A Hard Bargain? A cost benefit analysis of an improved cookstove program in India

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EXECUTIVE SUMMARY

INTRODUCTION

In developing countries, access to modern energy for cooking and heating still remains a challenge to raising households out of poverty. About 2.5 billion people depend on solid fuels such as biomass, wood, charcoal and animal dung. The use of solid fuels has negative outcomes for health, the environment and economic development (Universal Energy Access, UNDP). In low income countries, 1.3 million deaths occur due to indoor smoke or air pollution from burning solid fuels in small, confined and unventilated kitchens or homes. In addition, pollutants such as black carbon, methane and ozone, emitted when burning inefficient fuels, are responsible for a fraction of the climate change and air pollution (Scovronick, 2015). There are international efforts to promote the use of clean cookstoves in developing countries but limited evidence on the economic benefits of such distribution programs.

This study undertook a systematic economic evaluation of a program that distributed subsidized improved cookstoves to rural households in India. The evaluation examined the effect of different levels of subsidies on the net benefits to the household and to society. This paper answers the question, "*Ex post, what are the economic benefits to various stakeholders of a program that distributed subsidized improved cookstoves?*" In addressing this question, the evaluation used empirical data from India applied to a cost-benefit model to examine how subsidies affect the costs and the benefits of the biomass improved cookstove and the electric improved cookstove to different stakeholders.

METHODOLOGY

This study assesses a stove distribution project in Uttarakhand, India where households purchased either an improved biomass cookstove or an electric cookstove and paid for it in periodic installments. At the end of the payment period households were randomly offered a rebate of 2 percent, 20 percent or 33 percent of the stove cost. The analysis calculates the net benefits for each type of stove at the different subsidy levels. The model differentiates between private net benefits and social net benefits.

The costs include capital or stove costs, program costs, operational and maintenance costs and learning costs for households. The capital, program and the operation and maintenance costs were calculated based on information specific to the implementation of the Uttarakhand program. The benefits from improved cook stoves are health benefits particularly reductions is morbidity and mortality from acute lower respiratory infection (ALRI), chronic obstructive pulmonary disease (COPD), ischemic heart disease (IHD) and lung cancer. The other benefits are the time saved by households through reduced cooking time and fuel collection, fuel savings from greater fuel efficiency, and environmental benefits from reduced emissions and deforestation.

To account for uncertainties in the estimated parameters, the study runs Monte Carlo simulations of the net benefits of each model. These simulations provide a range of possible outcomes for the net benefits with various combinations of the parameter values to account for the uncertainty. The study also runs a sensitivity analysis that determines the main drivers of the net benefits. The sensitivity analysis informs us about the parameter values that have the most influence or can lead to the greatest variations in the outcomes.

KEY FINDINGS

Overall, the study finds that the net benefits from the improved biomass cookstove are largely negative while the net benefits from the improved electric cookstove are positive. At the baseline, we observe negative private and social net benefits from the biomass stove but positive private and social net benefits for the electric cookstove. There is a low extent of variation in the outcomes at different subsidy levels for households and for society. After running the Monte Carlo simulations and the sensitivity analysis, we observe four main results:

1. *Private net benefits from improved biomass cookstoves are highly negative.*

The Monte Carlo simulations show that for the private benefits of the improved biomass cookstove at every subsidy level, the probability of having a negative outcome was about 90 percent (Figure 1). The results are driven mainly by the capital costs of the stove, the learning costs (costs associated with learning how to use the stove), the cost of fuelwood and the quantity of wood required for the stove.

2. *Social net benefits from improved biomass cookstoves are highly negative*

Similarly, the social benefits of this stove are also negative for about 75 percent of the outcomes. Here also, the drivers of these negative results are the same for the private benefits - the capital costs of the stove, the learning costs and the lack of savings from fuelwood. An additional factor affecting the social benefits is the lack of reductions in carbon emissions.

3. *Private net benefits from improved electric cookstoves are highly positive*

For households using the improved electric cookstove, about 70 percent of the net benefits are positive. The results are driven by the time saved from using an electric stove, the fuelwood saved and the reductions in time spent collecting wood.

4. *Social net benefits from improved electric cookstoves are mixed.*

The results of the social benefits of the improved electric cookstove are mixed. About 60 percent of the time the net benefits are positive. These net benefits are influenced by the costs of the stove, the time saved and fuel saved and the reductions in the carbon emissions.

CONCLUSIONS

This study provides a detailed analysis of the costs and benefits arising from an improved cookstove program using a biomass cookstove and an electric cookstove. There are several policy implications of this study:

First, the analysis finds that subsidies have a positive influence yet minimal impact on the private net benefits to households. The results show that with higher levels of subsidies, the benefits are more likely to be positive. Poor households can gain access to and the benefits from improved cookstoves if these products are accessible at lower prices.

Second, time and fuel savings appear to have greater benefits for households while the health benefits appear to be minimal. This result implies that households attain larger economic benefits when switching to improved cookstoves through the time and fuel saved rather than the reductions in morbidity or mortality. There needs to be a greater emphasis

Third, environmental benefits such as the reduction in carbon emissions have an impact on the net benefits to society for both types of stoves. This finding can make a case for incorporating carbon offsets and other climate mitigation strategies into improved cookstove programs.

Finally, social implementers could consider the role of cleaner and more modern stove options such as electric cookstoves based on the positive benefits for households and for society. Improved electric cookstoves appear to have greater benefits than the improved biomass stoves. However, the main caveat is that there are limitations to promoting electric stoves due to the lack of electrification and consistent access to electricity in countries like India. Research and policy needs to focus more on electric cookstoves given the high benefits.