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Enablers of Strong Cookstove Sales through a Purchase Offer Approach in Rural Senegal - An Explorative Analysis

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Gunther Bensch and Jörg Peters[1]

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Abstract

The use of well-designed improved cookstoves (ICS) in regions devoid of modern energy yields high private and social returns, mostly related to considerable woodfuel savings. Take-up rates are nonetheless often very low when people have to pay cost-covering prices. This paper presents main results of a study in rural Senegal where households were individually invited to purchase ICS in their villages. Households' ICS purchases and willingness to pay levels turned out to be unexpectedly high. We therefore explore potential factors behind this surprisingly high adoption, particularly those features of our approach that deviate from common real-world ICS markets. We observe that especially the way we designed our personalized door-to-door sales offer is an important determinant. Based on our findings, we derive insights for the design of future ICS dissemination programs.

JEL Classification: D12, D83, O13, O33, Q41

Keywords: Energy access; technology adoption; willingness to pay; rural Africa

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1 Gunther Bensch, RWI; Jörg Peters, RWI, University of the Witwatersrand, Johannesburg - We thank research seminar participants at GIGA in Hamburg/ Germany for valuable comments. Financial support of the Federal Ministry for Economic Cooperation and Development (BMZ) via the Centre for Development Research in Bonn (ZEF) is gratefully acknowledged. Peters gratefully acknowledges the support of a special grant (Sondertatbestand) from the German Federal Ministry for Economic Affairs and Energy and the Ministry of Innovation, Science, and Research of the State of North Rhine-Westphalia. We further thank the team of Centre de Recherche Pour le Développement Economique et Social, Saint Louis, Senegal (CRDES) for their outstanding support in conducting the original research on which this publication is based. – All correspondence to: Gunther Bensch, RWI, Hohenzollernstr. 1/3, 45128 Essen, Germany, e-mail: bensch@rwi-essen.de

1. Introduction

Most of Senegal is characterized by an arid climate and low biomass production. Due to the little remaining woody cover, firewood for cooking is in scarce supply and common coping strategies of households are taking more time to collect the wood, but also to buy more firewood or plant trees on their estates. Alternatively, they complement the three-stone fireplaces by simple metal stoves for the use of agricultural residues as cooking fuel – mostly from millet and maize. These traditional cookstoves, however, are very inefficient due to bad heat storage and combustion processes. Improved cooking stoves (ICS), in contrast, provide a low-cost remedy to reduce firewood consumption, but usage rates in rural households are close to zero although a few producers and vendors sell them in towns.

Against this background, we have implemented a long-term study in twelve villages in the Peanut Basin region in central Senegal starting in 2009 to evaluate firewood ICS in terms of their socio-economic and environmental impacts as well as households' acceptance and willingness to pay (WTP). In the present article we scrutinize findings from an ICS purchase offer in 2015 in which we first asked each respondent to state her/his WTP and only subsequently randomly allocated a sales price. Only if the stated WTP exceeds the allocated price, the respondent could purchase the ICS. Since this procedure was clearly communicated to the respondent, the stated WTP can be assumed to be very similar to the individuals' real WTP. We find that more than 75 per cent of the 350 sampled households make a bid that reaches or exceeds the market price of the ICS in towns nearby. This came as a big surprise for all stakeholders including the Government of Senegal's ICS promotion programme implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). Hitherto, this programme as well as others has faced enormous difficulties to market ICS in rural areas. We therefore explore potential factors that may have triggered the strong sales in this setting.

Considering household energy transitions as conceptualized by van der Kroon et al. (2013), we hereby focus on the study-related *household decision context* that can be influenced by intervention design, such as the stove marketing approach and the access to markets.[1] More specifically, we explore those features of our approach that somehow deviate from the business-as-usual approach on the ICS market, i.e. the personalized door-to-door character of our sales offer and the fact that parts of our sample households were already informed about the benefits of ICS usage through a free distribution trial in 2009. These potential factors will be discussed in section 3 after a brief description of the applied purchase offer approach, the offered ICS types and main findings on households' ICS purchase decision in section 2.

2. The ICS purchase offer

We build on a randomized controlled trial carried out in twelve villages in rural Senegal. In 2009, 40 per cent of sampled households were randomly allocated to receive an ICS at zero price (see Bensch and Peters 2015). After what can be considered a full life-cycle trial period for this ICS type, six years later in 2015 we offered households to purchase the same type of ICS or a second ICS type, the so-called Jambaar and Sakkanal. Both stoves are depicted in Table 1. We additionally included another six villages from the same region into the sample. Our sample thus comprised three groups of households: (i) those who already used an ICS, (ii) those from the same villages who did not receive an ICS in 2009 but who might have gained some indirect experience through their neighbours, and (iii) households in a "pure" control group without any particular experience with ICSs.

Households were informed in advance about a visit of a stove seller that also includes a survey on energy use; the person responsible for taking financial decisions

[1] We thus abstain from discussing the other two components of the energy transition framework, namely *external environment* (such as climate and geography) and *household opportunity set* (household characteristics), which is discussed in Bensch and Peters (2016*a*) from a broader technology adoption perspective.

in the household was requested to be present. Six enumerators were trained to act as ICS sales agents and followed a predefined procedure. Once in the household, enumerators started with a presentation of the Jambaar cookstove along the characteristics depicted in Table 1. Interviewees were then introduced to the purchase offer procedure according to the so-called Becker-DeGroot-Marschak mechanism (Becker, DeGrott and Marschak 1964), which has already been widely used in laboratory and field experiments to elicit consumer preferences: the bidder is asked to state her WTP for the ICS knowing that the price will be randomly drawn only after bidding.

Table 1: The offered improved cookstoves

	Jambaar	**Sakkanal**
		
Main sales pitches (in line with regional ICS promotion programme and presented in this order)	• quick cooking (less than 1h30 compared to 2h00 to 2h30 for traditional stoves) • safety and robustness • wood savings (40-45% as compared to three stones) • heat preservation • health and cleanliness • improvement of women's living conditions • quality-verified production from a producer in Dakar	• quick cooking (even quicker than Jambaar, around 1h00) • good-quality metal • wood and charcoal savings (40-45% as compared to three stones) • easy to move (due to low weight) • health and cleanliness • improvement of women's living conditions
fuel type	firewood	firewood and charcoal
market price	~ 5000 CFA F (10 USD); (8000 CFA F in the capital Dakar)	~ 5000 CFA F (10 USD)
expected lifespan	2-4 years	2-3 years

If the participant's bid equals or exceeds the price drawn, the bidder can buy the product for the price drawn. If her bid falls below the drawn price, no transaction takes place. Through this procedure, participants are incentivized to reveal their true,

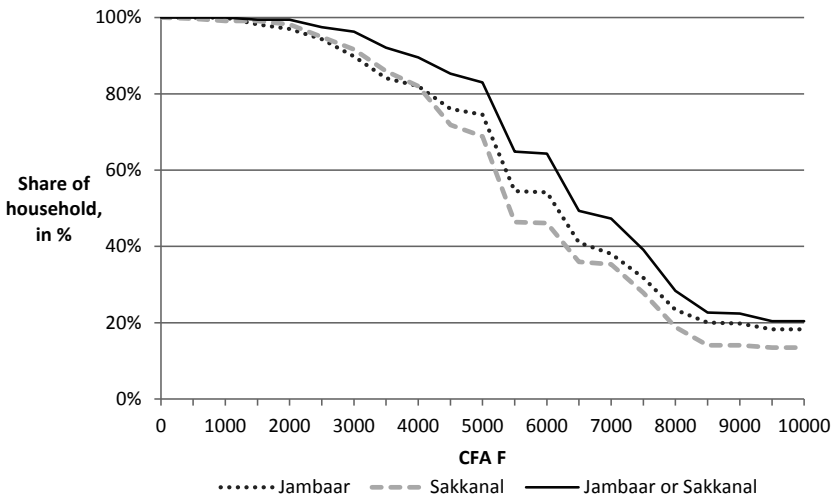
home-grown valuation for the stoves. During pre-tests, we noted that households were well able to grasp the purchase offer procedure and to confidently express their WTP. Households were allowed to make their payments with the village chief within a timeframe of about two and a half months, a time when most households tend to have sold at least parts of their harvest as a source of cash income. Subsequently, the enumerators revealed to the households that they could instead also buy another stove, the Sakkanal, for which the same purchase offer procedure followed. Virtually all visited households were willing to make a bid; only 5 households abstained from doing so.

After bidding for the stove and a structured interview, all survey participants came together later the same day to attend the public draw of the prices for the stoves. Those households who submitted a successful bid, signed contracts and received the stove. The draw balls contained prices between 4,500 and 6,000 CFA F, thus ranging around the market price of 5,000 CFA F (10 US$). Only during this afternoon meeting, but before signing the contract, households were informed about producers in the vicinity of around 5 to 20 kilometers who offer the ICSs at this market price; their contact details were also provided. Households were then allowed to withdraw from the contract, a right that was claimed by only six households. Similarly, merely seven households were found not to be willing or able to pay for the purchased stove, thus corroborating the validity of the expressed WTP values. Further details about the study setup can be found in Bensch and Peters (2016*a*).

For the remaining 337 households, Figure 1 depicts the demand curve that can be determined based on the WTP values. As many as 83 per cent of households expressed a WTP higher than 5,000 CFA F for either of the two ICSs and the average across all households amounts to 6,900 CFA F and 6,200 CFA F for the Jambaar and Sakkanal, respectively. This is clearly above prices charged by nearby stove producers and in striking contrast to very low WTP levels observed in other studies following similar elicitation methods for ICS and other entry-level energy access products (Beltramo et al. 2015; Yoon et al. 2016; Mobarak et al. 2012). Interestingly,

despite the lower WTP for the Sakkanal, two-thirds of households preferred this stove over the Jambaar, mainly because it can be used with both firewood and charcoal. Eventually, 150 Sakkanal and 115 Jambaar were sold.

Figure 1: Cookstove demand curve according to stove purchase offer bids



Although the BDM mechanism is incentive-compatible and implemented in a real market environment, the bids may deviate to some degree from what respondents would be willing to pay on an ordinary market – both positively and negatively. A main factor leading to a lower expressed WTP may be that the date of the purchase offer does not necessarily coincide with the intrinsically preferred purchase date, as the household may still dispose of a recently bought functional stove, for example (see also Table 2).

Table 2: Interviewee's approval of statements regarding their stove purchase offer bids

	Percentages		
	yes	no	I do not know
I would have wanted to bid more, but I haven't got more money than the bidden sum.	86	13	1
I think that this is the stove value on the market.	45	20	35
For me, the stoves have exactly the value of my bid.	64	17	19
I took the price of another stove as reference.	12	88	0
My bid would have been higher if it would have been at a time where I had needed a new stove (more).	82	12	6

3. Potential enablers of strong cookstove sales

Two general barriers that have been overcome through the stove purchase offer outlined in the previous section are lack of knowledge on improved stoves on the demand side and insufficient availability and marketing on the supply side. Yet, the relevance of these barriers in the given context is debatable. First, at least in the villages where we had conducted the ICS allocation in 2009, practical knowledge of the stoves existed but did not induce people to replace the ICSs over time as they became unusable.[2] Second, there are (albeit few) ICS producers in the area, notably in those towns where weekly markets are held that are highly frequented by people from the villages. It is thus questionable whether these two factors suffice to explain the previously observed very slack ICS uptake.

We therefore discuss further conditions of the household decision context that have been changed by the stove purchase offer and which may have contributed to the high and unexpected uptake of the ICSs. Main factors are listed in Table 3: first related to the specific interview condition created by our study, which may deliver insights to successful communication approaches and, second, related to the mode of delivery chosen in the study.

Table 3: Conditions of the household decision context changed by the stove purchase offer

Interview condition
one-to-one communication situation
household sampling
addressing person responsible for financial decisions
Mode of delivery
on-site stove delivery
payment period of around two and a half month (after harvest sales period)

With regards to the specific interview condition, the combination of the *one-to-one communication situation*, the *household sampling* (in our case, on average around every

[2] The impact of the stove allocation in 2009 on long-term ICS uptake behaviour is thoroughly analysed in Bensch and Peters (2016b).

third household got randomly sampled for the study) and *addressing the person responsible for financial decisions* seemed to have played a critical role. On the one hand, this has created a feeling of exclusiveness, which may have triggered more interest in the product and may have induced people to make more of an effort to obtain the product. Probably more importantly, in most cases we managed talking to those responsible for financial decisions, who are predominantly male in the rural Senegalese context (86 % of households report to have a male household head). This differs from common ICS marketing in the area which usually happens through product display at the blacksmiths' workshops or via women's groups, complemented by awareness campaigns by GIZ and similar stove actors.

The relevance of this factor is underscored by econometric estimation results where we regress such respondent-specific characteristics on the households willingness to pay (WTP) together with further socio-demographic, economic, and cooking-related controls (e.g. educational level of the household head, household expenditures, and main cookstove type, respectively). In cases where the person responsible for financial decisions was present during the bidding, the WTP for the Jambaar was 2,100 CFA F or 38 per cent and thus statistically significantly higher than in cases where that person was not present (p-value of 0.01). The respective differences for whether a person responsible for cooking was present during the interview or whether the household head is female are 800 and 350 CFA F, respectively (not statistically significant with p-values of 0.26 and 0.67). The picture for the Sakkanal stove is similar, though less strong and less clear-cut.

Two main conclusions can be drawn from this: first, while the literature rightly highlights the importance of women empowerment and that female-headed households may be more responsive to energy access interventions (see, for example, Karimu et al. 2016), our results show that communication strategies targeted to males can be highly effective in increasing stove sales in the short term. Second, sampling and intensive communication may serve as a cost-effective demand stimulating first

step before a larger and less resource-intensive roll-out in the same areas. In fact, feedback from the local ICS producers suggests that non-sampled households in the visited villages also purchased the stoves in larger numbers. We intend to follow-up on ICS diffusion in the study villages in a next step of our research.

The second set of conditions from Table 3, those related to the mode of delivery, may not only explain the high uptake of the ICSs, but present rational arguments for why households were willing to pay prices even higher than those charged by regional stove producers. *On-site stove delivery* may have nudged households, since transportation can be a relevant barrier for households to adopt cookstoves (see, for example, GACC 2013). In the present case, transportation is, however, unlikely an issue. Household members are regularly in the towns where ICSs are produced due to weekly markets. In addition, as many as 80 per cent of households own a donkey or horse cart. Transport can thus be easily and cheaply organized. While this is not necessarily for all regions in Senegal the case, this example underpins the importance of thorough market intelligence.

The second particularity of the mode of delivery adopted in our study was the *payment period of around two and a half month* granted to households. This definitely had an effect, as evidenced by the fact that the extension of the payment period from about one and a half to around two and a half months increased households' WTP for the Jambaar by about 650 CFA F (p-value of 0.07; no comparable question was asked for the Sakkanal). In this context it was also an important feature, that the purchase offer was conducted at a time of upcoming cash income due to harvest sales. Still, it is likely that the payment period rather helped to overcome short-term liquidity constraints than more fundamental credit constraints. Equipped with the information on stove producers, households could as well have waited for the upcoming harvest sales and then buy the stove themselves.

It thus seems plausible to conclude, that these two modes of delivery factors nudged households to translate their triggered interest into a stove purchase, though they are independently only of subordinate importance in the given context.

4. Summarizing conclusions

Market actors across rural Senegal but also in other African countries have a hard time in selling improved stoves (ICS, see for example Bensch et al. 2015; Mobarak et al. 2012; and Lewis and Pattanayak 2012). In our study, a large number of households living in relatively wood-scarce Senegalese villages was willing to purchase ICS at market prices or even above. The limited and specific sample can only provide indications on potential enablers of the strong cookstove sales. Similarly, the setup is not meant to be replicated as such in cookstove interventions. Nevertheless, our exercise provides some insights that might inform real-world ICS dissemination interventions. Our findings clearly suggest that people may be prepared to pay more for ICS than what is commonly expected. In our study context, however, certain nudges were necessary to make people actually purchasing the ICS. A particularly relevant feature seemed to be that we specifically addressed the person responsible to take financial decisions in the household, i.e. mostly males. Similarly, the study sampling may be a blueprint for designing cost-effective market activation approaches. In the best case, in a very first step evidence on the general acceptance, suitability and effectiveness of the respective product is gathered, as could be done in our study setup. While the stoves offered in this study are simple entry-level improved stoves, the results can likely be transferred to similar as well as higher-tier modern energy access technologies.

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