Factors Influencing ICS Adoption in Bangladesh: An Annotated Bibliography

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This annotated bibliography contains studies and reports published from 2006 through 2013 on improved cookstove (ICS) adoption in Bangladesh. The studies discuss factors that influence the adoption of ICS. A short summary and a web link to each resource are provided below and studies are organized by publication date.

2013 Studies/Reports

Learning about New Technologies through Opinion Leaders and Social Networks: Experimental Evidence on Non-Traditional Stoves in Rural Bangladesh. Miller, G. and A. M. Mobarak. 2013. (Full text)

This paper studies the behavioral underpinnings of low demand for a technology with substantial implications for population health and the environment: improved cookstoves. A multi-pronged field experiment was conducted in rural Bangladesh to investigate two commonly-cited reasons for low demand: (1) intra-household externalities and (2) tradition-based aversion. On the former, the study found that women – who bear disproportionate cooking costs – have stronger preference for improved stoves, especially health-saving stoves, but lack the authority to make purchases. On the latter, the study found that revealing information about technology choices by respected community members sharing common traditions influences adoption decisions more for technologies lacking self-evident benefits and more before common experience accumulates. Overall, the findings suggest that (1) if women cannot make independent choices, public policy may not be able to exploit gender differences in preferences to promote technology adoption absent broader social change; and (2) marketing and persuasion techniques may only increase adoption temporarily and may be less effective for technologies that households can evaluate for themselves.

Gender Differences in Preferences, Intra-Household Externalities and Low Demand for Improved Cookstoves. Working Paper. Miller, G. and A. M. Mobarak. 2013. (Full text)

This paper examines whether an intra-household externality prevents adoption of a technology with substantial implications for population health and the environment: improved cookstoves. Motivated by a model of intra-household decision-making, the experiment markets stoves to husbands or wives in turn at randomly varying prices. We find that women – who bear disproportionate cooking costs – have stronger preference for healthier stoves, but lack the authority to make purchases. Our findings suggest that if women cannot make independent choices about household resource use, public policy may not be able to exploit gender differences in preferences to promote technology adoption absent broader social change.

Knowledge of Health Hazards and Perception of Prevention Amongst Females Exposed to Biomass Fuel and Gas/Electricity Fuel in A District of Bangladesh. Modern Medical College Journal, Vol 4, No 1 (2013). Anwer Khan , Md Abdul Alim, Abu Sadat Mohammad Nurunnabi, Salahuddin Ahmad, Mohammad Adnan Khan, Sk Akhter Ahmad. (Full text)

A cross-sectional study was designed and conducted from March to June 2007, in Madla, a rural area, and in Thanthania, an urban area, under Bogra District of Bangladesh, to see and compare the prevalence of respiratory disease among female biomass fuel users and gas/electricity fuel users. A total of 103 females from the rural households meeting the defined enrollment criteria for biomass fuel group were selected purposively as cases, while 101 females from the urban households meeting the defined eligibility criteria for controls were included in gas/electricity fuel group. The participants were interviewed on a semi-structured questionnaire. Nearly 70% of the biomass fuel users used wood for the daily cooking and heating purposes, 64% leaves, 31.1% cow dung, crop residue 30.1% and 7.8% saw-dust. The biomass group exhibited a significantly higher frequency of respiratory problem (16.5%) compared to their gas/electricity counterpart (5%). The findings revealed that, 67.5% of the biomass group complained of eye problem followed by cold 36.1%, headache 33.8%, cough 13.9% and difficulty in breathing 11.1%. The respondents of gas/electricity group also complained about same health hazards but they were less aware of the problems. Both the group had fairly comparable level of perception of prevention of hazards of biomass fuel ($p>0.05$), except that a significantly higher proportion of biomass group (12.2%) told that the problem could be avoided by using kerosene stove compared to the gas/electricity group (1.2%).

Traditional Biomass Fuel Consumption by Rural Households in Degraded Sal (Shorea Robusta) Forest Areas of Bangladesh. International Journal of Emerging Technology and Advanced Engineering. Volume 3, Special Issue 3: ICERTSD 2013, Feb 2013, pages 537-544. Tapan Kumar Nath†, Tarit Kumar Baul, M. Maksudur Rahman, M. Tariqul Islam and M. Harun-or-Rashid Institute of Forestry and Environmental Sciences, University of Chittagong, Chittagong 4331, Bangladesh. (Download Full text)

This study explored the availability and consumption pattern of various traditional biomass fuels, preference of and expenditure for biomass fuels, problems with the uses of biomass fuels and villagers' strategy to cope with the biomass fuel problems. Data were collected from 330 households under three wealth categories – well-off, middle and poor households. Households were found to depend largely on biomass fuel including firewood, branches, leaves and twigs, bamboo, straw, husk and cow dung mainly for cooking. Firewood was the dominant biomass fuel of well-off households (43%) whereas middle (37%) and poor households (35%) used tree branches. Total biomass, firewood and cow dung consumption by well-off households was significantly higher than that of middle and poor households. More than 60% well-off households and 44% households of middle category collect tree biomass from their own homestead forests while 59% of poor households gather from neighbor's homestead forests. Households across three categories spend 8%, 13% and 16% of their total income for buying biomass fuels, respectively. Decreasing forest resources impose threats on availability of biomass fuels. Although 27% well-off households were using improved cooking stoves (ICS), mass motivation and subsidized ICS can increase

their uses. Along with reforestation programs government may take initiative for trading carbon offsets from ICS programs on carbon markets as part of the Clean Development Mechanism (CDM).

Understanding Consumer Preference and Willingness to Pay for Improved Cookstoves in Bangladesh. J. Rosenbaum, et al. / WASHplus. 2013. (Full text)

This study uses qualitative and quantitative methods that draw from social marketing and social science to explore consumer perceptions of five of the most promising ICS potentially available for distribution in Bangladesh. The study complements other efforts by a range of stakeholders to strengthen market-based approaches and consumer choice for improving household air quality and reducing the environmental impacts associated with dependence on biomass fuels.

2012 Studies/Reports

Bangladesh Market Assessment Intervention Options. Accenture. Global Alliance for Clean Cookstoves. 2012. (Full text)

This Market Assessment was conducted by Accenture Development Partnerships (ADP), the not-for-profit arm of the global management consultancy, Accenture, on behalf of the Global Alliance for Clean Cookstoves (the Alliance). It is intended to provide a high level snapshot of the sector that can then be used in conjunction with a number of research papers, consumer surveys and other sources (most published on the Alliance's website) to enhance sector market understanding and help the Alliance decide which countries and regions to prioritize. Each assessment has two parts: Sector Mapping – an objective mapping of the sector. Intervention Options – suggestions for removing the many barriers that currently prevent the creation of a thriving market for clean cooking solutions.

Assessment of the Improved Stove Market in Bangladesh. United States Agency for International Development, Winrock International, E+Co. 2012. (Full Text)

Bangladesh was selected as the target market for this study because of its potential to demonstrate rapid deployment of ICS given its unique position at the forefront of SHS commercialization and other off-grid renewables, its previous efforts in promoting ICS, as well as the government's interest in increasing adoption of ICS through market development, and to understand the bottlenecks of the ICS sector in order to help develop effective models for the commercialization of efficient cookstoves and, in doing so, make a major contribution to meeting the targets of the Global Alliance for Clean Cookstoves.

Pilot Intervention of Improved Cook Stoves in Rural Areas: Assessment of Effects on Fuel Use, Smoke Emission and Health. Research Monograph Series No. 53. Dey, N. et al. 2012. BRAC. (Full text)

This study aims to explore the impact of improved cook stoves (ICS) on fuel expenditure (consumption), smoke emission, and health of women (cook) in rural households of Bangladesh. In the follow-up survey (January-March 2010), 1,569 households, constituting

of both who received ICS immediately after baseline survey (July-September 2008) and who had refused to use any ICS, were selected for interview using a pre-tested structured questionnaire. The most convincing evidence showed lower fuel expenditure (>60% respondents reported), cooking time (45%), or time spent in collecting fuel for ICS compared to traditional stove. The respondents reported that smoke emission reduced (86.4%) and soot production dropped (89%) due to using ICS. This indicates the importance and potentials of ICS in reducing indoor air pollution and hence less exposure and lower effect on health. However, impediments still remained to see clear benefit of ICS by the users such as on technological aspects like design and maintenance of ICS, awareness rising (in terms of importance of ICS) and provision of interim monitoring whether ICS will work well or need supports. ICS intervention was successful in reducing fuel consumption expenditure, time spent in collecting fuel and cooking food, and reducing smoke emission and health hazards. Thus, it is necessary to pay more attention to these impediments to further improve the existing situation.

"**Up in Smoke: The Influence of Household Behavior on the Long-Run Impact of Improved Cooking Stoves**.".MIT, Department of Economics, Working Paper 12-10. Hanna, R., E. Duflo, and M. Greenstone. 2012. (Full text)

New evidence, from a randomized control trial conducted in rural Orissa, India (one of the poorest places in India), on the benefits of a commonly used improved stove that laboratory tests showed to reduce indoor air pollution and require less fuel. The study tracked households for up to four years after they received the stove. While there was a meaningful reduction in smoke inhalation in the first year, there is no effect over longer time horizons. The study found no evidence of improvements in lung functioning or health and there is no change in fuel consumption (and presumably greenhouse gas emissions). The difference between the laboratory and field findings appear to result from households' revealed low valuation of the stoves. Households failed to use the stoves regularly or appropriately, did not make the necessary investments to maintain them properly, and usage rates ultimately declined further over time. More broadly, this study underscores the need to test environmental and health technologies in real-world settings where behavior may temper impacts, and to test them over a long enough horizon to understand how this behavioral effect evolves over time.

An Analysis of Cross-sectional Variation in Energy Consumption Pattern at the Household Level in Disregarded Rural Bangladesh. J. Basic. Appl. Sci. Res., 2(4)3949-3963. Hassan M.K., Pelkonen P., Haider P., Pappinen A., (2012). (Full text)

This study aims to examine household energy consumption pattern in disregarded rural areas of Bangladesh. Total 240 households from four upazilas located in four distinct agro-ecological zones were selected through multistage sampling techniques. Data were analyzed with different statistical tests to show the variation in pattern and quantum of household total energy and bioenergy consumption. The analysis showed that family size, per capita income, per capita homestead area and per capita agricultural land influenced household biomass fuels consumption. The study identified that due to limited supply of firewood many rural households selected inferior types of biomass fuels, which were unsustainable and inefficient. Thus, the study recommends for improving the current biomass fuel

consumption pattern with more efficient and sustainable practices. The information from this study is helpful to formulate policies support tools to take into account the future challenges for demand of biomass fuel resources, their sustainable utilization, promotion, and development.

Low Demand for Nontraditional Cookstove Technologies. Proceedings of the National Academy of Sciences 109 (27): 10815-10820. doi:10.1073/pnas.1115571109. Mobarak, A. M., P. Dwivedi, R. Bailis, L. Hildemann, and G. Miller. 2012. (Full text)

This study analyzes the determinants of low demand for nontraditional cookstoves in rural Bangladesh by using both stated preference (from a nationally representative survey of rural women) and revealed preference (assessed by conducting a cluster-randomized trial of cookstove prices) approaches. The study finds consistent evidence across both analyses suggesting that the women in rural Bangladesh do not perceive indoor air pollution as a significant health hazard, prioritize other basic developmental needs over nontraditional cookstoves, and overwhelmingly rely on a free traditional cookstove technology and are therefore not willing to pay much for a new nontraditional cookstove. Efforts to improve health and abate environmental harm by promoting nontraditional cookstoves may be more successful by designing and disseminating nontraditional cookstoves with features valued more highly by users, such as reduction of operating costs, even when those features are not directly related to the cookstoves' health and environmental impacts.

2011 Studies and Reports

Promotion of Improved Cookstove in Rural Bangladesh, Working paper No. 22, Research and Evaluation Division, BRAC. Arif, T., Ashraf, A., Miller, G., Mobarak, M.A., Akter, N., Ali, A.R.M.M., Sarkar, M.A.Q., Hildemann, L., Dey, N.C., Rahman, M., Dwivedi, P., Wise, P., (2011). (Full text)

This study aimed to explore the factors affecting the promotion of improved cookstove (ICS) to replace traditional stove and hence to combat indoor air pollution (IAP). The study was conducted in 58 randomly selected villages of Jamalpur sadar and Hatia upazilas (29 villages in each) in 2008. Both qualitative and quantitative methods were used. Focus group discussions were performed in each village to divide the villages in three equal clusters as well as Paras and listed the opinion leader of the villages. Fifty randomly selected households and nine households of the opinion leaders were surveyed in each village. Thus, a total of 3,080 households were selected for quantitative survey with pre-designed questionnaire. These households were also offered two types of ICSs – portable and with-chimney under different experimental conditions. Among those who adopted ICS as was offered usually chose portable ICS since they believed this would reduce fuel consumption while they chose ICS with chimney to reduce pollution. We found that households were usually aware of IAP but not so much so of the existence of ICS. But once they came to know about it through this survey, they would expect ICS to be better than traditional stoves in producing better tasting food, less smoke emissions, less cooking and fuel collection time, etc. When compared with those who did not know about ICS before, prior knowledge on ICS was found to be associated with greater share of people thinking ICS was better than traditional in terms of taste of food and smoke emission. In most cases financial

constraints was stated as a reason for not to adopt an ICS. The adoption decision was also found to be highly responsive to price. On the other hand, opinion leaders appeared to have a stronger impact on households' decisions when the leaders decided against ICS as opposed to when they decided in its favour. Although this is a very product specific study the results can provide a guideline to understand similar constraints for many other improved technologies that exist but are not generally adopted.

Biomass fuel use, burning technique and reasons for the denial of improved cooking stoves by forest user groups of Rema-Kalenga Wildlife Sanctuary, Bangladesh. International Journal of Sustainable Development and World Ecology 18(1): 88–97. Chowdhury MSH, Koike M, Akther S, Miah MD (2011). (Full text)

A study was conducted among female Forest User Groups (FUGs) of Rema-Kalenga Wildlife Sanctuary, Bangladesh, to assess the status of ICS disseminated by the Forest Department (FD) under the Nishorgo (2009) Support Project, along with the community's biomass fuel consumption pattern. Wood consumption was highest (345 kg month−1 household−1) followed by agricultural residues (60 kg month−1 household−1), tree leaves (51 kg month−1 household−1) and cow dung (25 kg month−1 household−1). Neighbouring forests of the sanctuary was the core source for wood fuel, with little or no reduction in the extraction even after joining the FUG. Twenty-two species, both indigenous and introduced, were preferred as wood fuel. None of the respondents were found willing to use ICS although 43% owned one; either as a status symbol or to meet the conditions of the FD for membership in FUG. Seven negative features of the disseminated ICS were identified by households, which made them unwilling to use them further. Manufacturing faults may be responsible for some ICS demerits, while the FD failed to convince the community of the benefits. A proper examination of the disseminated ICS efficacy is crucial, with active involvement of community members. The Sustainable Energy Triangle Strategy (SETS) could be implemented for this purpose. Findings of the study are of immense importance in designing a strategy for the introduction of ICS into Bangladesh.

2010 Studies and Reports

Restoring Balance: Bangladesh's Rural Energy Realities. World Bank Working Paper No. 181. The World Bank, Washington, D.C. Asaduzzaman M., Barnes D. F., Khandker S. R., (2010). (Full text)

This study underscores how improved access to rural energy services can created multiple benefits for rural life - from income and labor productivity to education and women's health. Recommended or enhancement of programs for improved stoves, rural electrification, renewable energy and greater access to commercial liquid fuels can significantly improve both the rural productivity and enhance the quality of life in rural Bangladesh.

Improved Cookstoves and Better Health in Bangladesh: Lessons from Household Energy and Sanitation Programs. Washington, D.C.: The Work Bank. ESMAP. (2010b). (Full text)

This study identifies lessons for improving cookstoves in Bangladesh through an evaluation of existing programs, the international experience on improved stoves, and the lessons

learned from successes in the sanitation sector. The study consists of a national review of household energy programs, an evaluation of national sanitation programs, and an examination of improved cookstove programs from around the world.

Rural household energy consumption pattern in the disregarded villages of Bangladesh, Biomass Bioenergy 38:997-1003. Miah M.D., Kabir R.R.M.S., Koike M., Akther S., Shin M.Y., (2010). (Full text)

Energy is one of the most important ingredients required to alleviate poverty and realize socio-economic and human development, which is directly interconnected to the prominence of life in rural areas. An extensive survey on household energy consumption pattern interrelating socio-economic and demographic factors was carried out in the disregarded villages of Bangladesh using stratified random sampling technique of 120 households. This paper focuses on household energy consumption, various combinations of fuels and their expenditure in the study area. Biomass, kerosene, electricity, LPG and candle were found as the energy carrier used in the rural households in this study. The study shows that 92% households use biomass, 28% LPG, 89% kerosene, 78% electricity and 27% candle as fuel types. It was found that 56% households collected biomass from their own homesteads and/or agricultural lands. Bamboo, branches, cow dung, firewood, rice husk, leaves & twigs and straw were found as the biomass for household energy use. Average monthly household expenditure for total energy was US$ 9.67 (SE, 0.31) per month while the total monthly income of the household was US$ 123 (SE, 2.53). The ratio of the total monthly energy expenditure to the total monthly income was 7.86%. The study will be helpful to understand the energy consumption system and its expenditure in the rural areas of Bangladesh and to the policy formulation for energy production, consumption and utilization.

2009 Studies and Reports

Improving Indoor Air Quality for Poor Families: A Controlled Experiment in Bangladesh. Indoor Air 2009, 19(1):22-32. Kürschner E, Diehl E, Hermann-Friede J, Hornikel C, Rosenbusch J, Sagmeister E (2009) (Full text)

The World Health Organization's 2004 Global and Regional Burden of Disease Report estimates that acute respiratory infections from indoor air pollution (pollution from burning wood, animal dung, and other bio-fuels) kill a million children annually in developing countries, inflicting a particularly heavy toll on poor families in South Asia and Africa. This paper reports on an experiment that studied the use of different fuels in conjunction with different combinations of construction materials, space configurations, cooking locations, and household ventilation practices (use of doors and windows) as potentially-important determinants of indoor air pollution. Results from controlled experiments in Bangladesh were analyzed to test whether changes in these determinants can have significant effects on indoor air pollution. Analysis of the data shows, for example, that pollution from the cooking area is transported into living spaces rapidly and completely. Furthermore, it is important to factor in the interaction between outdoor and indoor air pollution. Hence, the optimal cooking location should take 'seasonality' in account. Among fuels, seasonal conditions seem to affect the relative severity of pollution from wood, dung, and other biomass fuels. However, there is no ambiguity about their collective impact. All are far dirtier than clean

(LPG and Kerosene) fuels. The analysis concludes that if cooking with clean fuels is not possible, then building the kitchen with permeable construction material and providing proper ventilation in cooking areas will yield a better indoor health environment.

Wood Fuel use in the Traditional Cooking Stoves in the Rural Floodplain Areas of Bangladesh: A Socio-Environmental Perspective. Biomass and Bioenergy, 33(1): 70-78. doi:10.1016/j.biombioe.2008.04.015. Miah, Md D., Al Rashid, Harun & Shin, Man Y. (2009). (Full text)

A study was conducted, using a multistage simple random sampling design, to determine the structural characteristics of the traditional cooking stoves, amount of wood fuel consumed in the rural floodplain areas in Bangladesh, and also to figure out the socio-economic and environmental consequences of wood fuel usage in the traditional cooking stove. The study showed that family size, income, amount cooked and burning hours significantly affected the amount of wood fuel used per family per year. Taking into account different family sizes, the study observed that 4.24 tonne fuelwood were consumed per family per year. The study showed that 42% of families used only biomass fuel, 5% used liquefied petroleum gas (LPG) and 53% used kerosene along with biomass fuels. The main source of biomass fuel was homestead forests (40%). It has been figured out that the incomplete combustion of biomass in the traditional cooking stove poses severe epidemiological consequences to human health and contributes to global warming. The study also showed that 83% of the respondents would prefer improved cooking stoves over traditional cooking stoves.

2006 Studies and Reports

Assessment of Existing Improved Cookstove in Bangladesh, Research and Evaluation Division, BRAC. Sarkar, Q.M.A., Akter, N., Rahman, M., (2006). (Full text)

There are different models of Improved Cook Stove (ICS) being used in Bangladesh. This study attempted to know which type of ICS people accepted more. Specific objectives were to know i. what fuels are being used in improved cook stove; ii. what types of ICS are being used and preferred; iii. the satisfaction level of the users of ICS; and iv. select some models of ICS that will be recommended for further experimentation. Study found that, basically the sampled households used two types of ICSs. These were fixed and portable ICS. About 56% of the households used fixed typed ICS, majority of which were without grate. Fifty-four percent of the users were completely satisfied with ICS. There are some limitations of using ICSs mentioned by the respondents. However, majority of the users mentioned some advantages of ICS that include creating less smoke in the kitchen, less time to cook, saving energy (fuel), etc. Fifty-six percent of the households used traditional cook stoves in addition to ICSs. A number of reasons behind using traditional cook stoves they mentioned which include feeling comfortable, fuel easily available, cheaper to use, meeting seasonal demands etc. However, majority of them said that they were habituated and felt comfortable in using traditional cook stove in addition to ICS. Study shows that 24% of the households faced problems related to fuels such as: cost of firewood, availability, smoke especially in the rainy season etc. However, all of the households were agreed to use ICS continuously. Among them seventy-three percent were agreed to pay for new ICS. Most of them opined to pay within the range of Tk. 50-100 for new ICS. It is quite clear from this study that any fixed type of ICS would not be suitable for all areas and households. Selection of appropriate and popular ICS depends largely on availability of fuels, energy

savings, and reduction in smoke emission. However, an effective laboratory test of selected ICS models is needed to find out the appropriate one that may be replicated countrywide after successful pilot intervention.

Improving Energy Efficiency and Emission Characteristics of Biomass Cooking Stoves by Incorporating Beneficial Aspects of Different Kilns. Md. Mominur Rahman, Assistant Professor Department of Chemical Engineering, BUET, Co-Investigator - Dr. Syeda Sultana Razia, Professor, Department of Chemical Engineering, BUET. (Full text)

The objectives of this research work were to design and develop biomass based low cost energy efficient and low polluting household cookstoves targeting the poor who otherwise cannot afford to carry the overload of health cost due to indoor air pollution and purchasing or collecting excessive biomass fuel required for their existing traditional cookstove. This research work also focuses on reducing greenhouse gas (GHG) emissions from the existing traditional household cookstoves through replacement with better designed stoves. Besides, with the goals in mind for conserving biomass fuel, reducing cooking time and reducing deforestation, four mud built stoves with double chimney were designed and developed to fit the average household size in context of Bangladesh. Developed stoves were named as: BUET-single pot mud stove, BUET-double pot mud stove (circular grate), BUET-double pot mud stove (elliptical grate), and BUET-triple pot mud stove. All the models were provided with preheating facility of combustion air to facilitate better combustion. Two other improved cookstove (ICS) models were brought from a leading NGO (Grameen Shakti) who is actively involved in disseminating ICSs in the local market. These models were named as Grameen Shakti-single pot concrete stove and Grameen Shakti-double pot concrete stove. Both stoves were single chimney concrete stoves and were claimed to be the most popular variant among the general households in Bangladesh. Standard water boiling test (WBT) and controlled cooking test (CCT) were performed on all the six stove models (four BUET models and two Grameen Shakti models) to compare thermal performance, emission performance, cooking time saving, fuel and energy saving, and also emission reduction potential.

For more information about WASHplus and its work on Improved Cookstoves
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