are easy to integrate in government policies/ decision-making, and with vendors and community partners.

2. Methodology

For the nudging experiment a mixed method approach was used, combining both quasi-experimental and randomized controlled trial (RCT) designs. The quasi-experiment utilized baseline data collected from earlier research stages - such as household surveys, focus group discussions, and Cooking Diaries & KPT information - alongside detailed profiling of cooking habits among selected households. The experiment also included a simplified RCT methodology, where reminders like calls or text messages were made to households to encourage them to use the new cooking solution. The main research question the experiment sought to answer was:

“How can we increase the share of the menu cooked using clean fuels by households in Sierra Leone?”

Action on Nudging

The nudging actions for the experiment were as follows:

- 1) Provision of an electric Rice Cooker (e-cooker) to test:
 - how e-cookers replace charcoal and/or LPG for cooking rice by households (N = 7, Baseline = 0: - no experience in using e-Rice Cookers)
 - whether the use of the e-cooker can be increased further through small behaviour nudges (calls, text messages), everything being equal (N=7: $P_e = 4$ and $P_c = 3$)
- 2) Provision of an insulated cooking bag (e-bag/Wonder Bag) to test:
 - the potential of increasing households' use of LPG in combination with an e-bag (N = 8, Baseline = 0: no experience in use of the Wonder Bag/e-Bag)
 - whether the use of the e-bag can be increased further through small behaviour nudges (calls, text messages), everything being equal (N=8: $P_e = 4$ and $P_c = 4$)

The experiment lasted 14 days. The first 7 days were used for the actual experiment, and the other 7 days were the cool-off period where households were not contacted until mid-week and the last day of the cool-off period to learn whether households volunteering used the new solution/technology for cooking during and after the experiment.

Experimental Procedures

The following steps were employed for the conduction of the experiment:

1. Selection of Participants

Twenty participants were purposively selected for the experiment from the 200 households in the scaled survey. The selected participants met the selection criteria for each of the two treatments, i.e., having no previous knowledge of using an e- rice cooker and e-bag, respectively, or have not used one for the past one month and why? Unfortunately, only fifteen households finally took part in the experiment. Five households did not participate in the training for personal reasons, so it was decided to not include them in the experiment.

2. Consent and Profiling

Participants were briefed on the purpose of the study and agreed to participate by signing a consent form. The households' profile was recorded, including their Names, Home Address, Telephone number, type of fuel and stove used to prepare Breakfast, Lunch, and Dinner in the past 7 days, knowledge of e-cooker and e-bag. This information was used as baseline data

3. Cooking Solutions' Training and Demonstration

Two separate trainings and demonstrations were conducted for the participants, one for households that use e-rice-cookers, and the other one for the e-bag users. Each household's participant was trained on how to use the technology provided. In the case of e-bag users, two methods of preparing rice were presented that had been tested beforehand. In the cold-water method, the rice with some salt is poured into cold water. The rice water mixture is heated to the boiling point and the cooked for 10 -15 minutes. The pot is then placed in the e-bag, where it remains for approx.20 – 25 minutes. In the hot-water method, the rice is poured into boiling water and cooked for 15 – 20 minutes. The pot is then transferred to the e-bag for around 35 minutes.

4. Experimentation

As discussed above, the experiment was conducted by two groups. Each group was supplied with a cooking solution that the households in each group were using for the first time. The aim of the experiment was to learn whether households use the technology for cooking rice based on their knowledge of its benefits, especially in relation to clean cooking.

All members of each group were supplied with the new technology and trained in its use. Four participants (Pe) in each group were randomly selected for nudging reminders (one call in the morning before cooking starts and after cooking in the late afternoon) for

the first seven days. The other group was the control (Pc). Pc received only one call after cooking in the late afternoon to find out whether the technology was used during cooking or not. Each household in each group was physically visited ones in the beginning of the experiment and upon request of the households or whenever a problem came up with the device.

5. Data Collection and Analysis

A simple data collection form was prepared to capture the households' profiles in each group, the daily responses of (Yes/No) to using the technology or not, and why not if not used, in the first 7 days. Additional data were collected in the cooling-off period of 7 days, whether HH used the new technology for cooking rice.

Data collected during the experimentation is analysed and presented in the present report. It is worth noting that the experiment only allows a preliminary first impression of the nudging effect. More in depth insights about possible nudging effects of the selected interventions on participants would require follow-up surveys with a much larger sample over a longer of period of time.

3. Results and Main Findings

3.1. Profiles of the Selected Households

E-bag households

The profile of the households that received an e-bag is summarized in Table 1. All households used charcoal as the main fuel. Six out of eight used LPG as secondary fuel. All households had access to grid electricity, but seven out of eight did not use it to cook rice or a full meal. Only one household occasionally used electric power for cooking. There was no difference between rice and the other ingredients in terms of fuel choice. The households had an average size of 6.25 members. The average monthly income was around 3500 NLe, which is equivalent to approximately £125. None of the HH had heard of the e-bag before.

Table 1: Profile of E-bag households

HH-ID	Household Size	Income Band	Heard of E-Bag	Electricity Access	Electricity Source	Primary Fuel	Secondary Fuel	Main Fuel Used for Rice	Secondary Fuel Used for Rice?
e-bag-001-rem	9	500	no	yes	grid	charcoal	firewood	charcoal	firewood
e-bag-002-rem	5	8000	no	yes	grid	charcoal	LPG	charcoal	LPG
e-bag-003-rem	5	1000	no	yes	grid	charcoal	LPG	charcoal	LPG
e-bag-004-rem	7	7500	no	yes	grid	charcoal	LPG	charcoal	LPG
e-bag-001-con	9	6000	no	yes	grid	charcoal	LPG	charcoal	LPG
e-bag-002-con	4	2500	no	yes	grid	charcoal	LPG	charcoal	LPG
e-bag-003-con	6	1000	no	yes	grid	charcoal	none	charcoal	none
e-bag-004-con	5	2000	no	yes	grid	charcoal	LPG/Electricity	charcoal	LPG/Electricity
Average	6.25	3562							

Electric Rice-Cooker households

Households that received an electric rice-cooker did not differ substantially from e-bag households (see table 2). All households also used charcoal as the main fuel. However, the number of households that used electricity as a secondary cooking energy source alongside LPG was significantly higher (4 out of 7). In these households, too, the fuel used for cooking rice did not differ from that used for other ingredients of the meals. The households had an average size of 6.57 members. The average income was around 3200 NLe, which is equivalent to approximately £115. The majority (4 out of 7) had heard of electric rice-cookers and had basic knowledge about the device.

Table 2: Profile of electric rice-cooker households

HH-ID	Household Size	Income Band	Heard Of E-RC	Electricity Access	Electricity Source	Primary Fuel	Secondary Fuel	Main Fuel Used For Rice	Secondary Fuel Used For Rice?
e-RC-001-rem	8	1000	no	yes	grid	charcoal	LPG/Electricity	charcoal	LPG/Electricity
e-RC-002-rem	8	3000	no	yes	grid	charcoal	LPG/Electricity	charcoal	LPG/Electricity
e-RC-003-rem	7	5000	no	yes	grid	charcoal	LPG/Electricity	charcoal	LPG/Electricity
e-RC-004-rem	4	500	no	yes	grid	charcoal	LPG/Electricity	charcoal	LPG/Electricity
e-RC-001-con	5	2800	yes	yes	grid	charcoal	none	charcoal	none
e-RC-002-con	6	5000	yes	yes	grid	charcoal	LPG	charcoal	LPG
e-RC-003-con	8	5000	yes	yes	grid	charcoal	firewood	charcoal	firewood
Average	6,57	3186							

3.2. E-bag Use

First week with daily contacts to the households

The results of the Kitchen Performance Test clearly showed that although cooking with LPG is significantly more energy-efficient than cooking with charcoal, the cost per meal is considerably higher. In the survey and focus group discussions, households cited high costs as one of the main obstacles to cooking with gas. The provision of an energy-saving cooking bag, known here as an e-bag, was intended to address this barrier. Using an e-bag can easily reduce fuel consumption and consequently save at least 20% of the cost by removing the pot from the stove in an early cooking stage and placing it in the heat-insulated e-bag, where the food continues to cook. The cost-saving effect is particularly noticeable with LPG as a relatively expensive fuel. For this reason, the cooking of rice with LPG in combination with the e-bag was used when introducing the e-bag into households and training them in its use. The finding shows that cost savings are also achieved by combining charcoal and e-bag.

The central hypothesis of this nudging approach was therefore that households would recognise and appreciate the energy and cost savings offered by the e-bag and would therefore continue to use it. In addition, both for the e-bag and the rice cooker, it was investigated whether reminding households daily in the morning of the advantages of the devices will nudge the households to increase the frequency of use compared to a non-reminded control group.

Table 3 summarizes the main results of the experiment with an e-bag as a nudging activity for the first seven days. Although six of the eight households owned a gas stove

and the corresponding gas cylinder, only one household used LPG on one day to cook rice during the study period. All other days and in all other households, the meals and rice were cooked with charcoal, except for one meal in one household, which was prepared with firewood. The main reason for this was that the gas cylinders in most households were empty and were not refilled. On several days during the experiment, however, refilled gas cylinders were also very difficult to obtain in retail outlets.

When households cooked rice, they used the e-bag in more than 90% of cases, showing a high adoption rate of the device.

Table 3: Use of e-bags for rice cooking during the first 7 days of the experiment

HH-ID	No of test days	LPG available (No. of days)	cooking rice (No. of days)	use of the e-bag (No. of days)	Fuels (charcoal, firewood or LPG) used to prepare rice (No. of days)		
					charcoal	firewood	LPG
e-bag-001-rem	7	0	6	3	5	1	0
e-bag-002-rem	7	1	7	7	6	0	1
e-bag-003-rem	7	1	7	7	7	0	0
e-bag-004-rem	7	0	6	5	6	0	0
e-bag-001-con	7	0	5	5	5	0	0
e-bag-002-con	7	0	5	5	5	0	0
e-bag-003-con	7	0	7	7	7	0	0
e-bag-004-con	7	0	4	4	4	0	0
total	56	2	47	43	45	1	1
% of total test days		3,57%	83,93%	76,79%	80,36%	1,79%	1,79%
Average		0,25	5,875	5,375	5,625	0,125	0,125

On days when the e-bag was not used (23% of all test days), it was usually because no rice or no meal was cooked (Figure 1). One household initially had problems with the

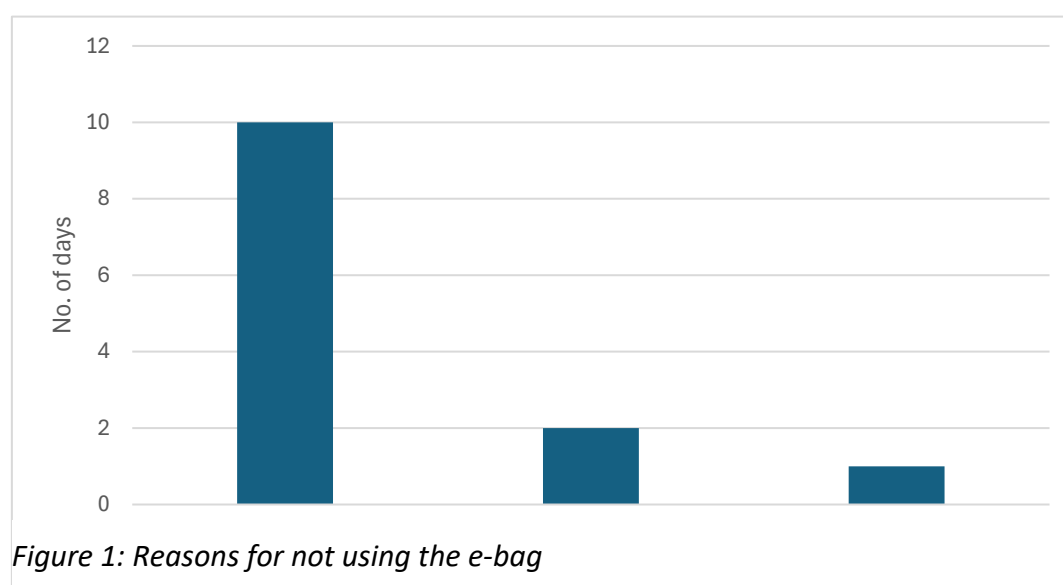


Figure 1: Reasons for not using the e-bag

small size of her e-bag compared to the size of her pot, so the HH received a larger e-bag. This household also had initial problems understanding how the e-bag works.

Second week without daily contacts to the households

The use of the e-bag did not decline even after the test households were no longer contacted on a daily basis. At the end of the fourth and seventh days of the second week of the experiment, the households were asked again whether and how often they had used the e-bag. Table 4 shows that, as in the first week, the e-bag was always used when rice was cooked. The usage rate here was 98%, irrespective of fuel used. In one cases the rice was cooked on an electric plate and the other used LPG for the entire seven days. All household assured that they would continue to use the e-bag. When asked whether they would sell the e-bag for around 10 USD, no one was willing to do so. Instead, some were interested to buy a second one.

Table 4: Use of the e-bag in the second week

HH-ID	No of test days	cooking rice (No. of days)	use of the e-bag (No. of days)	Fuels (charcoal, firewood or LPG) used to prepare rice (No. of days)		
				charcoal	electricity	LPG
e-bag-001-rem	7	7	7	7	0	0
e-bag-002-rem	7	7	7	0	0	7
e-bag-003-rem	7	6	6	6	0	0
e-bag-004-rem	7	7	7	7	0	0
e-bag-001-con	7	7	7	7	0	0
e-bag-002-con	7	1	1	1	0	0
e-bag-003-con	7	7	7	7	0	0
e-bag-004-con	7	7	6	6	1	0
total	56	49	48	41	1	7
% of total test days		87,50%	85,71%	73,21%	1,79%	12,50%
Average		6,125	6	5,125	0,125	0,875

3.3. E-Rice-Cooker Use

First week with daily contacts to the households

Rice is by far the most important staple food in Sierra Leone. It is mixed with different vegetables like potato and cassava leaves, beans, cabbage, tomatoes, okra, fish, and meat (see survey data). In most cases, rice, like the other components of the meal, is cooked on a charcoal stove in urban and peri-urban areas. LPG burners are used much less frequently, and electric cookers even less so. However, electric rice cookers offer a comparatively inexpensive and easy-to-use alternative for cooking rice, as their widespread use in Asia shows. Therefore, the provision of an electric rice cooker was chosen as the second nudging activity.

Our central hypothesis was that HH would find the electric rice cookers interesting once they had experience with them during the test phase. As a result, households would be willing use the rice cooker after the experiment. As already mentioned for the e-bag nudging, it was also investigated whether reminding households daily in the morning the advantages of the e-RC would increase the frequency of use compared to a non-reminded control group.

Table 5 summarizes the main results of the experiment with e-RC as nudging activity for the first seven days. All HH were connected to the grid. However, electricity was often not available during the test days (27 of 49 test days), which is reflected in the low usage rate of e-RCs.

Table 5 Use of electric rice cookers during the first 7 days of the experiment

HH-ID	No. of test days	Electricity available (No. of days)	cooking rice (No. of days)	use of the e-RC (No. of days)	Other fuels (charcoal, firewood or LPG) used to prepare rice (No. of days)		
					charcoal	firewood	LPG
e-RC-001-rem	7	4	7	4	4 ¹	0	0
e-RC-002-rem	7	2	7	2	5	0	0
e-RC-003-rem	7	2	7	2	5	0	0
e-RC-004-rem	7	2	7	2	6 ¹	0	0
e-RC-001-con	7	3	5	3	3 ¹	0	0
e-RC-002-con	7	4	7	4	3	0	0
e-RC-003-con	7	5	7	5	2	0	0
total	49	22	47	22	28	0	0
% of total test days		44,90%	95,92%	44,90%	57,14%	0,00%	0,00%
Average		3,14	6,71	3,14	4,00	0,00	0,00

Across all households, the rice cooker was used on 45% of days, or an average of 3.14 out of 7 days. This is identical to the number of days on which households had access to electricity. On all other days, when there was a power outage, households prepared the rice on a charcoal stove.

Second week without daily contacts to the households

The usage rate for the rice cooker remained high (57%) after the test households were no longer contacted daily, provided that the households had electricity (table 6). The latter was not the case on 43% of the days without electricity. On these days, the households mainly used charcoal to prepare rice. With a share of 57% of all prepared rice dishes, the number of days on which the rice cooker was used was exactly as high as the number of days with a stable power supply during the cooking time.

Household appreciated the high cleanliness and convenience of the rice cooker. The speed of the cooking depended on the voltage of the electricity. But in general, they household considered the time as satisfying. Households differed in their opinion about the cost. Some had the impression that they can save money, others referred to the high electricity cost, which would have a negative impact as a cost factor.

¹ The household used partly the rice cooker and partly a charcoal stove as a power outage happened during cooking.

Table 6: Use of the e-rice cooker in the second week

HH-ID	No. of test days	Electricity available (No. of days)	cooking rice (No. of days)	use of the e-RC (No. of days)	Other fuels (charcoal, firewood or LPG) used to prepare rice (No. of days)		
					charcoal	firewood	LPG
e-RC-001-rem	7	5	7	5	2	0	0
e-RC-002-rem	7	4	7	4	3	0	0
e-RC-003-rem	7	4	7	4	3	0	0
e-RC-004-rem	7	0	7	0	7	0	0
e-RC-001-con	7	3	7	3	4	0	0
e-RC-002-con	7	6	7	6	1	0	0
e-RC-003-con	7	6	7	6	1	0	0
total	49	28	49	28	21	0	0
% of total test days		57,14%	100,00%	57,14%	42,86%	0,00%	0,00%
Average		4,00	7,00	4,00	3,00	0,00	0,00

4. Conclusions

The results of the nudging experiment show that the adoption rate for both the electric rice cooker and the e-bag was high. This is reflected in the fact that both devices were used intensively under appropriate conditions. In the case of rice cookers, usage depended solely on whether households had electricity or were affected by power outages. The test households expressed a high level of appreciation for the devices.

Almost all households in the e-bag group highlighted that the e-bag saves time and fuel and is very economical compared to using the traditional method of preparing rice. Some households also realised that the e-bag can not only be used for cooking rice but also to keep food warm. This feature could be particularly useful during Ramadan as majority of Sierra Leoneans are Muslim.

Households appreciate the rice cooker above all for making their work easier and saving them time. The exact cooking time may vary depending on whether the voltage of the grid is stable at 220/40 V or drops to lower values. One household reported an increase in cooking time using the rice cooker, from 25 minutes on Day 1 to approximately 45 minutes on Day 2 due to voltage fluctuation. Households also found power failures during cooking highly frustrating. They then had to transfer the rice to another pot and usually cook it on a charcoal stove, which meant additional effort. A necessary condition for the increased use of electric rice cookers and other electrical appliances is a stable power supply.

Both rice cookers and e-bags have the potential to play an important role in increasing access to and use of clean cooking energy. However, their market penetration is hampered by cost and awareness of their significance.

The purchase price for a rice cooker for six servings is at least USD 30 in Sierra Leone. Added to this are the consumption costs. The rice-cooker in our experiment was a 1000-Watt cooker running for 37 minutes. It consumed about 0.62 kWh (kilowatt hours). At an electricity price of NLe 5.23 (=£ 0.18), the cooking of rice incurred electricity costs amounting to NLe 3.24 or about £ 0.11. In the KPT it was shown that the average cost of cooking 5 meals with LPG is £ 1.92, or £ 0.38 per meal. With charcoal, this amount is £0.85 for 5 meals (high charcoal price), or £ 0.17 per meal. Considering that we are only looking at cooking rice here, it can be concluded that the electricity costs of the rice cooker are roughly the same as the costs of LPG consumption. However, they are higher than when rice is cooked with charcoal.

The e-bags used in the present experiment are still test products. The e-bag is not yet established on the market in SL, which is why there is no commercial purchase price yet. Experiences with a comparable product in South Africa, known as Wonderbag show that it will be very difficult to launch the e-bag at a retail price below £ 20. Assuming that the e-bag saves 20% in fuel, this would mean savings of £0.08 per meal for LPG and £0.03 for charcoal. This means that the acquisition costs for the e-bag would be amortised after 250 meals with LPG and after 667 meals with charcoal. Under purely commercial conditions, the e-bag would only be a niche product with limited market success. However, one household with a high charcoal consumption was convinced that they can save a higher percentage of fuel and reduce the charcoal cost per day by NLe 10 = around £ 0.35. That would mean that a payback of the purchasing cost of the e-bag would be achieved already after 57 days. Thus, further research (particularly KPTs) would be needed to find out which savings through the e-bag are realistic for the majority of households. In any case, several households expressed their interest to buy an e-bag for around 10 USD.

To push both products in the market, they would need to be subsidised in terms of their purchase price. Only a drastic increase in fuel prices (especially for charcoal) would change this situation. In the case of rice cookers, however, the first prerequisite is a stable power supply.

Annex 1: Specs of the tested Rice Cooker

1. Name of e-Cooker: Winning Star
2. Model Number: ST9344
3. Wattage: 1000W/1kW
4. Voltage: 220/240
5. Frequency: 50/60Hz.
6. Capacity: 6 Litres
7. Rice Cooking Capacity: 6/8Cups



Energy consumption during cooking demonstration

No. of Cups Rice: 6 Local Cups

Cooking Time: Start Time 11:46 Stop Time: - 12:23 = 37 Minutes

Energy Consumption: 0.62 kWh

Cost of kWh (Prepaid): NLe 5.23 including other charges (GST, Meter, etc.)

Cost of Cooking 6 Cups: NLe 3.24

Annex 2: Photos of the e-bag

