

Maya Chandrasekaran – Research Statement

I am an applied economist working on topics in environment and development, especially where they overlap with gender. My research covers three main areas. First, I examine how access to improved energy technologies affects economic development and productivity in low- and middle- income countries (LMICs). Second, I analyze the gendered aspects of those outcomes, with a particular focus on how resource access affects women's livelihoods and measures of gender empowerment. Third, I use Bayesian modeling to investigate how the presence and magnitude of these outcomes are influenced by contextual factors and methodological decisions, and how we can better utilize new empirical findings in the context of existing evidence. As my work is deeply collaborative, I have partnered with a range of academics and non-academics domestically and internationally and conducted numerous field visits for piloting, training, and data collection. Taken together, my research identifies gendered impacts of access to improved technologies in LMICs and assesses policy-relevant questions using tools from applied microeconomics, econometrics, and Bayesian statistics.

The first part of my dissertation investigates the relationship between improved energy technologies and various proxies for gender empowerment, and has been published in *Environmental Research Letters* with related work published in *Energy Economics*. Specifically, I use datasets from seven developing countries in Sub-Saharan Africa and South and Southeast Asia to identify patterns between access to improved cookstoves, clean fuels, and electricity and changes in women's education, credit access, social capital, mobility, and employment. At the household level, I find a positive association between measures of women's empowerment and energy access variables, though this pattern does not hold across all countries. The heterogeneity in relationships across countries motivates further work in my dissertation that seeks to (1) identify the causal gendered impacts of improved energy technologies and (2) build flexible Bayesian models that help explain the variation in these patterns and provide policy recommendations.

In pursuit of aim (1) above, the second part of my dissertation evaluates the time and labor benefits to women of a fuel-efficient improved cookstove distribution program in Malawi, Tanzania, Kenya, and Zambia using primary data from a survey I co-designed and supervised. Specifically, we conduct a quasi-experiment to causally identify the time use, productivity, and complementary gender impacts of 1,000 women from each country. Uniquely, this survey included three methods for eliciting time use data. These include (1) a pictorial time diary I designed and piloted specifically for regions with low literacy and inability to regularly check the time, which inventively also collects information on multi-tasking, (2) a traditional time diary where the respondent recounts the events of the previous day in order, and (3) directly asking respondents to estimate time spent on a set of activities. Preliminary results from the impact evaluation suggest considerable heterogeneity in most key outcomes – including time spent on fuel collection - dependent on country, method of time use elicitation, household demographic and socio-economic characteristics, and baseline fuel use behaviors. This calls for the investigation of a larger issue: that the external validity of findings from a given setting and research design may be limited if outcomes are heavily affected by contextual factors and methodological decisions.

My job market paper then serves as a policy “tool” that helps dissect how population and intervention characteristics may influence the outcomes from technology interventions. Specifically, I use standard and hierarchical Bayesian models to investigate how different sources of variation influence time use estimates, though importantly these models are generalizable and can be applied to different interventions and outcomes. In the current version of this paper, I combine primary data from the improved cookstove intervention detailed above with energy-focused secondary datasets to examine how geography, level of connectedness of a given region, wealth, household size, baseline fuel use, and the method of time use elicitation influence measures of time spent on fuel collection. Like more common estimation methods, the models first output average time use estimates in fuel collection for each country in our primary dataset. However, my Bayesian models take it a step further. They also output how each source of variation affects fuel collection time estimates, and how that effect differs by country (e.g., the level of remoteness of a respondent's village may be more influential on how much time she spends collecting fuel in one country over another).

There are several findings that have implications for NGOs, researchers, or policy makers. For example, average time spent in fuel collection appears to be 13 min/day when using traditional time diaries and 132 min/day when using direct questioning methods. The range of time use estimates by elicitation method are largest in Tanzania and smallest in Zambia, suggesting that (1) traditional time diaries lead to more conservative time use estimates and (2) the method of time use elicitation is most impactful in Tanzania. This may direct researchers studying purported time benefits of a given technology to use multiple methods to report a range of estimates in specific study locations. Second, higher wealth levels and the use of clean fuels indicate lower time spent on fuel collection in all countries, but wealth is most impactful in Kenya, where time

spent on fuel collection in the wealthiest households is 55 min/day lower than average. NGOs or policy makers seeking investment in a new technology may then want to concentrate efforts on wealthier rural samples where benefits would be greatest, or consider technologies that are less susceptible to wealth differences. Third, household size significantly affects time spent on fuel collection in Tanzania, where larger households spend less time collecting fuel. Interestingly, household size does not affect fuel collection time in the other three countries. Further investigation supports the idea that this effect is concentrated in households in Tanzania that have more adults; therefore, policy makers may want to consider household make up when setting forth new interventions. These and further results, available on my website, help us to better predict the outcomes we can expect to see in different population groups and therefore to provide contextually specific policy recommendations.

I plan to continue prioritizing research that can provide insights to researchers and policy makers regarding investments in improved technologies in LMICs. For example, most guidance on time valuation pertains to developed contexts where people have the notion that “time is money” and often trade time for wage income or salary. But this is less appropriate in a subsistence or informal economy. To address this issue, I am co-writing a book that speaks to the challenges of time measurement and of stated and revealed preference methods for time valuation in LMIC. The book includes best practices for time measurement and valuation in both developed and developing contexts, and advises on the critical parameters to understanding the benefits of new technologies in LMICs. It is due for publication in May 2024.

My commitment to thoughtful survey design and interdisciplinary methods to address both gaps in the literature and policy relevant questions motivates my growing research agenda. As an example of upcoming research, one measure of gender empowerment is the notion of bargaining power. Bargaining power is difficult to measure because spouses may have more or less power and knowledge over some categories of decisions than others. However, most bargaining power measures are based on who controls the decisions about one type of household purchase, which may not capture the full scope of household dynamics. I created and deployed a bargaining game that captures individual knowledge and perceived power over the household budget, and then captures if and how spouses work together to make decisions about each purchasing category. I plan to investigate the relationship between those variables and access to cooking fuels, improved cookstoves, and electricity, as well as whether households in which women have higher bargaining power levels are more likely to uptake improved energy technologies.

Another example of future work explores new methods of obtaining time use information. I recently secured a \$25,000 grant from the Clean Cooking Alliance and a \$10,000 grant from Duke’s Global Health Institute to further understand the accuracy of time elicitation methods using GPS tracking on a sub-sample of women in Eastern Kenya. I plan to use these trackers to measure time spent on fuel collection, water collection, paid and unpaid labor, and socialization. I also plan to include regular follow up surveys regarding multi-tasking and making stops along the way, as this may impact the amount of time an activity takes. These results can be used to define best practices for different time use elicitation methods. For example, if we find large amounts of multi-tasking in a region, we may prefer to use a hybrid time diary. If we find individuals are making many stops during outings, for example dropping kids off at school on the way to collect fuel, we may prefer a traditional time diary that logs each activity in order.

I also helped develop a set of questions measuring household food security and resilience to shocks that was administered one year before and three months after cyclone Freddy in southern Malawi. I plan to use this data to examine if and how households cope with climate shocks, and to characterize the types of households - in terms of demographic characteristics, empowerment levels, and time poverty - that receive information about upcoming shocks and/or seem more capable of handling them. This serves to inform policy makers of the types of development projects that might have higher uptake rates, and where those efforts could be concentrated for maximum impact.

Finally, while collecting data on numerous measures important to women’s well-being, I realized I had considered emotional and mental well-being to a lesser extent. As a starting point, I am in contact with academics who have worked in the space of happiness measurement to brainstorm how best to capture these aspects as a metric.

Taken together, my research agenda investigates how numerous factors of well-being such as time availability and agency, income, empowerment, and food security are connected to access, uptake, and use of resources. I especially focus on how development work and new technologies can deliver the greatest benefits. Key to my research is thoughtful survey design, partnership with LMIC scholars, rigorous testing of how and why we find variation in outcomes, and the related implications on policy and research decisions. Going forward, I will continue to address such policy- and research- relevant questions using an interdisciplinary, econometrically rooted, and data driven approach.