Gender and Fossil Fuel Subsidy Reform in Bangladesh:

Findings and recommendations

GSI REPORT

Global Subsidies Initiative-IISD
Bangladesh Institute for Development Studies

IISD International Institute for Sustainable Development

Global Subsidies Initiative

ENERGIA INTERNATIONAL NETWORK ON GENDER AND SUSTAINABLE ENERGY

BIDS বাংলাদেশ উন্নয়ন গবেষণা প্রতিষ্ঠান

UKaid from the British people

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About GSI

The IISD Global Subsidies Initiative (GSI) supports international processes, national governments and civil society organizations to align subsidies with sustainable development. GSI does this by promoting transparency on the nature and size of subsidies; evaluating the economic, social and environmental impacts of subsidies; and, where necessary, advising on how inefficient and wasteful subsidies can best be reformed. GSI is headquartered in Geneva, Switzerland, and works with partners located around the world. Its principal funders have included the governments of Denmark, Finland, New Zealand, Norway, Sweden, Switzerland and the United Kingdom, as well as the KR Foundation.

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Gender and Fossil Fuel Subsidy Reform: Findings from and recommendations for Bangladesh

February 2020

Global Subsidies Initiative-IISD and BIDS

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Executive Summary

The report examines from a gender perspective the impact of subsidies and reform to kerosene in Bangladesh. The research was based around two overall research questions: "How do existing kerosene policies affect the welfare, productivity and empowerment of women and girls in low-income households?" and "How might this change given a change in subsidy policy or mitigation measures?" These questions were explored using secondary data, household surveys (that reached 630 households) and focus group discussions. The questions were answered within the context of hypotheses made during the scoping phase and literature review for the research. This research attempted to answer the above questions in relation to an income effect, energy use effect and an energy supply effect, from a gender perspective. The report is part of a broader project that also examined gender and fossil fuel subsidies in India and Nigeria.

There is a push within the United Nations' Sustainable Development Goals (SDGs) to "leave no one behind." What this research found is that in many cases, kerosene subsidies in Bangladesh *are* leaving people behind in terms of access to modern energy—households are paying more than subsidized government prices. Yet the lack of affordable alternatives for lighting results in limited options to switch away from kerosene. Where subsidies do lower prices, they entrench kerosene use, with attendant health and safety implications.

Potential kerosene price increases would appear to affect men and women equally in Bangladesh. The research found that with a hypothetical 20 per cent price increase most households said they would absorb the cost via an increase in income-generating activities (IGAs) and 47 per cent of households would reduce their use of kerosene. Faced with a potential doubling of the price of kerosene, 67 per cent of households said they would reduce expenditure on both kerosene and other goods (such as food) as well as increase IGAs. In case of a price shock, women overall do not seem to be more vulnerable than men, with 74 per cent of households reporting that all members would be equally affected. Because men purchase kerosene, a price increase may affect men's incomes more than women's.

Households are not experiencing the full benefit of the kerosene subsidy. More than 80 per cent of surveyed households did not know that the official price is BDT 65 per litre and 95 per cent of households were not aware of the subsidy at all. Retail prices were always found to be above BDT 65, thus the official price cut from BDT 68 to 65 per litre in 2016 was not been passed on to consumers. Indeed, the research found surveyed kerosene prices were higher than the official price by 14 per cent, at an average of BDT 77 per litre, and in some places 17 per cent higher than the official price. Also, a large share of subsidies accrues to wealthier segments of the population given their higher consumption and access to energy.

In Bangladesh, as in many other countries, women do the cooking. This means they are inside more often and exposed to harmful indoor air pollution from kerosene and biomass cooking (the prevalent fuel in the surveyed households). The research found an overwhelming desire from women to switch away from kerosene for lighting and toward electricity (either solar or grid). Little was understood about the health impacts of kerosene across those surveyed. Many women (45 per cent) indicated they would set up IGAs given access to electricity.

Despite the dominant role of women in household chores, the research found that men make the decisions on energy sources for lighting (46 per cent) and cooking (39 per cent). Furthermore, men also have the role of purchasing kerosene (94 per cent). Education of both genders as well as female empowerment is therefore necessary to encourage switching to cleaner fuels.

In addition to health implications, subsidizing kerosene is problematic because the fuel is easily diverted to illegal uses, and rent seeking frequently occurs along the supply chain, pushing up prices. Rather than fix the kerosene subsidies, policy-makers should direct funding toward desired outcomes rather than specific fuels.

This would likely imply shifting to cash transfers or subsidizing a range of lighting solution such solar or grid electricity, or small solar lamps.

Providing targeted subsidies for energy connections (infrastructure) rather than ongoing consumer subsidies can improve energy access without leading to large and ongoing subsidy bills. In India, household electrification is approaching 100 per cent due to a recent push for grid and off-grid connections in rural areas. Other programs provide poor women with clean cooking infrastructure.

The research concludes with five overarching findings. First, overall fuel subsidies are not working well for poor women. Second, better targeting of support for energy access is both needed and possible. Third, subsidy reform needs to be undertaken with care, and mitigation measures are needed to protect poor women. Fourth, other factors could be significant for fuel switching and better access to cleaner fuels for women. Finally, investing in subsidy alternatives could empower women more directly. A summary of these and other findings, including those from across the three countries, can be found at the end of this report.

Bangladesh is a "high-impact" country, in that the total number of people without access to electricity or clean cooking is among the highest in the world. Like many countries, Bangladesh is reviewing energy subsidies, undergoing reforms and increasing prices but also has goals to increase energy access and women's empowerment. These reforms present an opportunity for policy-makers to deliver and target policies that cluster gender and energy access benefits toward poor, often rural, women and ensure that no one is left behind.

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Abbreviations

BIDS	Bangladesh Institute of Development Studies
BDT	Bangladesh taka
BPC	Bangladesh Petroleum Corporation
CCT	conditional cash transfer
GSI	Global Subsidies Initiative
HH	Household
IEA	International Energy Agency
IGAs	Income-generating activities
IRADe	Integrated Research and Action for Development
KII	Key Informant Interview
LPG	liquified petroleum gas
OLS	Ordinary Least Squares
PMUY	*Pradhan Mantri Ujjwala Yojana*
PV	photovoltaic
S4C	Spaces for Change
SDG	Sustainable Development Goals
SHS	solar home system
USD	United States dollar

Glossary

Consumption subsidy	A consumption subsidy is a transfer that covers some or all of the cost of a product when it is consumed.
Connection subsidy	A connection subsidy is a transfer that covers some or all of the cost associated with using a product for the first time. For LPG, this includes the metal cylinder that contains the gas, the first load of gas in the cylinder and the stove and associated equipment required to use LPG for cooking.
Empowerment	Empowerment is defined as "the process through which people take control and action in order to overcome obstacles of structural inequality which have previously put them in a disadvantaged position" (ENERGIA, 2012, p. 4).
Energy sector reform	Structural changes in the policies and institutions that govern any part—production, transmission or distribution—of the energy value chain, and any fuel within this value chain.
Fossil fuel consumer subsidy	A fossil fuel consumer subsidy is a policy that reduces the retail price of fossil-derived energy by shifting part of the cost burden onto other actors in the economy. Most often, the cost burden is shifted onto the public budget, where taxpayer money or foregone tax revenue is used to keep energy prices low. But costs can be shifted in other ways too: for example, by requiring energy distributors to operate at a loss. The economic cost of energy includes opportunity costs, so it is still a consumer subsidy if countries provide domestically produced energy at prices below the international market level. Fossil fuel subsidies do not truly reduce the cost of energy for a country; they simply alter who pays and how.
Gender	Gender "refers to the socially-constructed attitudes, values, roles and responsibilities of women and men, in a given culture and location. These attitudes, values and roles are influenced by perceptions and expectations arising from cultural, political, economic, social and religious factors, as well as from custom, law, class, ethnicity and individual or institutional bias. Gender attitudes and behaviours are learnt and change over time" (ENERGIA, 2012, p. 4). As a social construct, gender is often defined in contrast with sex, which refers to the assignation of "male" or "female" to a body based on the identification of physical, biological differences.
Gender equality	Gender equality is a state where "there is no discrimination on grounds of a person's sex in the allocation of resources or benefits, or in the access to services. Equality exists when both men and women are attributed equal social value, equal rights and equal responsibilities, and have equal access to the means (resources, opportunities) to exercise them. Gender equality may be measured in terms of whether there is equality of opportunity, or equality of results" (ENERGIA, 2012, p. 5).
Gender equity	Gender equity refers to "fairness and justice in the distribution of benefits and responsibilities. Gender equity is the process of being fair to women and men. To ensure fairness, measures must often be available to compensate for historical and social disadvantages that prevent men and women from otherwise operating on a level playing field. Equity leads to equality" (ENERGIA, 2012, p. 5).

Modern energy access

There is no universally accepted definition of modern energy access. Sustainable Energy for All (2013) states that there is growing consensus that "access" should not be defined as a binary state (access or no access) but as a continuum of improvement against a number of metrics. This scoping paper defines modern energy access as the supply of fuels and combustion technologies that are reliable, convenient and do not cause indoor air pollution, as well as the increased rate of consumption of such fuels and combustion technologies. By this definition, improving modern energy access might include expanding the supply and increasing the consumption of electricity among households, as well as liquefied petroleum gas, clean cooking fuels, clean cooking stoves, advanced biomass cookstoves and biogas systems.

Non-solid fuel

Non-solid fuels include liquid fuels like kerosene, ethanol and biodiesel, and gaseous fuels like LPG, natural gas and biogas. This is in contrast to solid fuels like wood, charcoal, agricultural residue, dung and coal.

1.0 Introduction

Analysis of energy subsidy policies rarely considers effects of policies depending upon the gender of the consumer (Kitson, Merrill, Beaton, & Sharma, 2016). Instead, attention has focused on identifying the size and nature of fossil fuel subsidies, assessing performance with respect to aspects of social welfare (e.g., del Granado, Coady, & Gillingham, 2012; Coady, Flamini, & Sears, 2015), price control and supply (e.g., Adeoti, Chete, Beaton, & Clarke, 2016), and their environmental impact (e.g., Gerasimchuk, et al., 2017, Jewell, et al., 2018; Merrill, Bassi, Bridle, & Christensen, 2015). A further body of research considers the effects of reforming subsidies, particularly on poorer consumers, and measures to protect these consumers (e.g., ADB, 2016; Cameron, et al. 2016; Beaton, et al., 2013).

Broadly speaking, this literature points to three main effects of subsidies and reform (Kitson et al., 2016): an "income effect," where the subsidies represent an effective transfer to household incomes due to lower fuel prices; an "energy use effect," where the subsidies may influence the type or quantity of fuel that is used by the household; and an "energy supply effect," where the subsidy changes the availability of an energy source. Each of these effects may have specific consequences for women, as described in Figure 1. However, to date, there has been no empirical work exploring or quantifying these potential effects. The research described here is a first attempt to address this gap, focusing on the income and energy use effects of subsidies and subsidy reform.

This report focuses on Bangladesh as a country that has gender inequality gaps, fossil fuel subsidies and energy access issues. According to the Gender Gap Index of 144 countries, Bangladesh ranks 47 (where one has the smallest gap and 144 the largest) (World Economic Forum, 2017). Access to modern energy, as estimated by available metrics, is limited (see Table 1). The study is part of a broader project that also examined gender and fossil fuel subsidies in India and Nigeria (Box 1).

In 2016, expenditure on fossil fuel subsidies in Bangladesh was 0.4 per cent of GDP or USD 1.018 billion (IEA, 2018). This is significantly lower than previous years, such in as 2013, due to a lower world oil price and active reforms. Total fossil fuel subsidies per household in 2016 were USD 28 in Bangladesh, based on International Energy Agency (IEA) subsidy figures.

Table 1. Bangladesh's fossil fuel subsidies (total, per HH) and population without access to modern energy

Total fossil fuel subsidies 2014 (million USD)	Total fossil fuel subsidies 2016 (million USD)	Total subsidies per cent GDP 2016 (2013)	Subsidies per household 2016 (USD)	Population without access to electricity in 2016 (million; percentage of population)	Population without access to clean cooking in 2016 (million; percentage of population)
3,332	1,018	0.4 (3.2)	28	39 (24%)	134 (89%)

Sources: World Bank, 2018a; IEA, 2014; IEA, 2018; United Nations Department of Economic and Social Affairs, 2017; World Bank, 2018b; authors' calculations

The research focused on kerosene subsidies. Kerosene is primarily used for lighting in Bangladesh. It is a thin, clear liquid primarily derived from refined petroleum and often described as a "poor person's fuel." There is a growing awareness of the potential health risks of kerosene and that "policymakers may consider alternatives to kerosene subsidies, such as shifting support to cleaner technologies for lighting and cooking" (Lam et al., 2012, p. 426). The World Health Organization (WHO) discourages the further use of kerosene based on evidence that it can lead to levels of particulate matter and other pollutants that exceed WHO guidelines (WHO, 2014).

Kerosene also gives low-quality light (limiting educational and income-generating opportunities) and creates indoor air pollution that causes serious health impacts (Jain & Ramji, 2016). In addition, results from India reveal that up to 45 per cent of subsidized kerosene is diverted for illegal uses (Gupta, 2014).

Box 1. Multi-country study summary

When this study commenced, Bangladesh, India and Nigeria were the countries with the largest number of people globally without access to electricity (in 2016): India (15 per cent of population, 270 million), Nigeria (41 per cent, 76 million) and Bangladesh (24 per cent, 39.2 million) (World Bank, 2018). With China, they also have the largest populations without access to clean cooking (India: 781 million, China: 572 million, Nigeria: 177 million, Bangladesh: 135 million).

All three countries have gender inequality gaps and fossil fuel subsidies. India and Nigeria rank 108 and 122 on the Gender Gap Index, respectively. In Nigeria, the focus was on subsidized kerosene, where it is used for both cooking and lighting. In India, liquified petroleum gas (LPG) subsidies for cooking gas were examined.

A coordinated multi-country study was undertaken by in-country researchers and an international team. The methodology was broadly consistent across countries, and results were analyzed for country-specific and cross-country findings. A summary of the cross-country findings and recommendations is provided at the end of this report but readers are encouraged to view the multi-country report for full details (Global Subsidies Initiative-IISD, BIDS, IRADe & Spaces for Change, 2019).

As part of this research a data audit of secondary data was undertaken in 2017 regarding LPG subsidies in Indonesia from a gender perspective, with findings published in Kusumawardhani et al. (2017). Indonesia is highly relevant because it has a long history of subsidizing LPG, a policy that mostly benefits the wealthy (Lembaga Survei Indonesia [LSI], 2014). Due to rising costs, the government is considering ways to better target the subsidy, which have been politically difficult to implement. Any potential reforms to LPG subsidies would be likely to target the subsidy to the poor or replace the subsidy with a social assistance cash transfer program.

The research was informed by a literature review (Kitson et al., 2016), that reviewed the literature on Bangladesh as well as India and Nigeria. The research also reviewed 28 reform episodes from across the globe from a gender perspective, finding that 18 relied on targeted mitigation measures, including expansion of public works, education and health programs in poor areas. Gender-sensitive policy-making can consider the extent to which such policies can be designed to compensate for inequalities in intra-household decision making. This might include the use of universal or conditional cash transfers (CCTs), structured to be more likely to increase the power of women in determining household expenditure decisions. Alternatively, policies might include social assistance measures intended to meet women's essential needs, such as health care, or to enable their participation in the labour market, such as infrastructure programs or microloans targeted at women.

Overall, the literature review (Kitson et al., 2016) also found that there is a substantial body of knowledge examining the range of measures that can address the adverse impacts of increased energy prices resulting from subsidy reform. This knowledge is drawn from analysis of previous reform attempts, as well as more theoretical analyses. However, to date, few of the measures implemented or discussed with respect to fuel subsidy reform consider how the specific effects on men and women can be addressed. As with fuel subsidy policies themselves, reform policies are rarely gender-specific and can thus have unintended impacts upon gender equality. If the government objective is to promote gender equality, reforms should be designed and implemented so as to not only counteract potentially negative effects upon women, but also to maximize opportunities for improving women's lives.

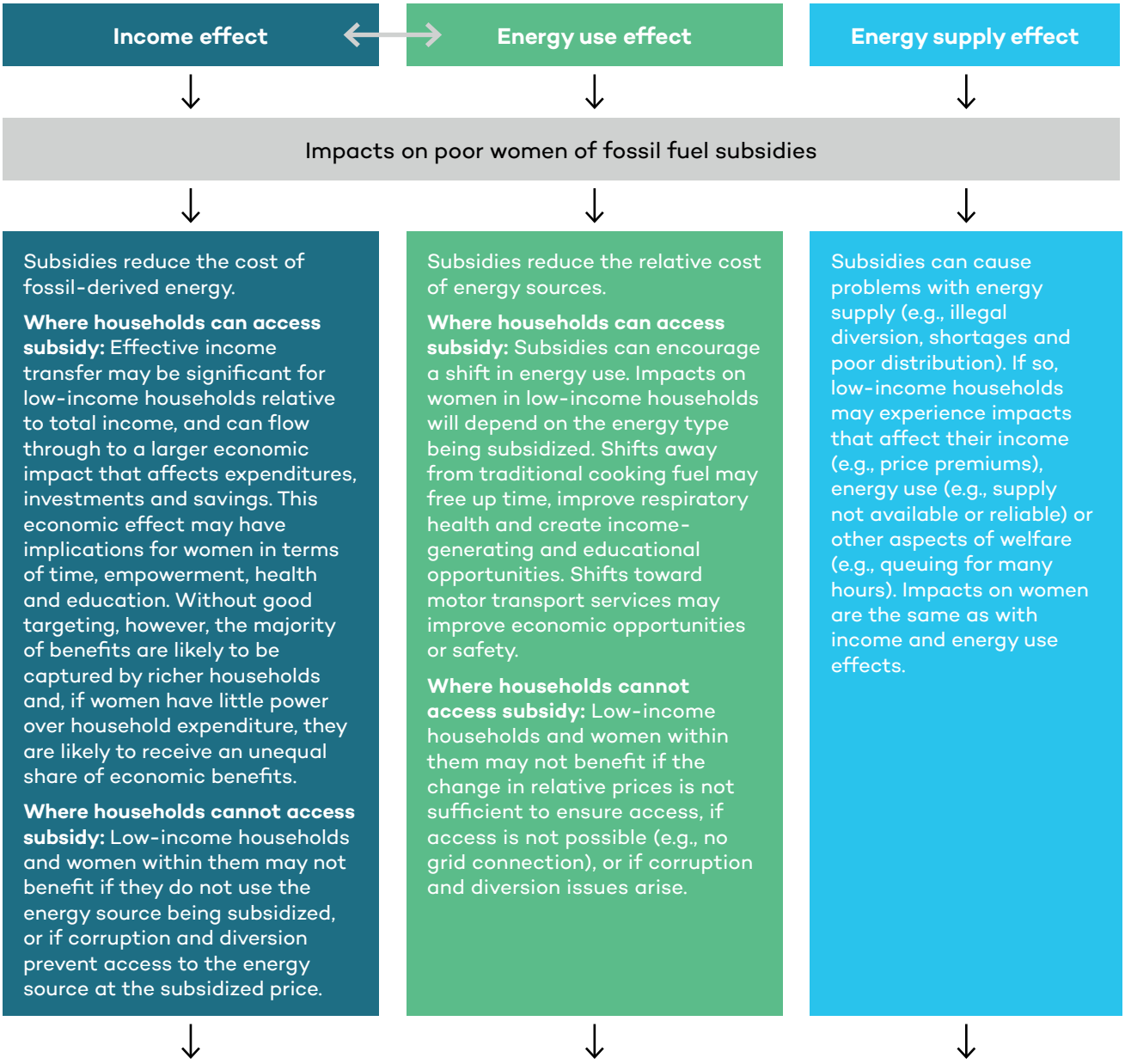
The literature review further revealed that the impacts of energy subsidies, the impacts of energy sector reform, and workable or appropriate mitigation measures associated with any reforms are extremely context-specific.

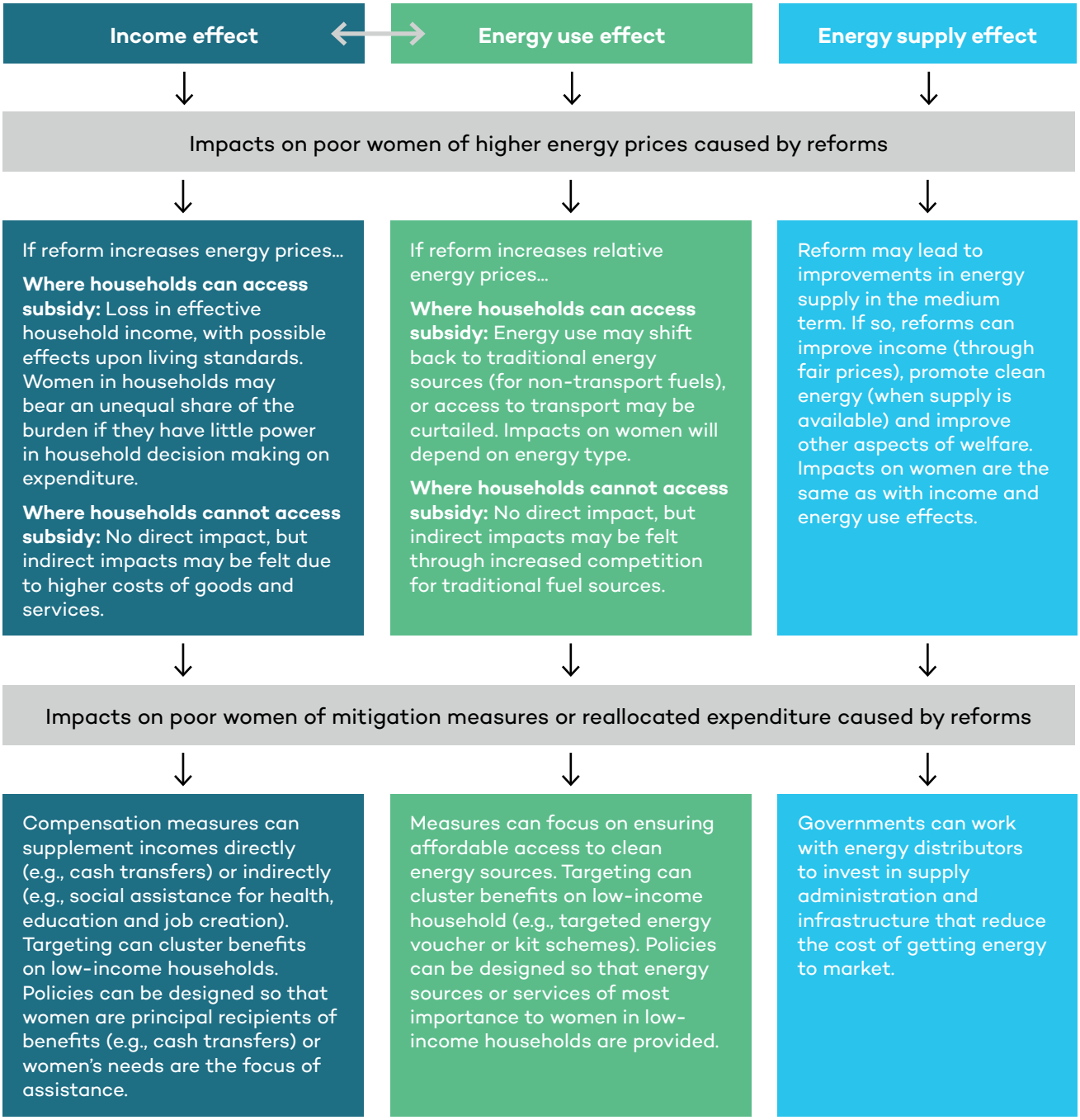
Nonetheless, strong evidence indicates that in many countries a significant proportion of subsidy benefits are captured by well-off households, suggesting a general phenomenon of energy subsidy inefficiency if the desired policy objective is to target income and energy access benefits to women and men living in poverty.

Based on the literature review, primary research was conducted in Bangladesh, India and Nigeria with local partners. The research focused around two main research questions: *"How do existing kerosene and LPG subsidy policies affect the welfare, productivity and empowerment of women and girls in low-income households?"* and *"How might the welfare, productivity and empowerment of women and girls in low-income households change as a result of specific, nationally relevant proposals for the reform of existing kerosene and LPG subsidies?"*

Figure 1 describes the hypothesis as set out based on the literature review. This is followed by a chapter describing the research methodology, followed by the country-specific results for Bangladesh. The final chapter presents findings for Bangladesh and a summary of overall findings across the three counties.

Figure 1. Likely impacts of subsidies, their reform and mitigation measures on women





Source: Kitson et al., 2016.

2.0 Methodology

On the basis of the literature review, two overarching research questions were established. The first sought to clarify the extent to which existing subsidies for cooking and/or lighting fuel in each country have distinct gender-disaggregated effects on the welfare, productivity and empowerment of poor women and girls. The second sought to clarify how specific, nationally relevant reforms might have additional gender-disaggregated impacts on poor women and girls, including the provision of alternatives to fossil fuel subsidies.

This two-stage approach reflected the facts that: a) the literature review found a paucity of research on the impacts of subsidies themselves on gender; and b) the policy agenda in many countries is focused on the reform of fossil fuel subsidies, such as the phasing out of kerosene, as well as policies to incentivize decentralized renewable energy generation. Bangladesh did not introduce policy changes during the research phase of this project (2017) and therefore consideration of kerosene price adjustments in the research was hypothetical. However, in 2016 the government cut the price of kerosene: researchers asked if households knew of this price decrease. The full research questions are outlined in Table 2.

Table 2. Overall research questions; questions specific to Bangladesh

Overall research questions	
How do existing kerosene and LPG subsidy policies affect the welfare, productivity and empowerment of women and girls in low-income households, taking into account: • Impacts of the subsidy on kerosene and LPG distribution? • The extent to which the subsidized price is actually reflected in kerosene and LPG retail prices paid by consumers? • The extent to which lower kerosene and LPG retail prices influence household fuel use?	How might the welfare, productivity and empowerment of women in low-income households be impacted through changes in subsidy policies and mitigation measures?
Specific to Bangladesh	
How would changes in kerosene subsidy policies affect the welfare, productivity and empowerment of women in low-income households in Barisal, Rangpur, Chittagong in Bangladesh, taking into account: • Impacts of the subsidy on kerosene distribution? • The extent to which the subsidized price is actually reflected in the kerosene retail prices paid by consumers? • The extent to which lower (higher) kerosene retail prices influence household fuel use?	How might the welfare, productivity and empowerment of women in low-income households change as a result of replacing kerosene subsidies (through price change) in villages with policy interventions intended to promote solar homes, biogas and LPG?

A qualitative comparative case study approach was taken, consisting of a review of existing secondary data, household surveys and focus group discussions or interviews. The review of secondary data included examination of major official data sets such as census data, national socioeconomic and household surveys, as well as relevant independent studies. Where possible, the female head of household was sought as the interviewee.

A total of 630 household surveys were conducted between March and May 2017 in the districts of Rangpur, Chittagong and Barisal, where a substantial proportion of households use kerosene and have high poverty rates. The survey was focused in regions where solar or grid electricity is present, or where electricity is not present, and yet a substantial proportion of households are still using kerosene, and regions where the poverty level is comparably higher. Figure 2 shows the selection process. Figure 3 shows the prevalence of energy sources for lighting and poverty across divisions in Bangladesh.

Based on these criteria, Bhola, Patuakhali, Barguna of Barisal division (in the southern part of country), Kurigram, Lalmonirhat, Panchagarh of Rangpur division (in the northern part of country) and Banderban, Khagrachhari of Chittagong (in the southeastern part of the country) were selected for the household survey. Table 3 shows the prevalence of energy use for lighting across the surveyed districts.

Two rounds of household surveys were conducted: a pilot survey in January 2017 and a final survey in May 2017 involving 630 households.[1] The final survey questionnaire was conducted with five households from each of the 126 villages. The focus of the research was on kerosene use by women in low-income households—therefore low-income households using only kerosene were surveyed. Households were identified as low-income because of the materials used for roofing and walls (mainly *kutcha* and *semi-pucca* dwellings)[2] (Table 4).

Figure 2. Selection criteria

Note: BDP is Bangladesh Diesel Plant Ltd (an electricity generating company); IDCOL is the Bangladesh Infrastructure Development Company Ltd (an energy and infrastructure financing company)

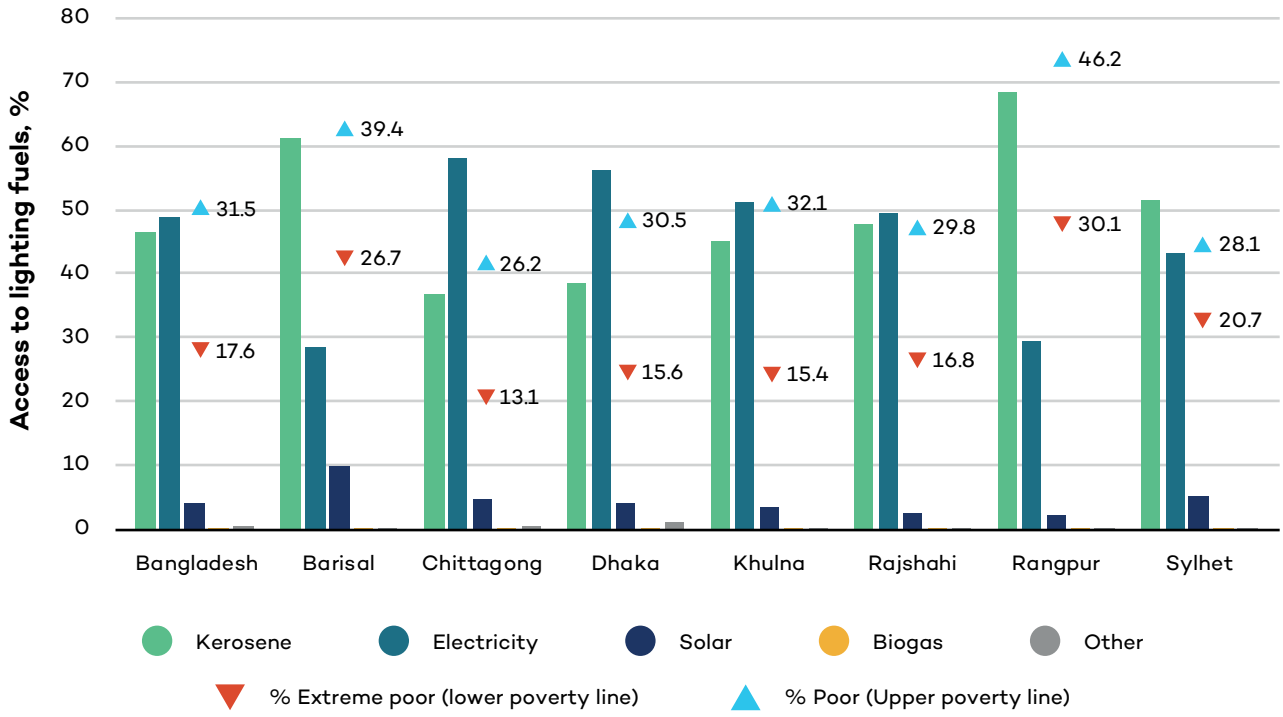


Figure 3. Access to lighting fuels across divisions with poverty level

Source: Population and Housing Census (Socio-Economic and Demographic Report) 2011 and HIES 2010

[1] Comprising 210 households from Chittagong division (105 Households from each of Banderban and Khagrachhari districts), 210 households from Barisal division (70 from each of the districts Bhola, Patuakhali, Barguna) and 210 from Rangpur division (70 from each of Kurigram, Lalmonirhat, Panchagarh districts).

[2] Kutcha dwellings are semi-permanent buildings constructed from mud brick, hay, bamboo or hemp. Pucca dwellings are constructed from more enduring materials such as stone, brick, cement, timber or iron. Semi-pucca dwelling are a mixture, e.g. mud brick walls and a roof made from corrugated iron.

Table 3. Prevalence of grid and solar electricity across sample districts (number of villages) and kerosene use (percent of households)

		Prevalence of grid and solar electricity					
Division	**District**	**Both grid and solar electricity**	**Only grid electricity**	**Only solar electricity**	**Neither grid nor solar electricity**	**# of villages**	**per cent HH using kerosene**
Rangpur	Kurigram	10		4		14	37
	Lalmonirhat	7		7		14	26
	Ponchogarh	9		5		14	36
Chittagong	Banderbaan	2	1	12	6	21	85
	Khagrachhari	4		9	8	21	88
Barisal	Bhola	2		12		14	15
	Patuakhali		6		8	14	16
	Barguna	8		6		14	9
Total		42	7	55	22	126	44

Table 4. Type of dwelling

	Type of dwelling			
Household	**Kutcha**	**Semi-Pucca**	**Pucca**	**Total**
Number	597	27	6	630
Percentage	95	4	1	100

Focus group discussions and interviews were designed to collect textured information about the rationale and experiences of vendors and households with respect to the data collected from second and primary sources. Interviews were conducted in November 2017 and focused on key informant interviews with kerosene dealers and selected households (Annex 2 provides the outline of the full methodology and results).

A consistent approach was used in India and Nigeria (Box 2).

Box 2. Multi-country methodology

Household surveys focused on selected regions in each country. A common questionnaire structure was developed, piloted and adapted to suit national circumstances. In total, 2,400 surveys were conducted across the three countries. Each country (Bangladesh, India and Nigeria) was analyzed independently before attempting to conduct a comparative analysis, such that perspectives deriving from each individual case would organically inform the larger whole. Conducted jointly by all partners in the consortium, the analysis is based on interpretation of descriptive primary and secondary quantitative data within the broader context of qualitative analysis of other literature and qualitative data. The comparison between countries is qualitative in nature.

3.0 Results

3.1 Bangladesh's Energy Sector

In the past decade, due to below-market pricing of fuels, state-owned energy enterprises in Bangladesh have experienced long-term deficits that have been paid through subsidies. The fall in international oil prices from 2014 allowed the government to maintain a stable price level, and state-owned companies until recently operated at breakeven point. For example, in 2018 energy subsidies in Bangladesh were estimated to be 1 per cent of GDP or USD 2.8 billion (IEA, 2019) (see Figure 4 below). Yet in 2013 energy subsidies stood much higher at 3.2 per cent of GDP (IEA, 2014) and almost USD 30 per capita.

The Government of Bangladesh has set out a number of actions to change the energy mix in the Seventh Five Year Plan (2016–2020). These involve increasing gas exploration and establishing a domestic gas allocation policy; setting up a coal import facility; and promoting the careful management and use of LPG imports in the domestic and transport sector. With energy demand always outstripping supply, the government has established an Energy Efficiency and Conservation Master Plan, which includes an Improved Cookstove Program (Sustainable and Renewable Energy Development Authority and Power Division, 2015).

In April 2016, when many countries were taking the opportunity to reform energy systems (often through reducing subsidies and sometimes without the need to increase prices), Bangladesh rather reduced official prices, potentially increasing subsidies for oil products. The price for kerosene was reported to be cut by BDT 3 from BDT 68 to 65 per litre (Daily Star, April 2016). This research found that households using kerosene did not know, or benefit from this price cut, since it was not passed through to consumers. In 2018, there were calls to increase prices on kerosene because of losses to the Bangladesh Petroleum Corporation (BPC) of BDT 11.50 per litre for kerosene (Byron & Suman, 2018). The BPC proposed an 11 per cent increase in the price of diesel and kerosene to BDT 72 per litre (Rahman, 2018). This research, undertaken via household surveys and backed up with key informant interviews, looked specifically at the impact of subsidies and hypothetical prices increases (20 per cent and 50 per cent) in kerosene for women and households.

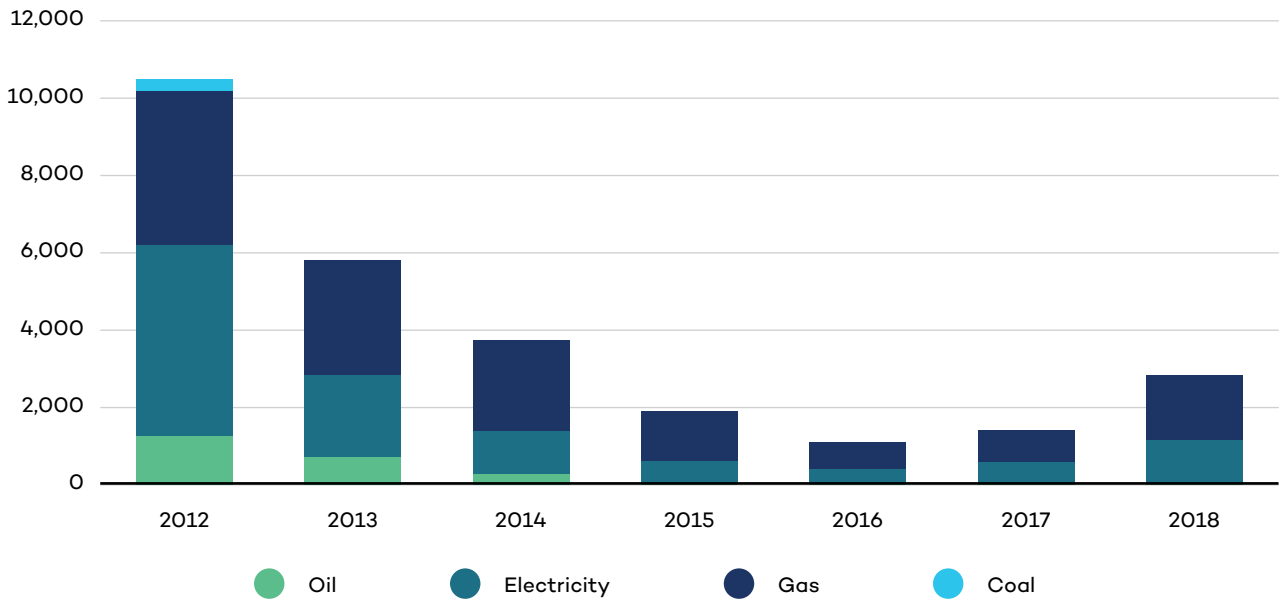


Figure 4. Fossil fuel subsidies in Bangladesh (2012-2018) (USD, millions)

Source: International Energy Agency (2019).

Bangladesh has used subsidies as a policy instrument for many years in agriculture, health, education, food and exports, as well as in the energy sector. Subsidies apply to petroleum products (petrol, diesel and kerosene), natural gas and electricity. While energy subsidies have been cited as important for facilitating energy access for the poor, they disproportionately benefit the wealthier sectors of society.

Despite ongoing subsidies to gas and electricity, there are still serious deficits in access to electricity and non-solid fuel cooking fuels across Bangladesh. The country expanded electricity access by more than 8 percentage points annually between 2014 (62 per cent electrification) and 2017 (88 per cent electrification)[3] (World Bank, 2019). Recent national estimates put the percentage of population with access to electricity even higher at 93 per cent in 2017–18 (PowerCell, 2019). Bangladesh has significantly expanded access via solar home systems (SHS), with 4.13 million SHSs providing access to solar electricity to about 12 per cent of the total population as of 2019 (Hossain et al., 2019).

Recent data available at the domestic level show that kerosene use has declined in recent years with improvements in electrification. In 2010–11 kerosene comprised 8 per cent of total petroleum sales compared to 2.5 per cent in 2017–18 (Bangladesh Petroleum Corporation, 2019).

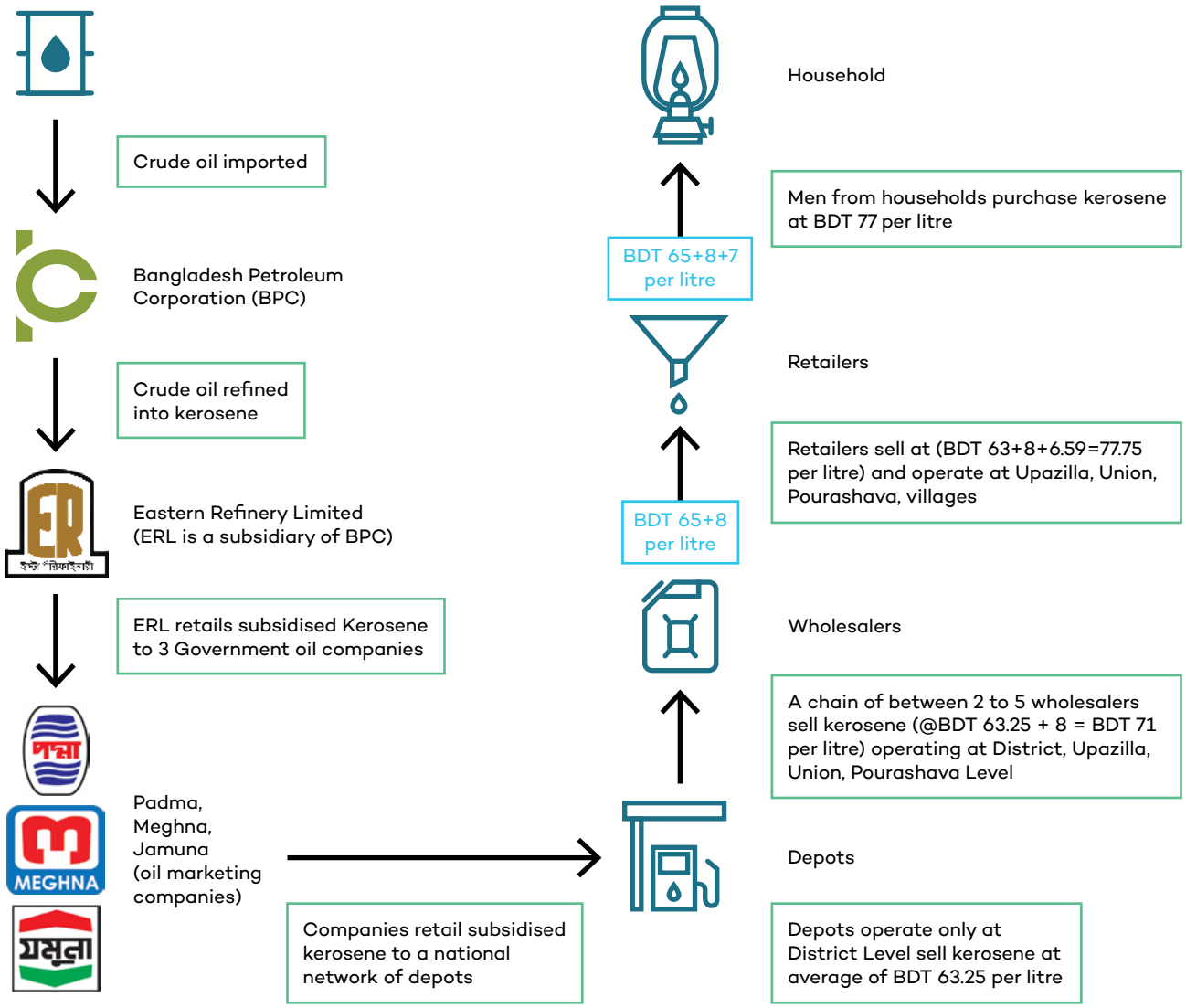


Figure 5. Diagram of kerosene supply chain and average price per litre in survey areas

Source: Global Subsidies Initiative-IISD et al., 2019.

[3] Most recent World Bank data as of October 2019

The government-determined price is fixed throughout the country at BDT 65, and this price structure should be maintained in any retail transaction. Nevertheless, the field survey showed that the price paid by households is significantly higher (on average 13.7 per cent) than the registered price.

Kerosene is processed in Bangladesh from imported crude oil. Bangladesh Petroleum Corporation (BPC) is the responsible agency for the import of crude and refined oil. The value chain of kerosene involves a number of stages starting from raw form (crude oil) to final consumption as outlined in Figure 5.

Enumerators carried out key informant interviews with each agent of the value chain and identified average prices and markup between producers and consumers, as well as profit margins. Final retailers revealed profit of between 56–65 per cent as a percentage of the markup price, compared to depots with profit of between 16-18 per cent as a percentage of the markup price. The full outline of results from the value chain analysis are provided in Annex 1. Findings concluded that:

- Retail sellers (from households where mostly men buy kerosene) enjoy the highest profit margin[4] in the value chain of kerosene (56–65 per cent).
- Transportation costs came up as a major factor in price differential across all types of sellers.
- Depots had the lowest profit margin in the value chain (16-18 per cent).

3.2 Do Existing Kerosene Subsidies Work for Poor Women?

3.2.1 Income Effect

Across the areas surveyed average monthly fuel expenditure costs on average BDT 210 per household per month, or 74 BDT per capita. This is equivalent to 4.6 per cent of monthly expenditure (Figures 7 & 8) and around one litre of kerosene per person per month based on average market prices (Table 5). National data for 2010 finds household expenditure on fuel and lighting in rural areas to be 6 per cent of total consumption expenditure (Bangladesh Bureau of Statistics, 2010). In the survey area all kerosene is purchased and used for lighting, with around 30 per cent of firewood purchased and the rest collected. Most fuel used for cooking was collected rather than purchased (Figure 9). In terms of the household fuel mix, almost all households used kerosene for lighting (99.5 per cent), with households using a mix of dried leaves, firewood, agricultural by-products and cow dung/ bhushi[5]/wood powder all for cooking (Figure 6). In the three districts (Kurigram, Lalmonirhat, Panchagarh) of Rangpur, where 50 per cent of firewood is purchased many households are collecting and using agricultural by-products such as paddy and hag, as well as cow dung, bhushi and wood powder for cooking. None of the kerosene-using households surveyed had access to electricity. These households were drawn from across 126 villages, of which only 14 had no grid or solar electricity. Across the sample area around 44 per cent of households were using kerosene: other households in the villages surveyed were accessing electricity, but the research focused on very poor women using kerosene.

[4] This profit margin is not calculated as an actual monetary amount (here in terms of BDT) but as a proportion. This shows only the proportion of profit of each seller in the respective value addition chain.

[5] Bhusi is a powder form of wood which is a by-product of the production process of wood furniture or equipment.

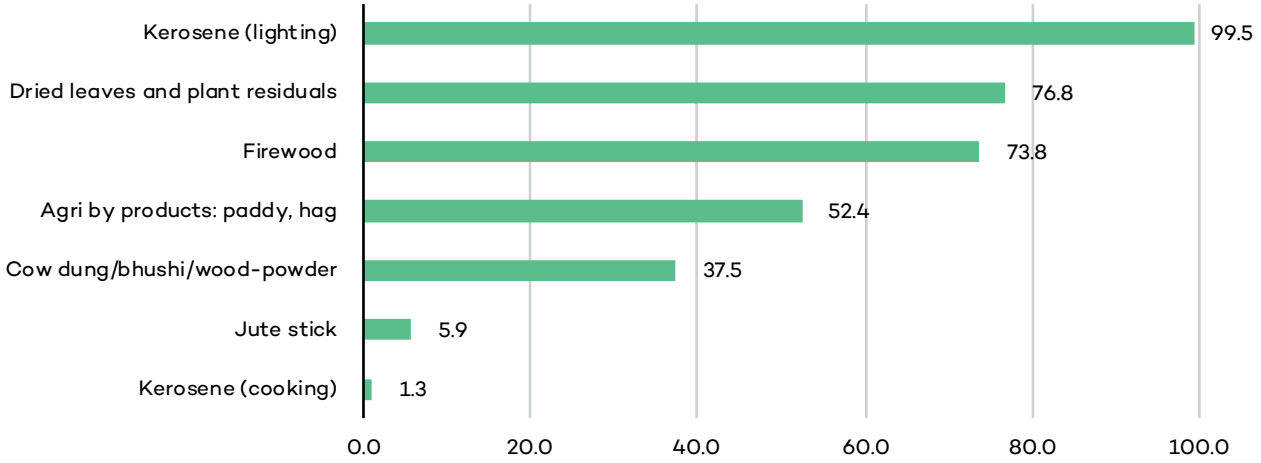


Figure 6. **HH use of cooking and lighting fuels, per cent**

Table 5. **Average market price per unit of cooking and lighting fuel, BDT**

	Rangpur (Panchagarh, Kurigram, Lalmonirhat)	Chittagong (Banderban, Khagrachari)	Barisal (Bhola. Patuakhali, Barguna)	Average in eight districts
Kerosene (litre)	76	78.7	77.3	77.3
Firewood (kg)	2.6	2.5	3.8	3.1

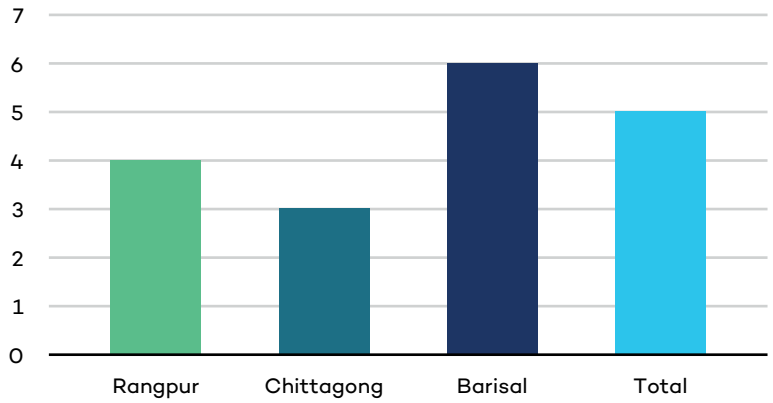


Figure 7. **Monthly fuel expenditure for cooking and lighting, percentage of monthly HH expenditure**

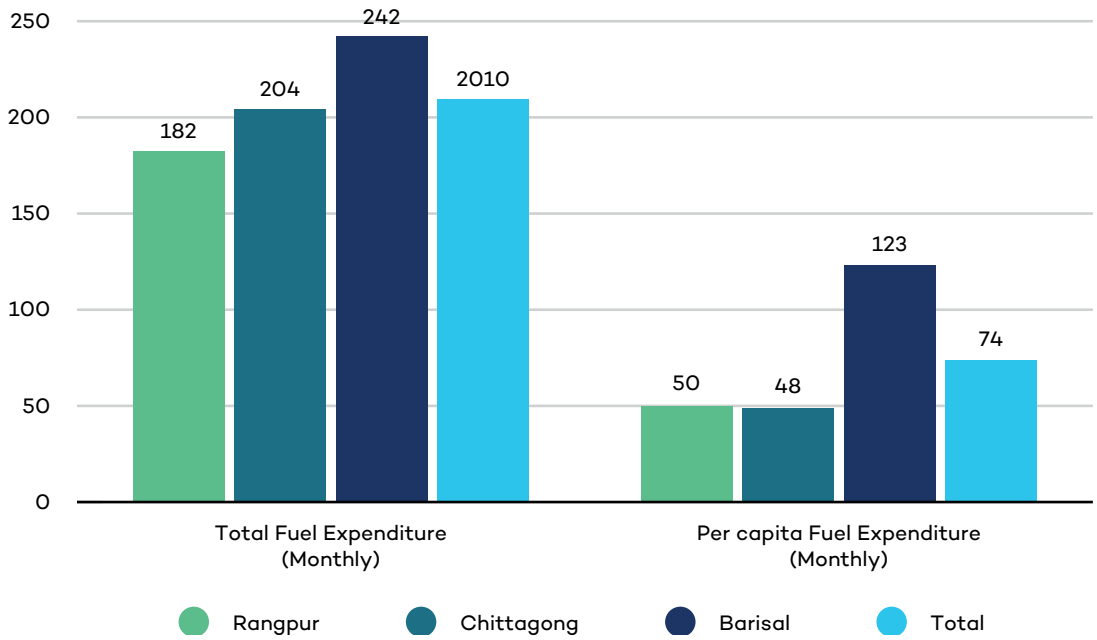


Figure 8. **Total HH and per capita fuel expenditure monthly (BDT)**

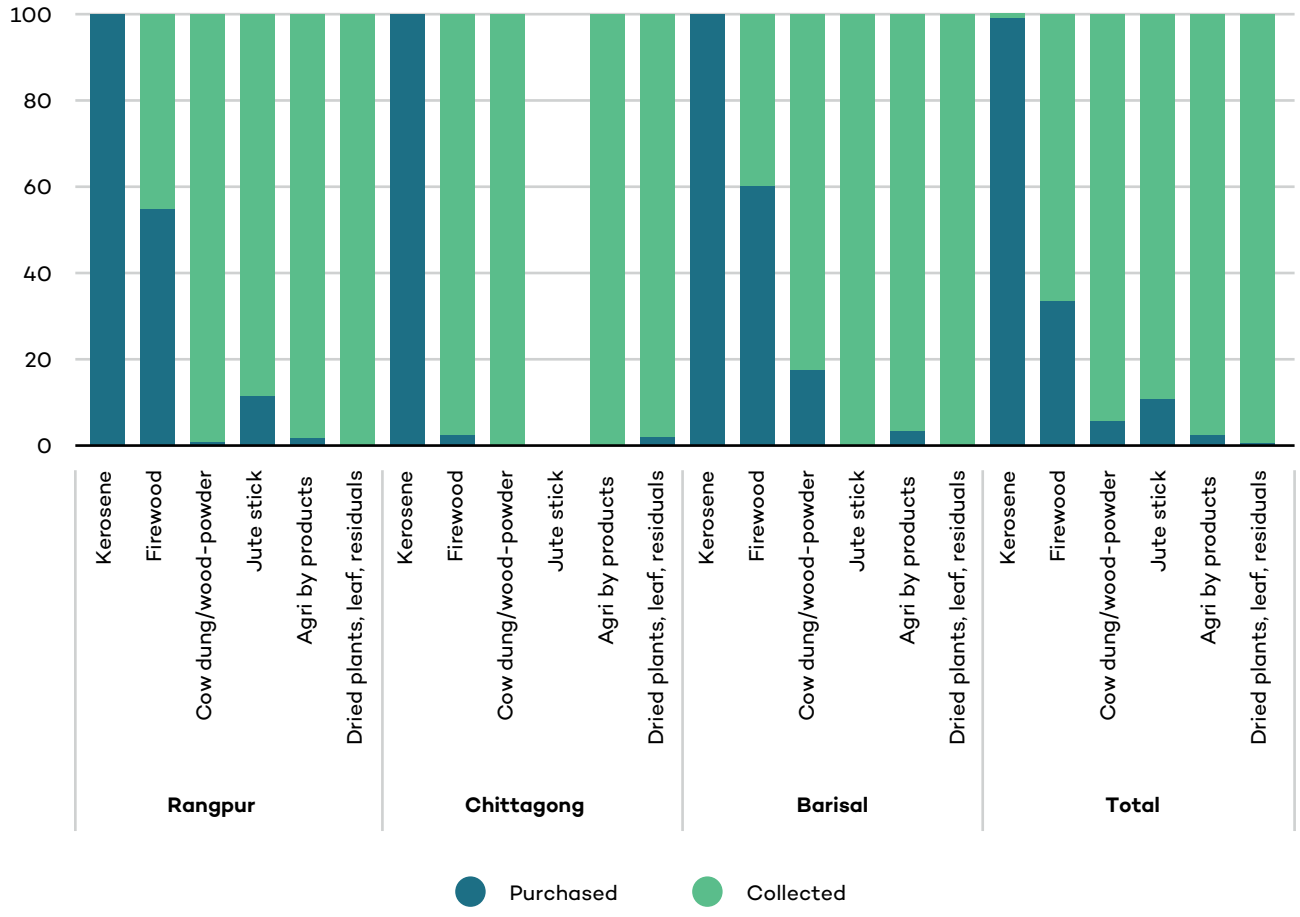


Figure 9. **Cooking and lighting fuel purchased or collected by district, per cent**

Men are responsible for buying kerosene for more than 94 per cent of households and reported purchasing kerosene on average about once a week (see Figure 10), all households surveyed registered the household head as male. The survey found that 99 per cent of households bought from local stores, on average, around 1.5 km away with an average purchase time of around 46 minutes. Almost a quarter of households (21 per cent) purchasing from local stores had faced unavailability of kerosene in the last six months. Virtually no women purchase kerosene, yet 48 per cent of total female respondents use kerosene for lighting while cooking at night. Only nine men reported to be engaged in cooking in the survey of 630 households. A field survey revealed that, on average, women reported spending 80 minutes daily, and that they spend 9 hours and 20 minutes cooking weekly.

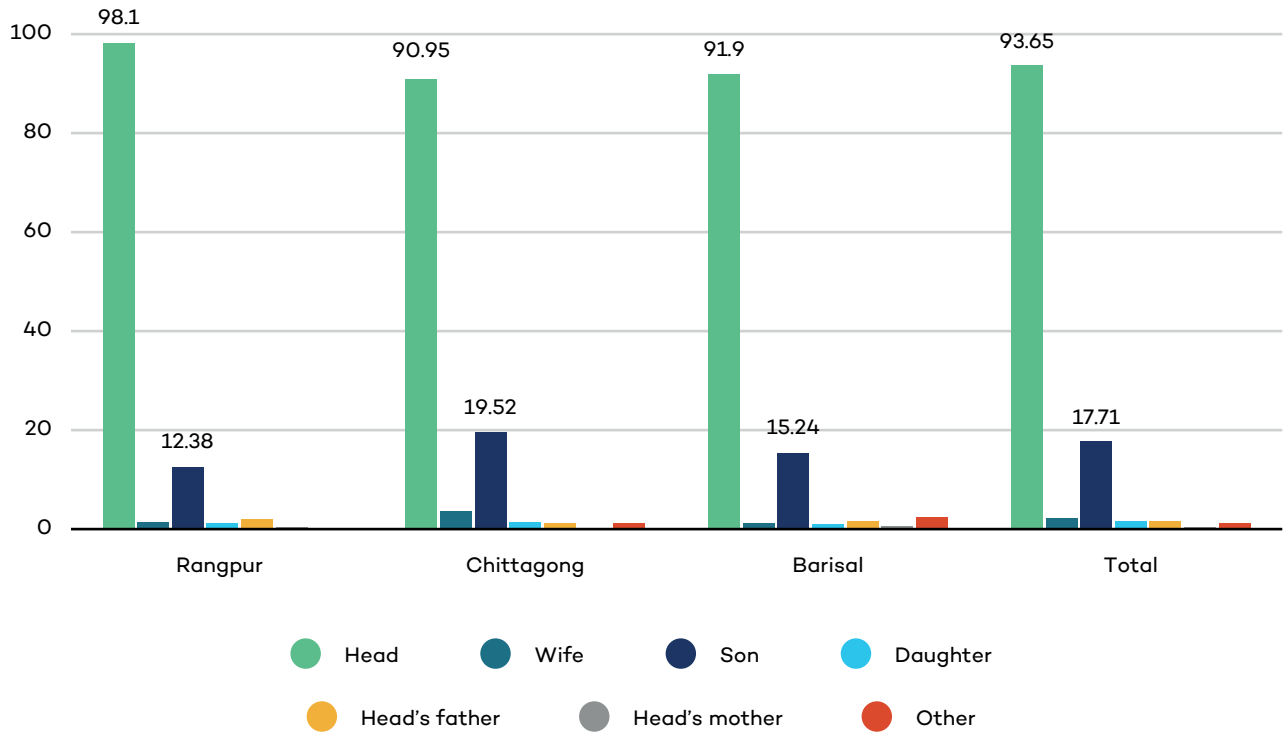


Figure 10. Percentage of HHs reporting different family members who buy kerosene

The survey also asked about the level of decision making that women experienced within the household and found that in 62 per cent of households women can decide how to spend any income they earn for themselves. However, only 9 per cent of households surveyed have women engaged in paid work, with the majority (44 per cent) engaged in unpaid work (household chores), followed by students (30 per cent). Women engaged in paid work (121 of a survey that included 1,497 women) are mostly day labourers (agriculture 40 per cent, non-agriculture 40 per cent).

Furthermore, in terms of decision making the survey found that women are able to take a decision about going to the market to shop in less than a quarter of households, and that for key energy decisions around lighting (46 per cent) and for cooking energy sources (39 per cent) decisions would be taken by the husband or father only (Figure 11). This suggests that in the areas surveyed, even though it is overwhelmingly women who are performing the task of cooking, they do not have the decision-making power to switch energy fuels for cooking or lighting. Furthermore, because it is men who purchase kerosene, it is also likely men who would need to be targeted to encourage switching away from one fuel to another (e.g., from kerosene to solar), or between one cookstove and another.

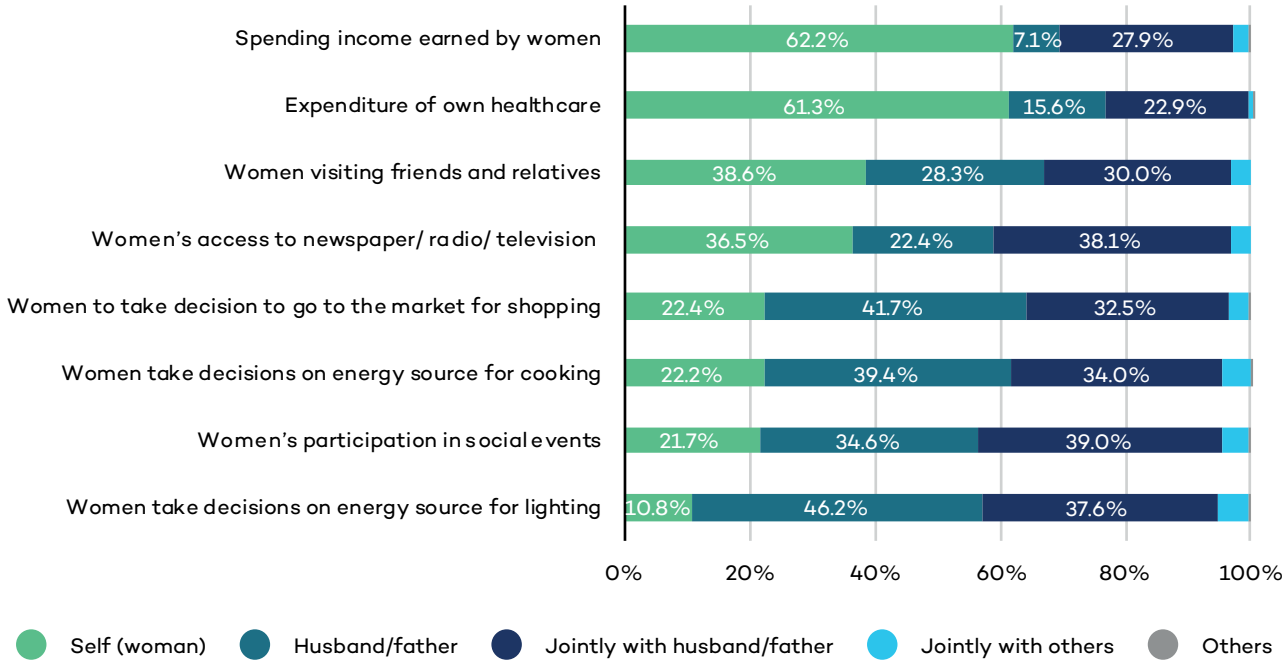


Figure 11. Decision-making ability reported for women and different family members, per cent of HHs

The survey, which was focused on rural, poor areas of Bangladesh, found low levels of education compared to the national average. For example, 38 per cent of females surveyed had no schooling, and almost 29 per cent of females had not completed primary education (Figure 12). In contrast, the 2011 national census found only 9.5 per cent of rural females reported "no class passed" and 35 per cent had completed primary school (Bangladesh Bureau of Statistics, 2011).

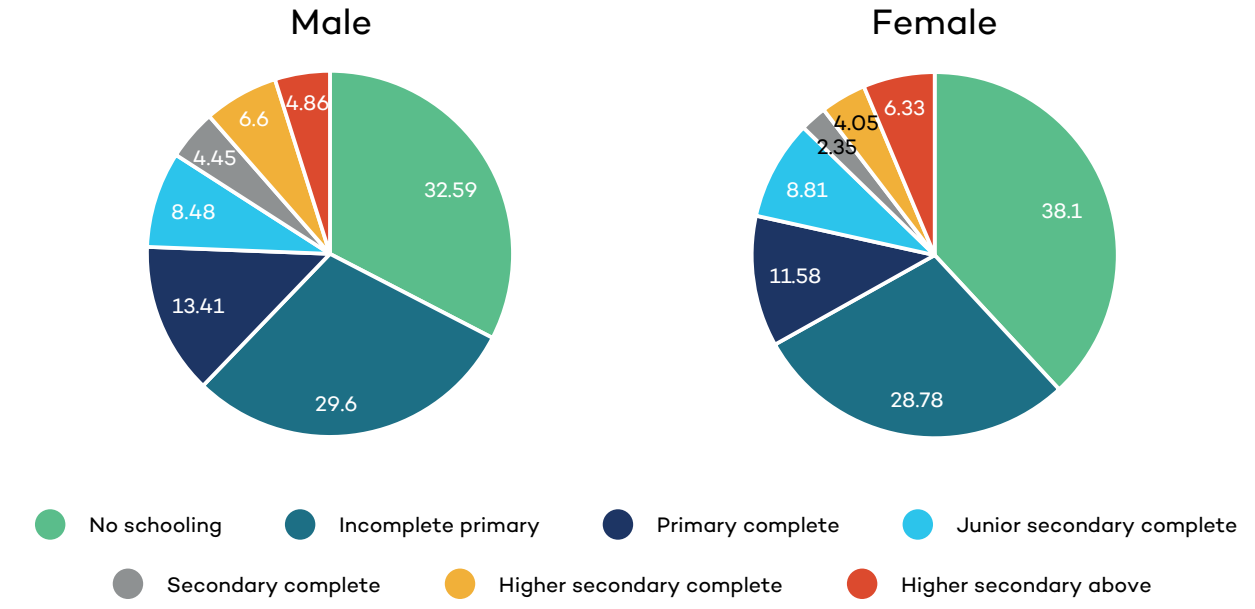


Figure 12. Female and male education levels surveyed, percentage of HHs

3.2.2 Energy Use Effect

In Bangladesh more than 80 per cent of surveyed households did not know about the government registered (subsidized) price of kerosene (BDT 65 per litre) and 95 per cent of households were not aware of the subsidy (Figure 13).

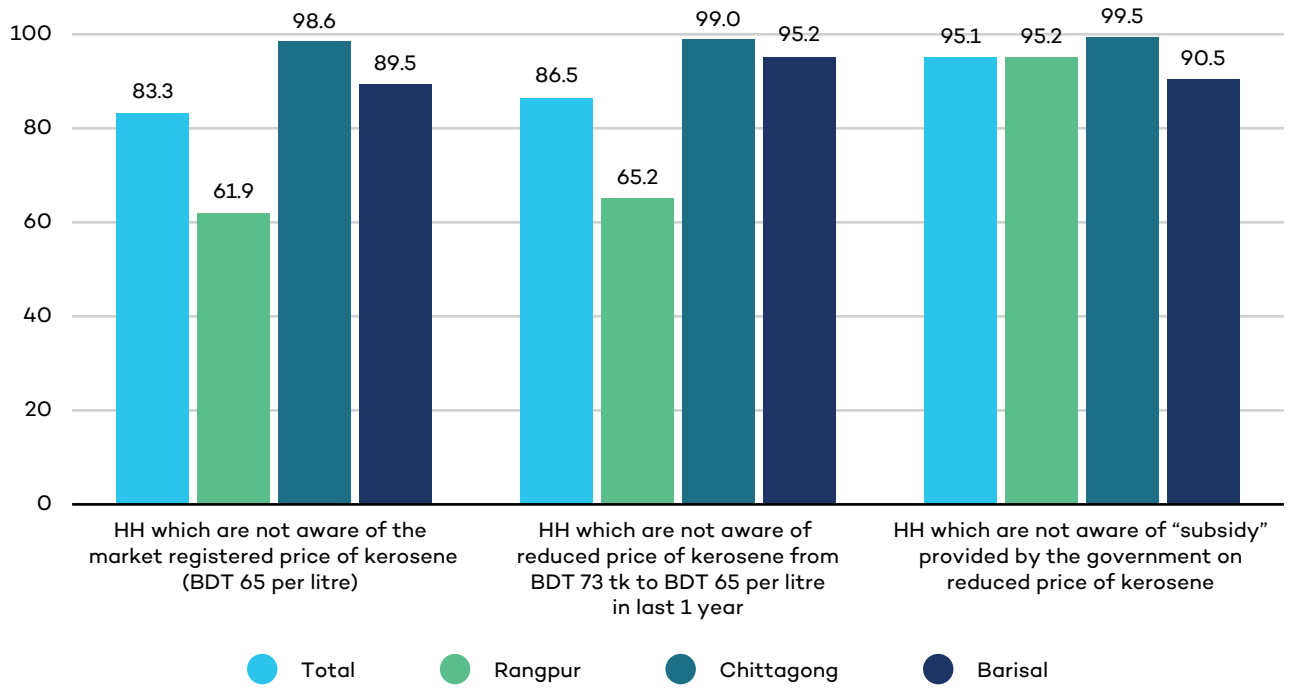


Figure 13. Percentage of HHs with knowledge of subsidized price of kerosene

A regression analysis was used to test the effect of kerosene price and household income on per capita kerosene consumption. Both price and income were found to be significantly correlated with kerosene consumption. When price increased, kerosene consumption decreased. When income increased, kerosene consumption increased. Looking at the trends, factors that appeared to reduce kerosene consumption were larger household size, higher price differential and greater distance to kerosene purchasing source, and existence of a grid connection in the village. Results from the analysis are available in Annex 2.

Households overwhelmingly demonstrated a desire to shift away from kerosene—99 per cent of households revealed their willingness to substitute kerosene with other fuels (Figure 14). The households' preference (except in Chittagong) leaned toward grid electricity but households surveyed in Chittagong preferring solar over electricity systems to replace kerosene.

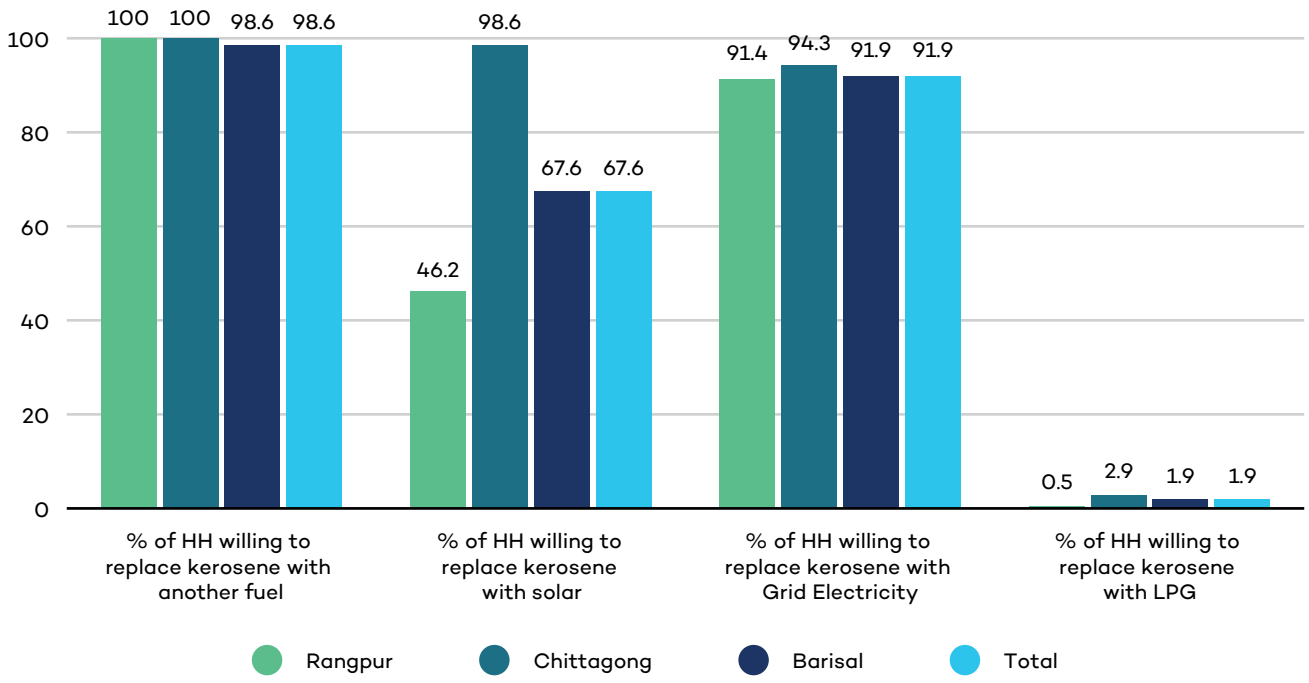


Figure 14. Percentage of HHs willing to replace kerosene with other fuel

Despite price controls and potential subsidies, households listed the lack of adequate lighting (92 per cent) and high price of kerosene (85 per cent) as the major reasons why they wanted to replace the fuel, with poor lighting from kerosene seen as the primary reason (Table 6). The high price of kerosene seemed to be the main factor for around 95 per cent of households in Chittagong and Barisal: 44 per cent of households want to switch away from kerosene because of the soot, but fewer recognized the health impacts from kerosene linked to these emissions, particularly in Barisal. This suggests that awareness around kerosene's health impacts is low.

Table 6. Percentage of HHs with different reasons for replacing kerosene with other fuel

	Rangpur	Chittagong	Barisal	Total
Lack of adequate lighting using kerosene	97	87	92	92
High price of kerosene	64	96	94	85
Dirty and black emissions from kerosene	46	57	28	44
Time-consuming process of collection of kerosene	6	7	7	7
Negative health impacts (e.g., coughing, eye diseases) from usage of kerosene	27	30	6	21
Unreliable supply of kerosene	4	3	14	7
Others	5	0.5	0	2

Note: Numbers have been rounded.

3.2.3 Energy Supply Effect

The survey found that the price paid per litre of kerosene deviates from the official registered price by 14 per cent on average, with some districts displaying the highest average price difference between the market price and the official government price of BDT 65 of around 17 per cent (Figure 15).

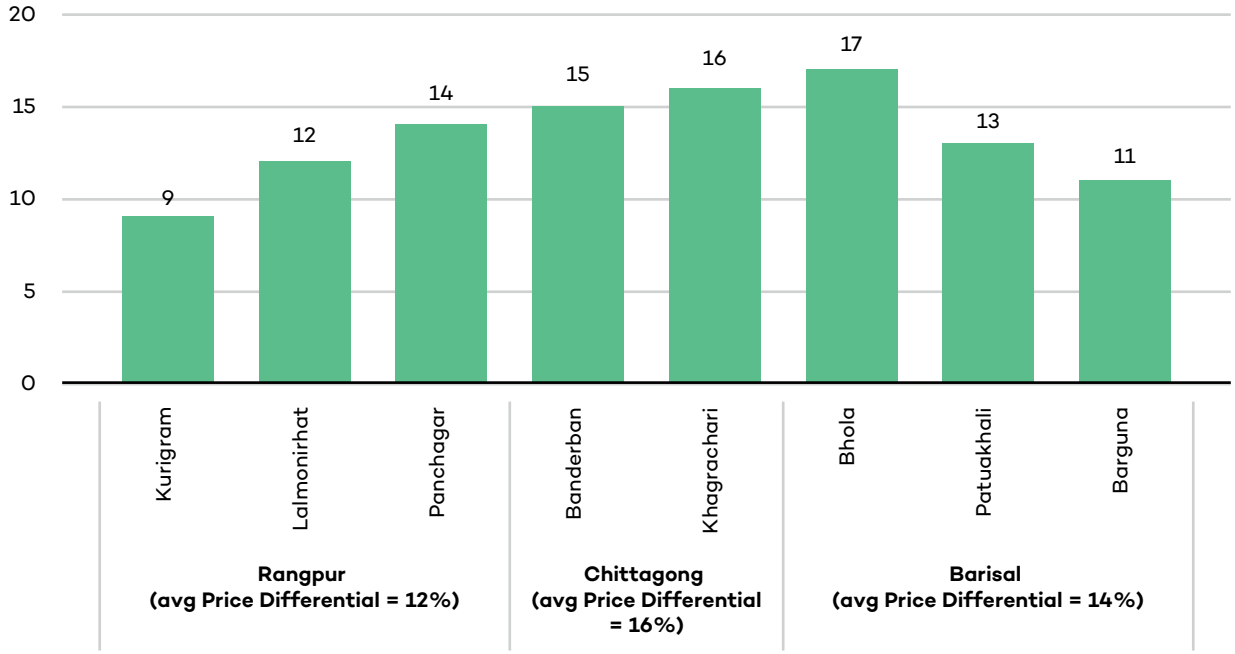


Figure 15. Average price differential across surveyed districts, per cent

Most households surveyed (99 per cent) buy kerosene from local stores. The average mean retail price paid by households for a litre of kerosene was BDT 77 from local stores, and BDT 79 from roadside vendors. The highest price paid for a litre was 95 BDT recorded in Barisal, while the lowest price paid was 68 BDT, recorded in Rangpur. Nowhere was registering a retail price at the official registered price of BDT 65. The processing of kerosene takes place in Chittagong, yet Chittagong experienced the highest price differential for the fuel. Households also reported their perceptions regarding the high retail price they pay for kerosene. The involvement of middlemen in the distribution channel and profiteering intention of suppliers came up as the major two factors (see Annex 1 for more information on the breakdown of price buildup across the supply chain).

3.3 How Could Kerosene Subsidy Reforms Impact Poor Women?

3.3.1 Income Effect

Households were asked about potential coping mechanisms when faced with a potential price increase in kerosene associated with a removal of subsidies (Figure 16). With a 20 per cent price increase most households said they would absorb the cost via an increase in income-generating activities (IGAs), but overall 47 per cent of households would reduce the use of kerosene (alone or in conjunction with other strategies) because of the increased price. Given a larger potential doubling of the price of kerosene (50 per cent increase) more households used multiple coping mechanisms to manage, with 67 per cent of households reducing the use of kerosene within their coping strategy including other elements such as reducing expenditure on other goods and increasing IGAs.

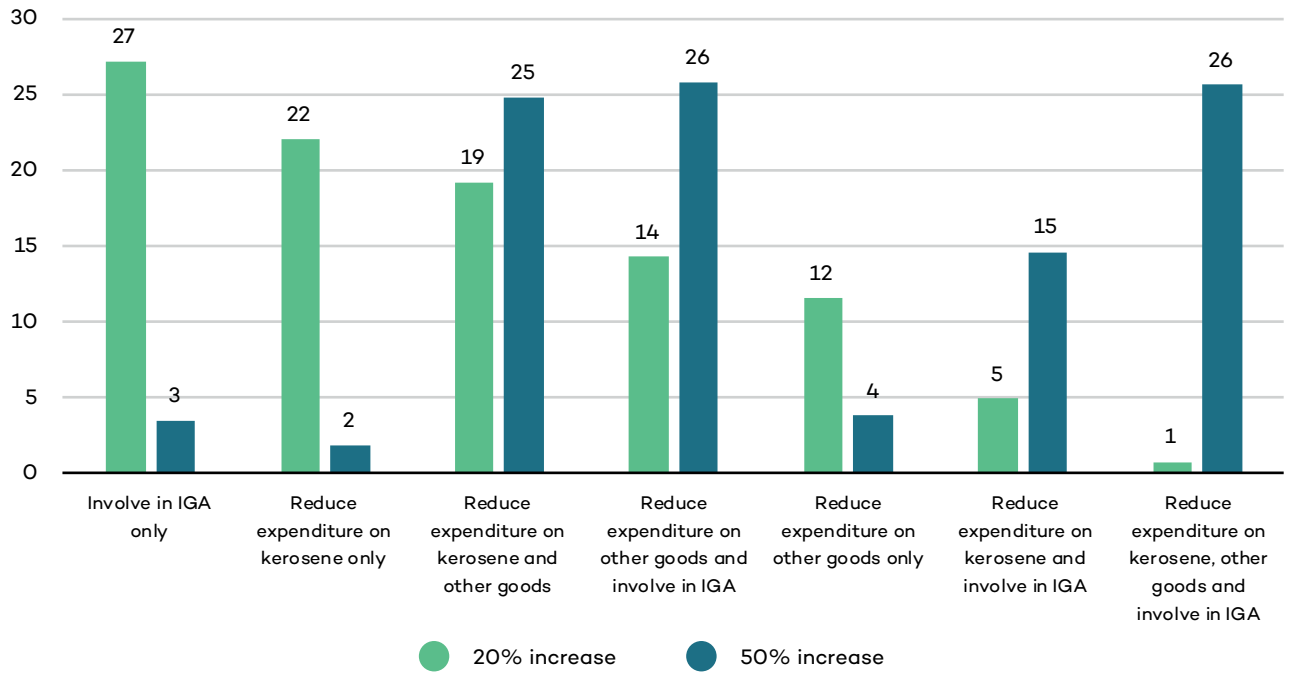


Figure 16. Coping mechanisms of HHs (per cent) given a 20 per cent and 50 per cent increase in kerosene, percentage of HHs

Where households explained they would increase income by engaging in more IGAs, the main approach was to increase working hours by the male household head (all households surveyed registered the household head as male). Other mechanisms for increasing income to cover a rise in the price of kerosene included drawing on household savings, saving less compared to before, or borrowing. Where households explained they would reduce expenditure on other goods as part of their coping mechanism to manage an increase in kerosene prices the majority indicated that the reduction in expenditure would be made in food, followed by recreation and clothes. Reduced expenditure on food as a way of coping with a price increase was particularly pronounced when faced with a potential doubling in the price of kerosene. This is a dangerous prospect given Bangladesh has prevalent poor maternal nutrition and 19 per cent of women aged 15–49 (and 31 per cent of adolescent girls aged 15–19) are underweight (BMI < 18.5) (USAID, 2018). Therefore, it is likely women could become more vulnerable where households reported a change in expenditure on food as a result of increases in prices in fuel. On the other hand, households were asked to state which members of the family would be affected most by an increase in either the price of food or fuel. In case of a price shock, overall it seems that women do not seem to be more vulnerable than men, with 74 per cent of households reporting that all members will be equally affected (see Figure 17).

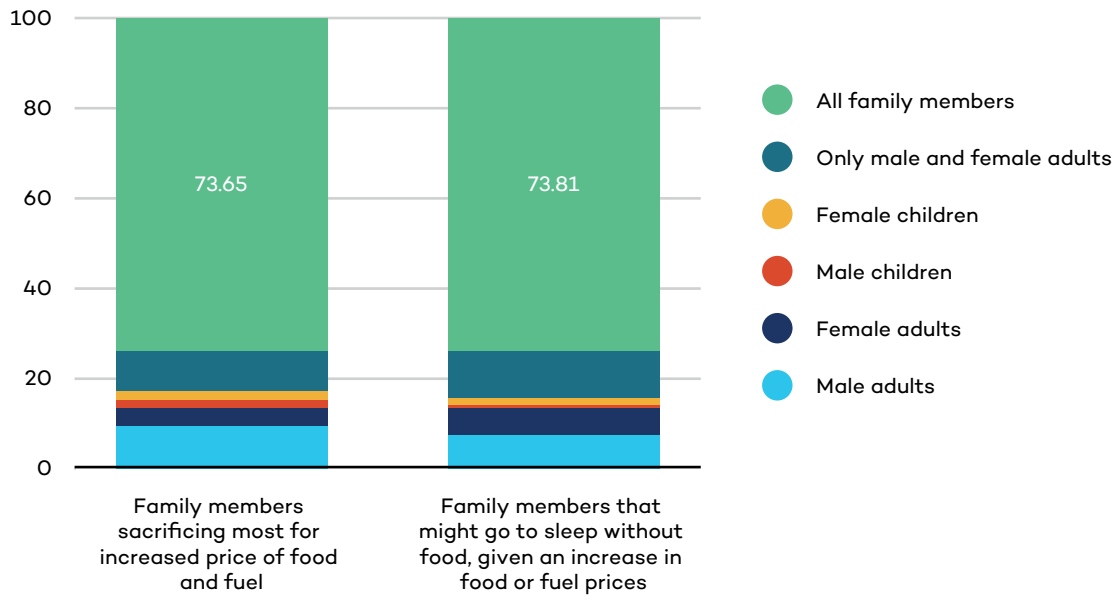


Figure 17. Percentage of HHs reporting effects of food and price shock across different family members

A multinomial logit regression revealed that the mode of decision-making authority (solely by female member/ solely by male member/jointly by family members) over usage of lighting fuel does not vary across price differentials (Annex 2). In other words, the price differential does not affect the authority of female members to decide over use of lighting fuel.

Households were asked directly: "If kerosene were no longer available or there was an increase in price, would there be an impact on women's authority in the household across a number of different issues?" (e.g., from visitation rights to access to the news); however, all households reported that across all activities a woman's authority would not change.

3.3.2 Energy Use Effect

When asked about a potential price increase in kerosene (and therefore the cost of lighting) households were also asked about changes in behaviour for male and female household members in terms of duration of activities including studying, cooking,[6] IGAs and leisure activities, following potential price increases, as well as how household behaviour might change to accommodate this (for example shifting activities into daylight hours).

[6] Only nine men in the survey were found to be involved in cooking. The result is not surprising because in Bangladesh cooking is typically done by women. Although urban areas seem to be a little different, in rural Bangladesh the same perception is widely held.

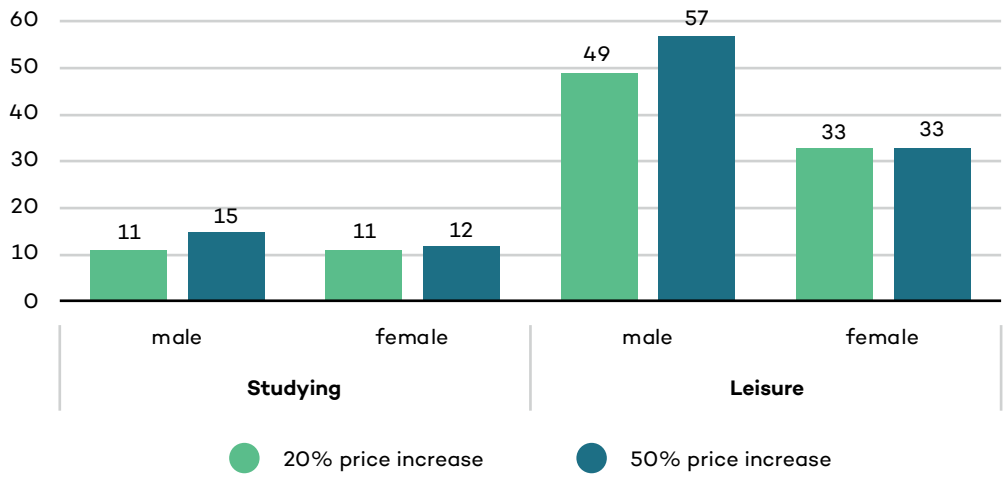


Figure 18. Reduction in duration of study and leisure activity, mean of percentage

Note: The mean difference between males and females for studying came up as statistically insignificant under a 20 per cent and a 50 per cent hypothetical price increase in kerosene. For leisure, the mean difference between males and females came up as statistically significant under a 20 per cent and a 50 per cent hypothetical price increase.

Regression analysis (Annex 2) suggests that women are less affected by a potential kerosene price increase than men in terms of study and leisure duration. When tested against actual kerosene prices, study and leisure duration, it should be noted that, on average, female students were found to study less than males (37 minutes per day) and enjoy less leisure time (17 minutes per day). Yet females were found to be less affected by an increase in kerosene prices than their male counterparts (Figure 18). This is also supported by the results above, when households were asked about potential changes in duration of activities following hypothetical kerosene price increases. This does not mean that an increased price differential will not be associated with any adverse effects on women. An increase in the price of kerosene will decrease study and leisure duration for both men and women, but women's study and leisure duration will be less sensitive than men's to a price increase. This means that, for example, given a hypothetical 20 per cent price increase in kerosene, male students anticipated reducing study time by 11.2 per cent, and women by 11.3 per cent.

This finding has implications for any potential reform of kerosene subsidies that results in price increases. As discussed earlier, the government's decision to keep the kerosene price artificially low via subsidies does not seem to deliver the lower official government price, in that households in the survey were found to be paying higher prices than the official fixed price.

3.3.3 Energy Supply Effect

The survey areas were chosen because they were rural, high in kerosene use, although often not lacking in electricity or SHS prevalence. Therefore, the option for households to switch between lighting fuels or services—i.e., from kerosene lighting to electricity, when for example, a price rise might be experienced in kerosene—could be limited because of affordability constraints. Households are seemingly "stuck" with kerosene use for lighting, with little alternative to switch to either due to a lack of grid connection or the fact that grid or solar electricity is currently financially out of reach. Yet all the households desired to make the shift away from kerosene. Therefore, households were asked about preferences for energy other than kerosene, and about solar electricity and electricity in general.

Women in the households were also asked about what changes they might expect for IGAs with access to electricity either via the grid or via solar. Most women (54 per cent) explained that they would continue with their current activity, but 45 per cent (where women are not currently involved in an IGA) indicated that they would get involved in IGAs given access to electricity (see Table 7). This suggests that, given the chance,

women are keen to access electricity and many want to set up new IGAs, potentially leading to additional income and savings.

Table 7. Percentage of HHs reporting that women would become involved in (or change) income-generating activity (IGA) if the HH received electricity through grid/solar

	Rangpur	Chittagong	Barisal	Total
Begin IGA	28	46	60	45
Change the existing IGA	1	0.5	3	1
Continue the existing IGA	71	53	37	54

Note: Numbers have been rounded.

Households were asked about changes in activities carried out by female members of the household if they had more time available as a result of reduced time spent on fuel collection or from more hours of available light. It is interesting to note that households surveyed identified that this would mostly mean more time for women to perform household chores and spend more time with the children, with opportunities for additional activities such as paid work, leisure or study being perceived to be a lot fewer: more time for women was translated into greater household productivity but not necessarily women's empowerment (Table 8).

Table 8. How females would spend time saved from collecting fuel or with longer hours of available light, per cent of females interviewed

	Rangpur	Chittagong	Barisal	Total
Household chores	94	71	97	87
Spending time with children	83	65	73	74
Visiting friends and relatives	23	83	14	40
Paid work	19	3	46	23
Watching tv	5	1	1	3
Reading/pursuing education	0.5	3	4	2
Unpaid work – volunteering/ community activities	0	0.5	0	0.2

Note: Numbers have been rounded.

3.4 What Subsidies and Government Support Do Poor Women Prefer?

Households were asked to identify those goods and services that they thought would benefit women the most—69 per cent of households reported that electricity access would provide the most beneficial services for women, well above support for other services including clean cooking and cash (Figure 19).

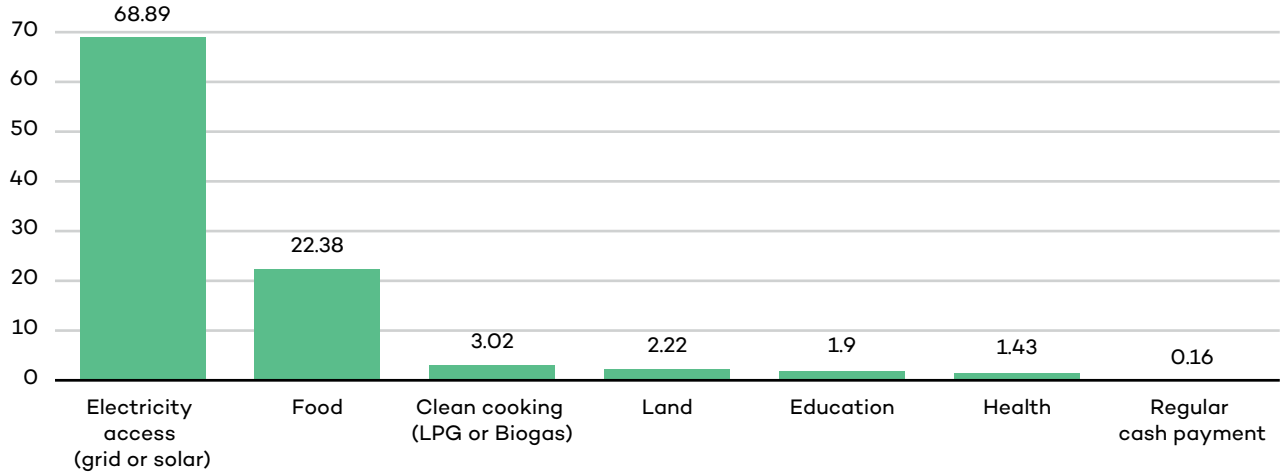


Figure 19. Perceptions regarding the most beneficial goods and services for women, percentage of HHs interviewed

However, when asked why grid electricity and solar systems are not utilized respondents described the high price of grid electricity and solar system electricity as the main barrier. Around 60 per cent of households and 95 per cent of total households reported high price as the reason for not using electricity and solar respectively (Table 9).

Table 9. HHs reporting high price as reason for not using electricity and solar system (per cent)

Reasons	Rangpur	Chittagong	Barisal	Total
Grid electricity price is very high	56 (n=210)	72 (n=210)	57 (n=210)	62 (n=630)
Solar appliance or Solar Home System price is very high	89 (n=210)	98 (n=210)	98 (n=210)	95 (n=630)

In regression analysis of survey data from six countries, Kojima et al. (2011) found that income and relative fuel prices were the two most important factors influencing household fuel choice, followed by education. In Bangladesh, findings confirmed this in that kerosene costs on average BDT 210 per household per month (USD 2.64)[7], or 4.6 per cent of monthly expenditure.

Income and relative fuel price also seem key to switching. Households were asked about the additional income needed by households per month to access electricity, and described on average BDT 3,084 (USD 39) (grid) and 3,091 (USD 39) (solar) electricity (see Figure 20). Households perceive the monthly cost of electricity access to be around 15 times higher than kerosene, yet monthly instalments for solar home systems (USD 13) (Khandker et al., 2014, p. 13) are actually around five times higher than current monthly spending on kerosene. Households perceive LPG and natural gas to be even more expensive, requiring an additional BDT 7,325 (USD 91.92) per month. New solar systems are now linked to a "Free of Cost" government program under a Money-for-Work framework. This has been reported to create a potential disruption of the existing SHS business model and has raised governance concerns (Rahman & Mirza, 2018).

[7] Exchange rate used: BDT 1 = USD 0.012548594.

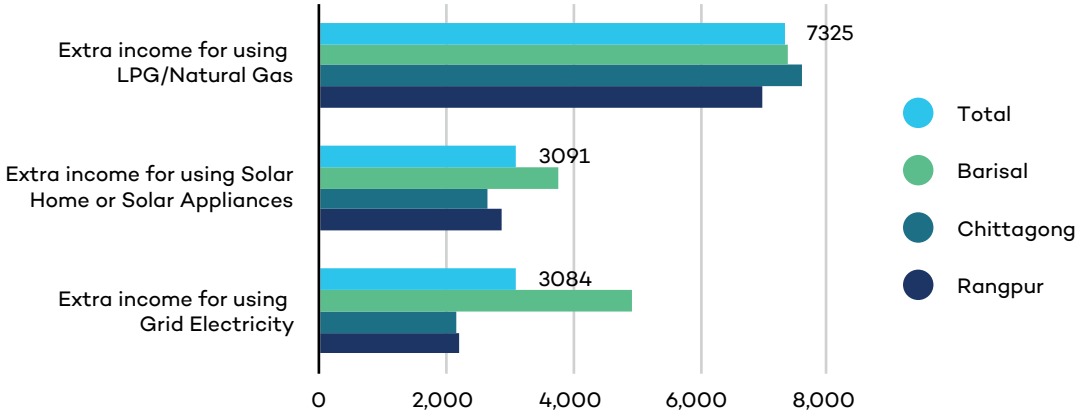


Figure 20. Perceived additional mean monthly income (BDT) needed by HHs surveyed for fuel and electricity

4.0 Key Findings and Policy Recommendations

The key findings of the research are outlined below, followed by country-specific recommendations, the cross-country finding and the overarching policy recommendations.

4.1 Key Findings

Current subsidies are not working well for households. Our survey found that there was little awareness of government subsidies offering price support toward kerosene via state oil companies. Households did not experience a decrease in the price of kerosene via a passthrough to the consumer from an official price cut from BDT 68 to BDT 65 per litre of kerosene in 2016. Indeed, the research found that in the areas surveyed kerosene prices were 14 per cent higher than the official price, at an average of BDT 77 per litre, and in some places as much as 17 per cent higher. Also, a large share of subsidies accrues to wealthier segments of the population given their higher consumption and access to energy.

Kerosene subsidy reform needs to be handled carefully. In Bangladesh, poor families use kerosene for lighting. Any increase in the price of kerosene thus needs to be handled with care, especially if households have no opportunity to switch to electricity via solar or the grid for lighting needs. The research found that with a hypothetical 20 per cent price increase most households said they would absorb the cost via an increase in IGAs, but overall 47 per cent of households would reduce the use of kerosene (alone or in conjunction with other strategies). Given a larger potential doubling of the price of kerosene (50 per cent increase) more households would use multiple coping mechanisms to manage, with 67 per cent of households reducing their use of kerosene along with other elements, such as reducing expenditure on other goods (e.g., food) and increasing IGAs. In case of a price shock, overall it seems that women do not seem to be more vulnerable than men, with 74 per cent of households reporting that all members would be equally affected. Furthermore, because men purchase kerosene, a price increase may affect men's incomes more than women's.

Using regression analysis, the research found that the price differential (between the government and the retail price) of kerosene is negatively related with study duration for both males and females. From a gender perspective, the results reveal that female students do study less on average but are less sensitive than males to price changes in terms of reduced study time. Similar results from regression analysis were found regarding duration of leisure activities, i.e., with an increased price differential both males and females experience less leisure time, but females are less affected by an increased price differential than males (Annex 2). Regression analysis revealed that kerosene price does not affect the authority of female members to decide over use of lighting fuel.

Kerosene appears to be cheaper in the short term, but there are mid-term options that are cost-comparable. The survey found that fuel costs families around BDT 210 per month, (the majority of which comprised of kerosene, which was purchased more often than fuel wood) or 4.6 per cent of monthly expenditure. Households perceived the additional income needed to access grid or solar electricity to be about BDT 3,000 per month (15 times higher than kerosene).

Solar PV lamps are available for around BDT 1,550 (USD 18) (Laan et al., 2019), or BDT 65/month (assuming a two-year lifespan). This is far less than the average expenditure on kerosene (although noting that a solar lantern provides only a single light point).

Prices for home systems have also fallen dramatically. A solar home system can be purchased from around BDT 30,000 (USD 350) (Hossain et al., 2019). Based on a highly conservative estimate that the system would last two years, the monthly cost (without interest payments) would be BDT 1,250 per month, significantly lower than the perceived price of BDT 3,000. The monthly price would be even lower (BDT

500 per month) assuming a more realistic lifespan of at least five years. Plus SHSs can provide electricity and multiple light points.

Keeping kerosene prices artificially low may lock many households into kerosene use and undercut better alternatives. Subsidies for solar lamps to replace kerosene lamps in very poor households could be considered alongside grid and mini-grid electrification efforts.

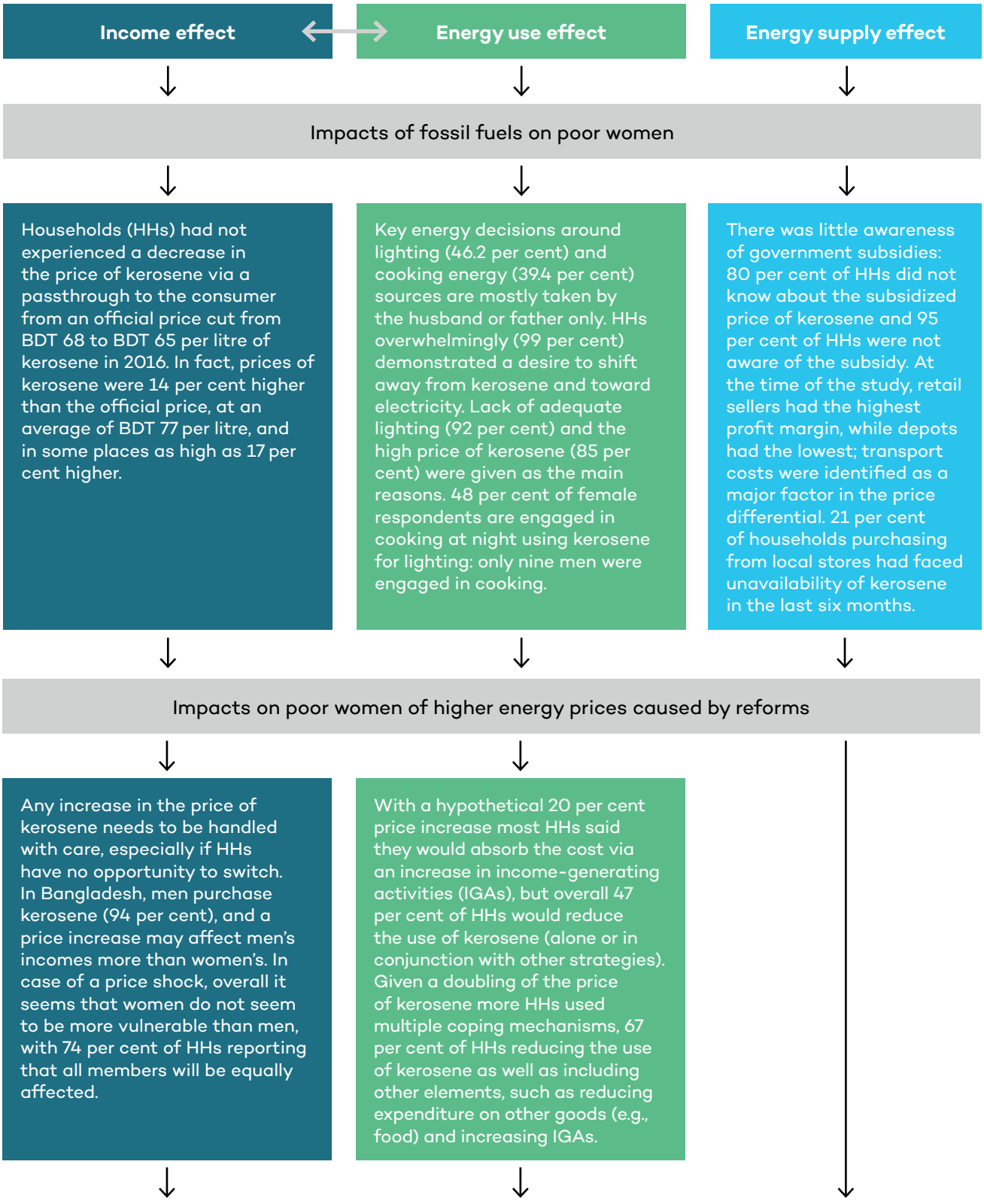
Women want to access and use electricity: As noted earlier, Bangladesh has seen a reduction in kerosene use alongside an increased electrification of the country. Households still using kerosene want to transition away from it because of the poor lighting quality and high price, but little was understood about the health impacts of kerosene across those surveyed.

69 per cent of households reported that electricity access would provide the most beneficial services for women, well above support for other services including clean cooking and cash. Women in households in Bangladesh were also asked about what changes they might expect for IGAs with access to electricity either via the grid or via solar. Most women (54 per cent) explained that they would continue with their current activity, but 45 per cent (where women are not involved in IGAs at present) indicated that they would get involved in IGAs given access to electricity. Our survey with households in Bangladesh overwhelmingly (99 per cent) demonstrated the desire to shift away from kerosene and toward electricity.

Women may be more exposed to indoor air pollution during cooking activities. The survey revealed that women are typically the primary cooks, spending 80 minutes every day cooking. Only nine men reported being engaged in cooking in the survey of 630 households in Bangladesh. Women are therefore inside more often and exposed to the harmful effects of indoor air pollution from kerosene lighting and biomass stoves. The survey found that on average female students study 37 minutes less per day than their male counterparts, and access 17 minutes per day less of leisure time.

Men make the decisions on energy purchases. Even though women do the cooking, the surveys revealed that it was overwhelmingly men who take decisions on energy sources for lighting (46 per cent) and cooking (39 per cent). Men also have the role of purchasing kerosene (94 per cent). Any policies to encourage a switch away from kerosene for lighting or toward non-solid fuels for cooking would need to empower women or involve men strongly.

Figure 21 summarizes the key findings in terms of income, energy use and energy supply effects.


Income effect
Energy use effect
Energy supply effect
Impacts of fossil fuels on poor women
Households (HHs) had not experienced a decrease in the price of kerosene via a passthrough to the consumer from an official price cut from BDT 68 to BDT 65 per litre of kerosene in 2016. In fact, prices of kerosene were 14 per cent higher than the official price, at an average of BDT 77 per litre, and in some places as high as 17 per cent higher.
Key energy decisions around lighting (46.2 per cent) and cooking energy (39.4 per cent) sources are mostly taken by the husband or father only. HHs overwhelmingly (99 per cent) demonstrated a desire to shift away from kerosene and toward electricity. Lack of adequate lighting (92 per cent) and the high price of kerosene (85 per cent) were given as the main reasons. 48 per cent of female respondents are engaged in cooking at night using kerosene for lighting: only nine men were engaged in cooking.
There was little awareness of government subsidies: 80 per cent of HHs did not know about the subsidized price of kerosene and 95 per cent of HHs were not aware of the subsidy. At the time of the study, retail sellers had the highest profit margin, while depots had the lowest; transport costs were identified as a major factor in the price differential. 21 per cent of households purchasing from local stores had faced unavailability of kerosene in the last six months.
Impacts on poor women of higher energy prices caused by reforms
Any increase in the price of kerosene needs to be handled with care, especially if HHs have no opportunity to switch. In Bangladesh, men purchase kerosene (94 per cent), and a price increase may affect men's incomes more than women's. In case of a price shock, overall it seems that women do not seem to be more vulnerable than men, with 74 per cent of HHs reporting that all members will be equally affected.
With a hypothetical 20 per cent price increase most HHs said they would absorb the cost via an increase in income-generating activities (IGAs), but overall 47 per cent of HHs would reduce the use of kerosene (alone or in conjunction with other strategies). Given a doubling of the price of kerosene more HHs used multiple coping mechanisms, 67 per cent of HHs reducing the use of kerosene as well as including other elements, such as reducing expenditure on other goods (e.g., food) and increasing IGAs.

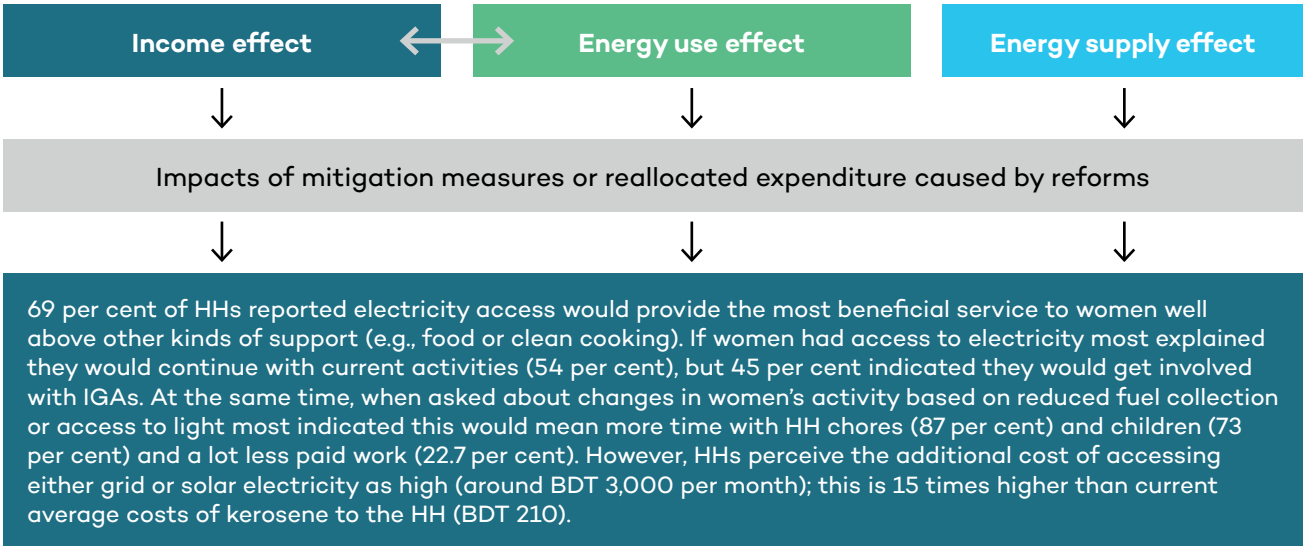


Figure 21. Summarized findings from the impacts of fossil fuel subsidies, their reform and mitigation on poor women in Bangladesh

Source: This research, unless otherwise sourced.

4.2 Policy Recommendations for Bangladesh

Kerosene is clearly an important source of lighting for the poor in Bangladesh. However, allowing continued dependence on subsidized kerosene is neither socially or economically responsible. While this report did not reveal strong gender-differentiated impacts, it is clear that the welfare, productivity and empowerment of women and girls in Bangladesh are not well served by kerosene. Kerosene gives low-quality light, limiting education and income-generating opportunities, while generating toxic indoor air pollution that is a danger to all householders, but particularly women, who are indoors more for cooking. Women indicated a strong preference to switch to electricity or solar lighting, which could increase IGAs.

For these reasons, a shift away from kerosene is recommended rather than attempting improvements to the kerosene subsidy system. Solar alternatives such as lanterns, home-systems and micro-grids are a reliable and affordable alternative to kerosene, either for off-grid households or as a backup source of clean lighting. In India, solar products have been demonstrated to be cheaper than kerosene over the lifespan of the technology (Laan et al., 2019). However, due to their higher upfront cost, low-income households need assistance to purchase these products.

In the short term, the government could consider shifting subsidies to off-grid solar PV products as a means to fund the energy transition for these marginalized households. Subsidy mechanisms would need to foster rather than flood the emerging off-grid solar market. Consumer choice and competition can be maintained through mechanisms such as competitive tenders or subsidized micro-financing. For an examination of the swaps concept in India, see the report *Kerosene to Solar PV Subsidy Swap: The business case for redirecting subsidy expenditure from kerosene to off-grid solar* (Gill et al., 2018).

A focus on connection over consumption subsidies can encourage gender empowerment around decisions to purchase new equipment such as solar lanterns, home systems or mini-grids and overcome upfront connection costs. Such connection subsidies, however, also require good targeting to ensure they benefit the poor and are not mostly harnessed by the relatively wealthy. India's *Pradhan Mantri Ujjwala Yojana* (PMUY) scheme for LPG provides connection subsidies for poor households targeting poor women as the eligible

recipients. Such policy structures can play a positive role in encouraging women to pursue financial inclusion and in bolstering their voice and agency on household energy choices.

In the longer term, continuation of the push for universal electrification is needed. While electricity access does reduce kerosene use, as observed in Bangladesh in recent years, it does not necessarily eliminate it. Electricity can be too expensive for poor households plus limited reliability and duration of electricity supply may result in continued household dependence on kerosene, as seen in India (Laan et al., 2019). This reinforces the rationale for replacing kerosene with a clean alternative.

4.3 Core Findings From Multi-Country Study

The detailed results from the studies of India (LPG for cooking) and Nigeria (kerosene for cooking) are available in Global Subsidies Initiative-IISD, BIDS, IRADe and Spaces for Change (2019). This section provides a summary of the key themes.

Women do all the cooking in all three countries. In Nigeria, in both urban and rural areas, women are primarily responsible for cooking (~86 per cent) with kerosene and a host of other cooking fuels. In Bangladesh, nine men reported to be engaged in cooking in the survey of 630 households in Bangladesh. In India, from across 810 households, five households responded that male members are primarily responsible for cooking and 521 households confirmed that a male had cooked at least one meal in the last 30 days.

Clean cooking subsidies are helping some but not all poor women. In India, among surveyed households, 50 per cent of households did not use LPG at all. In Nigeria, biomass accounted for 64 per cent of cooking fuels, with only the minority of households using kerosene.

Subsidies are not always reaching those in need. In Nigeria, households reported prices that were between two and six times the official sales price. Fuel distribution was unreliable, and characterized by smuggling, inefficiencies and corruption. During periods of kerosene scarcity, women would often queue for hours.

Better targeting of LPG subsidies is needed. In India, only 48 per cent of recipients of free connections (under the PMUY scheme) were among the poorest 40 per cent of households. And more than half of poor households surveyed in the states of Chhattisgarh and Jharkhand did not use LPG and therefore did not benefit from PMUY.

LPG subsidies are working for poor women who can access them. In rural areas in India, when subsidies are helping households convert to LPG, women are benefiting through decreased indoor air pollution and fuel management responsibility, freeing their time for other activities and reducing their drudgery. In general, women in India were found to have greater decision-making power than men for cooking energy, and the active targeting and requirement of gas connection subsidies to female beneficiaries is likely to strengthen women's control over decision making.

Subsidy reform needs to be undertaken with care to avoid negative energy access impacts. In India, when asked to imagine a scenario where prices increased by 40-50 per cent, the majority said they would reduce LPG consumption and/or revert to biomass. While only 18 per cent of households in Lagos, Nigeria, reported switching to or using more biomass, over 50 per cent of rural households would employ this strategy, particularly the poorest. The higher cost of kerosene reduced available household income, especially women's budgets. Cost is an important factor influencing fuel choices and prices need to reflect ability to pay for the poorest if a switch from biomass is to occur.

Subsidies are not the only element that leads to fuel switching and better access. Fuel subsidies are not sufficient to promote the use of modern fuels. To promote alternatives to biomass—especially LPG and

electricity—several factors are necessary: reliable distribution systems adapted to the needs of poor households, education about the health benefits and safety of LPG, and better regulation. The surveys found a high correlation between the level of education and the preference for modern fuels.

Investing in fuels rather than outcomes may be hindering more effective options. The large sums invested in subsidizing one fuel could be used more efficiently to support economic and social empowerment. "Picking winners" with fuel subsidies can crowd out effective policy alternatives such as addressing non-price barriers (distribution, price competition) or innovative solutions (such as biogas). In India and Nigeria, women indicated their preference for support with jobs, health, education and the general cost of living. There is, therefore, a large potential to improve the effectiveness of social programs to empower women.

4.4 Cross-Country Policy Recommendations

In terms of broad policy recommendations to governments, this research suggests that governments could

- Continue to phase out fossil fuel subsidies that do not support energy access for poor women or the target population. In particular, there is a need to phase out subsidies for kerosene, (which is prone to large-scale diversion, can be more costly than other lighting alternatives and is not clean-burning) while also ensuring there is a clean alternative.
- Work to better target subsidies for fuels that are currently deemed necessary for sustainable energy access so more resources are available to efficiently help achieve SDG7 on energy access and to fund programs that support women and promote gender empowerment.
- Make energy access support more technology-neutral, to achieve better outcomes and avoid technology lock-in by fostering solutions adapted to the context. This should include not only focusing access policies on transitional fossil fuels but also on ensuring that the right market incentives and structures are in place to cultivate new and renewable lighting and cooking technologies.
- Consider alternative support policies such as social safety nets, health care, education or business loans for women.
- Recognize that subsidy reform needs to be undertaken extremely carefully, based on an impact analysis that accounts for the effects on poor women and alongside a robust package of measures to mitigate against potential negative impacts of price increases.
- Use comprehensive strategies for energy access that recognize the importance of gender and incorporate it into policy design.

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Annex 1: Value Chain of Kerosene Price

The value chain of kerosene involves a number of stages. Government monitoring occurs up until the dealer level. Therefore, the research ran from the buildup of price from the dealer level to final consumption, to fully understand the whole value chain. This was achieved via key informant interviews (KIIs) with each of the agents of the value chain based on a sample of 30 targeted households from eight districts across three divisions (Barisal, Rangpur and Chittagong) that were found to face a high differential between the official and retail price of kerosene from the main survey. Specific households with both the highest and the lowest price differential, compared to the average price differential, in each of the districts were selected for the value chain survey. These included, for example, households with registered price differentials of between 8 per cent to 23 per cent.

The households were asked to report details of the source of kerosene purchased: enumerators then visited these outlets and interviewed sellers regarding the buying and selling price, and cost composition of kerosene. To establish a full depiction of the value chain, the enumerators then visited each of the purchase (sale) points of kerosene within the full chain back to the depot, one by one. The depot is the selling point of the registered dealer. Hence, the survey established 30 distinct value chains starting from each of the households. The survey traced up to a maximum of six points of purchase (sale) from households' source of purchase back to the depot and official government level, but the majority of points in the kerosene value chain covered between two to three points of sale before purchase.

Because all of the points serve as both buyers and sellers of kerosene, the difference between the buying and selling price of these points is one of the primary indicators to understand the cost structure, as well as profit margin, at each one.

Out of the 30 value chains in the survey, 25 identified Point 1 as the highest proportion of profit earned in the respective value chain i.e., the point in the value chain that is furthest from the depot and the official price. Depots, on the other hand received the lowest proportion of profit across 28 value chains. All the sellers in Point 1 were retail sellers, and almost all the sellers in Point 2 & 3 are wholesalers.

Profit comprises more than 55 per cent of price difference of Point 1 (i.e., the retailer where the household makes its purchase) in Chittagong and more than 60 per cent in Barisal and Rangpur (Figure A1.1) Transport follows in Chittagong (22 per cent) and Barisal (29 per cent). However, for Rangpur, quantity loss[8] came next in this regard (24 per cent) and transport cost comprised 11 per cent.

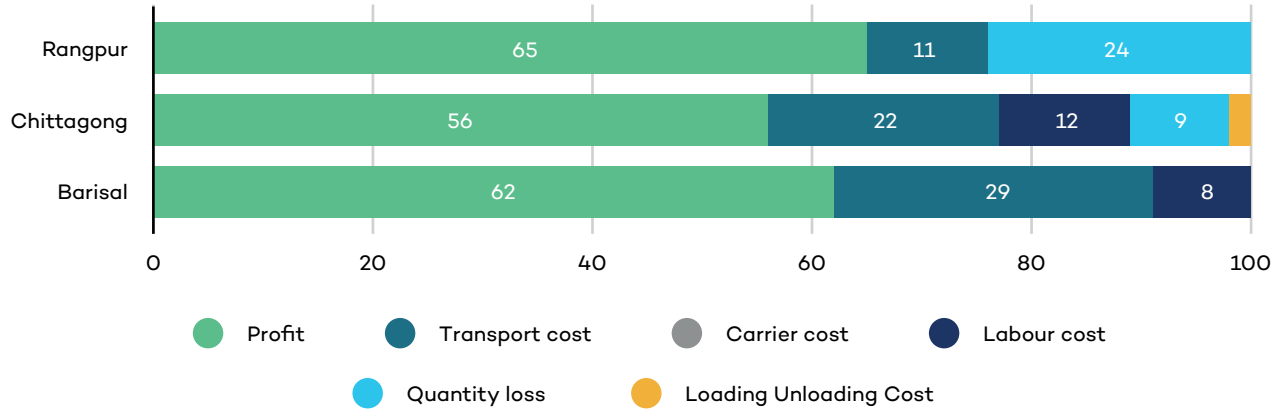

Figure A1.1. Profit & cost of Point 1 (from where HHs purchase) as percentage of price difference

[8] "Quantity loss" refers to transport losses by the retailer. A retailer may purchase 10 litres of kerosene from the wholesaler but lose, say, 10 per cent due to poor containers leaking or spills during transport. Retailers cover quantity losses by selling at higher price.

The share of profit of Point 2 (wholesaler) to total price difference was lower than the share of Point 1 for Chittagong (32 per cent) and Barisal (33 per cent) (Figure A1.2). However, the share is almost the same to Point 1 in case of Rangpur (65 per cent). Transport cost comes next in the composition across all the three districts. Quantity loss holds a share of around 9 per cent for Chittagong whereas the share is very small for Barisal and Rangpur. On the other hand, Barisal provides a markup for a "commission to middlemen" (10 per cent).

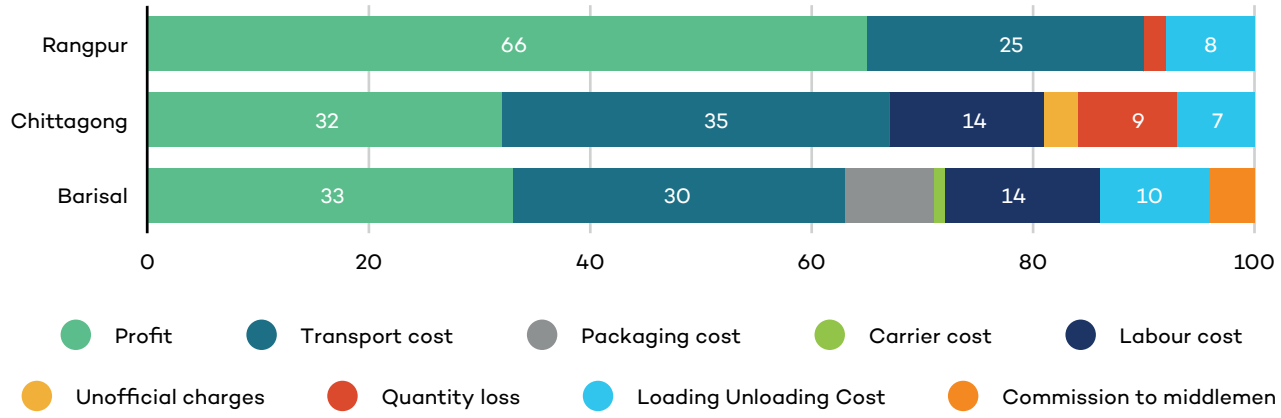

Figure A1.2. Profit & cost of Point 2 (from where HH purchase) as percentage of price difference

Transport cost represented the major share of the price difference for depots across all the three districts (Figure A1.3). Refining costs (the costs incurred by depots) comprises around 20 per cent for Chittagong, 8 per cent for Rangpur and 2 per cent for Barisal. The share of profit was the same for Chittagong and Barisal (around 18 per cent) whereas depots of Rangpur had a profit share of 16 per cent.

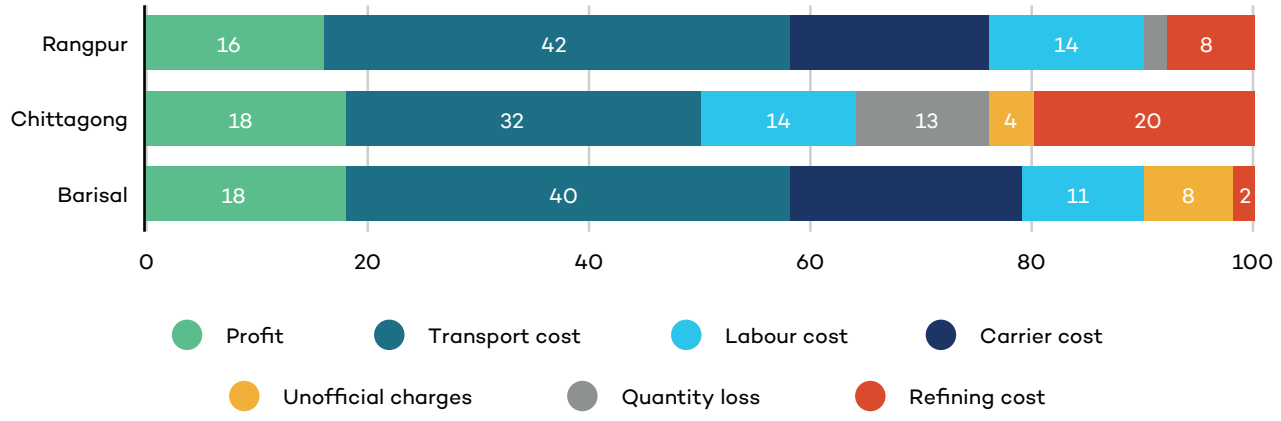

Figure A1.3. Depot's profit and costs as percentage of price difference

Annex 2: Regression of Determinants of Household Kerosene Consumption (Bangladesh)

Interpretation of Table A2.1: Determinants of household kerosene consumption

Table A2.1. OLS Regression of Determinants of Household Kerosene Consumption

	Coefficient	Robust Std Error	P-value
Ln price of kerosene (per litre)	-0.4845*	0.156	0.002
Ln per capita monthly income	0.4508*	0.031	0.000
Ln distance from HH to kerosene purchase source	-0.0072	0.010	0.482
Ln daily lighting hours (average) using kerosene	0.0685*	0.030	0.024
Share of kerosene expenditure to total expenditure	0.1770*	0.008	0.000
Share of energy expenditure to total expenditure	0.0265*	0.003	0.000
Student ratio in HH	0.0006	0.000	0.168
Female ratio in HH	0.0003	0.000	0.492
Education of HH head	0.0037	0.002	0.104
Proportion of kerosene-using HH in village	0.0007*	0.000	0.028
SOLAR or GRID dummy (If solar or grid electricity exists in village, base = neither solar nor grid)			
Dummy _Solar Only (only solar system exists)	0.0586	0.031	0.062
Dummy _Grid Only (only grid connection exists)	-0.0755*	0.022	0.001
Dummy_Both Grid & Solar	-0.1268*	0.025	0.000
Dummy_Decision on use of fuel for lighting (who decides, base=joint decision of female member & other HH member)			
Solely by husband/father	0.1148*	0.016	0.000
Self by female member	0.1005*	0.025	0.000
Constant	-2.6946*	0.270	0.000
Number of observation	630		
F(15, 612)	74.72		
Prob > F	0.000		
R-squared	0.650		
Root MSE	0.172		

*The * stands to show those variables that are statistically significant.*

Only off-grid households were surveyed: in some cases solar or grid power was available in the village but not being used in the household. Results are based on actual data recorded in the survey including kerosene price, rather than results from hypothetical questions about behaviour change based on potential price changes.

- Effect of kerosene price on kerosene consumption

Table A2.1 shows the price elasticity and income elasticity of per capita kerosene consumption. Hence, if all the variables that have an effect on per capita kerosene consumption (by litre) remain unchanged, a 1 per cent increase in the price paid by HH for kerosene will decrease per capita kerosene consumption by 0.48 per cent. Hence, the price elasticity of kerosene consumption is negative and inelastic.

- Effect of income on kerosene consumption

  Again, the response of kerosene consumption with respect to a change in income is positive and inelastic. If all the variables that have an effect on per capita kerosene consumption (by litre) remain unchanged, a 1 per cent increase in per capita monthly income will increase per capita kerosene consumption by 0.45 per cent.

- Effect of higher share of kerosene expenditure and energy expenditure, higher lighting hours and higher proportion of kerosene on kerosene consumption

  Higher consumption of kerosene (per capita) is driven by a higher share of kerosene expenditure and energy expenditure, higher lighting hours and higher proportion of kerosene-using households in the locality.

  If all the variables that have an effect on per capita kerosene consumption (by litre) remain unchanged, a 1 per cent increase in daily lighting hours will increase per capita kerosene consumption by 0.07 per cent.

  If all the variables that have an effect on per capita kerosene consumption (by litre) remain unchanged, a 1 per cent increase in "Share of kerosene expenditure" to "Total expenditure" will increase per capita kerosene consumption by 0.18 per cent.

  If all the variables that have an effect on per capita kerosene consumption (by litre) remain unchanged, a 1 per cent increase in "Share of energy expenditure" to "Total expenditure" will increase per capita kerosene consumption by 0.03 per cent.

  If all the variables that have an effect on per capita kerosene consumption (by litre) remain unchanged, a 1 per cent increase in "Proportion of kerosene-using HHs in village" will increase per capita kerosene consumption by 0.001 per cent.

- Effect of access of solar or grid electricity in village on kerosene consumption

  No households interviewed had access to electricity, but the villages where households were located had access to either grid electricity or solar or both. There are also some villages which had neither grid nor solar. The variable "SOLAR or GRID dummy" has been used in the regression to examine the effect of existence or non-existence of electricity in the villages (where households are located) over kerosene consumption of households.

  Except for the variable "SOLAR or GRID dummy," if all the variables that have an effect on kerosene consumption of households remain unchanged, per capita monthly kerosene consumption for households located in the villages with access to solar systems will be higher by 0.06 litres than the per capita monthly kerosene consumption of the households located in the village with no access to electricity (neither solar nor grid electricity). This is shown by the variable "Dummy _Solar Only (only solar system exists)" in Table A2.1. Similarly, the per capita monthly kerosene consumption of households that are located in villages with access to grid electricity will be lower by 0.08 litres than the per capita monthly kerosene consumption of the households located in villages with no access to electricity (either solar nor grid electricity). This is shown by the variable "Dummy _Grid Only (only grid connection exists)." The per capita monthly kerosene consumption of households located in villages with access to both grid electricity and solar will be lower by 0.13 litres than the per capita monthly kerosene consumption for those households located in villages with no access to electricity (either solar nor grid electricity). This is shown by the variable "Dummy_Both Grid & Solar."

- Effect of decisions on lighting fuel type on kerosene consumption

  Households where decisions on lighting fuel type are determined solely either by the husband/father or by female members have higher kerosene consumption than those households where the decision is made jointly by female and other family members.

  This is explained by the variable "Dummy Decision on use of fuel for lighting." Thus, if all the variables that have an effect on kerosene consumption of households remain unchanged, per capita monthly kerosene consumption of the households where decisions on lighting fuel type are made solely by the husband/father is higher by 12 litres than per capita monthly kerosene consumption of the household where decisions on lighting fuel type are made jointly by female and other family members. If all the variables that have an effect on kerosene consumption of households remain unchanged, per capita monthly kerosene consumption of the households where decisions on lighting fuel type are made solely by female members is higher by 10 litres than the households where decisions on lighting fuel type are made jointly by female and other family members.

Interpretation of Table A2.2. Determinants of duration of studying

Table A2.2. Determinants of duration of studying

	Coefficient	Robust Std Error	P-value
Female _ dummy	-37.00*	12.96	0.004
Female*price differential	2.15*	1.00	0.032
Price differential	-3.61*	0.74	0.000
Per capita monthly income	0.01*	0.00	0.008
Share of kerosene expenditure to Total expenditure (per capita)	17.68*	2.52	0.000
Share of energy expenditure to total expenditure (per capita)	-0.96	0.83	0.249
SOLAR or GRID dummy (if solar or grid electricity exists in village, base = neither solar nor grid))	—	—	—
Solar Only (only solar System exists)	25.80*	9.23	0.005
Grid Only (only grid connection exists)	13.57*	4.93	0.006
Both grid & solar	33.22*	5.61	0.000
Student ratio in HH	0.30*	0.14	0.033
Female ratio in HH	-0.05	0.11	0.669
Daily lighting hours (average) using kerosene	4.04*	1.81	0.026
Distance from HH to kerosene purchase source	-2.74*	0.90	0.002
Land holding	0.08*	0.05	0.077
Education stipend dummy (1=If HH receives at least one stipend program, 0=If HH receives no stipend)	-8.85*	3.78	0.019
Constant	95.27	16.65	0.000
Number of observation	872		
F(15, 856)	14.85		
Prob > F	0		
R-squared	0.1898		
Root MSE	55.293		

*Note: * indicates show those variables that are statistically significant.*

The duration of studying (minutes) of household members has been used as the independent variable. Since price change is the variable of interest, the price differential (difference between price currently paid by each household and price fixed by the government) has been used as the key regressor. To capture the gender-differentiated effect, a gender dummy (which takes two values; 0 if the student is male and 1 if the respondent is female) and an interactive term between gender dummy and price differential have also been used as other regressors.

Furthermore, the proportion of students in the HH; proportion of females in HH; per capita monthly HH income; share of kerosene expenditure to total energy expenditure; share of energy expenditure to total HH expenditure; average lighting hours; per capita kerosene consumption; distance from house to kerosene purchasing source; education level of HH head; dummy variable denoting if solar or grid connection exists in the village; dummy variable with decision-making authority in using lighting fuel; dummy variable denoting if HH receives any education stipend have all been used as control variables.

- How does an increase in the price differential in kerosene affect males and females differently?

  Here, actual price differential (difference between price currently paid by each household and price fixed by the government) has been used. No hypothetical price increase had been considered in the regression analyses.

  The results imply that the price differential is negatively related with study duration. This means that an increase in the price differential will reduce study duration for both males and females. The coefficient of the variable "female _ dummy" shows that female students do study less on average, but they are less affected by an increase in kerosene prices than their male counterparts. This can be seen by the positive sign in the interaction term "female* price differential." Both female dummy and female *price differential" came up as statistically significant.

- What does the coefficient value of "female_dummy" and coefficient value of "female*price differential" imply?

  If all the variables that have an effect on study duration of a student remain unchanged (meaning that all variables in Table A2.2 do not increase or decrease), then on average, a female student studies 37 minutes less than a male student. This is denoted by the coefficient value of "female_dummy."

  Except for price differential, if all the variables that have an effect on study duration of a student remain unchanged, an increase of the price differential by one BDT will reduce daily study duration of a male student by 3.61 minutes. An increase of the price differential by one BDT will reduce daily study duration of a female student by 1.46 minutes. Hence, female students are less sensitive to price changes—in terms of studying minutes—than males).

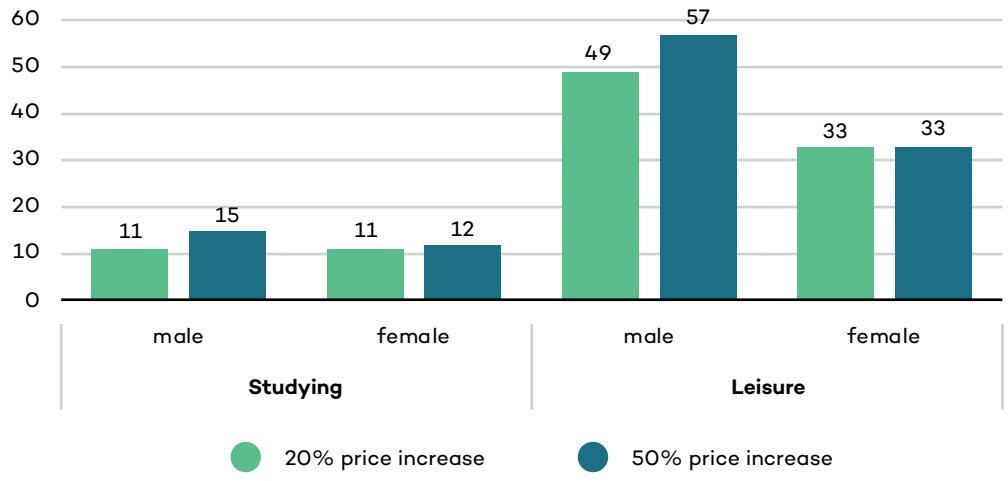

Figure A2.1 Reduction in studying and leisure activity duration compared to before a price increase, mean of percentage

This is also supported by results from the perception of households under hypothetical price scenarios. On average, male students will reduce study duration by 11 per cent daily compared to before under a hypothetical price increase of 20 per cent (this means that if study duration was 100 minutes per day for a male student before price increase, then study duration is expected to decline to 89 minutes after a 20 per cent price increase). The reduction is almost the same for female students when the price is hypothetically increased by 20 per cent. Female students will reduce their study duration by 11.3 per cent compared to before under a hypothetical price increase of 20 per cent. But when the price is increased by 50 per cent (hypothetically), male students expect to reduce their study duration by 15 per cent. On the other hand, female students expect to reduce their study duration by 12 per cent compared to before under a hypothetical price increase of 50 per cent. Thus, male students are more sensitive to price increases than female students. The reduction is 11 per cent and 15 per cent for males for 20 per cent and 50 per cent price increases respectively. The reduction is 11.3 per cent and 11.7 per cent for females for 20 per cent and 50 per cent price increases respectively.

- How does the existence of solar or grid electricity in village affect study duration?

  No households interviewed had access to electricity, but the villages where households were located had access to either grid electricity or solar or both. There are also some villages which had neither grid nor solar. The variable "SOLAR or GRID dummy" had been used in the regression to examine the effect of existence or non-existence of electricity in the villages (where households are located) over the study duration of each student.

  Except for the variable "SOLAR or GRID dummy," if all the variables that have an effect on study duration of a student remain unchanged the daily study duration of a student in the households located in a village with access to a solar system will be 26 minutes longer than the daily study duration of a student of a household located in a village with no access to electricity (neither solar nor grid electricity). This is shown by the variable "Solar only (only solar system exists)" in Table A2.2. Similarly, the daily study duration of a student in a household located in a village with access to grid electricity will be higher by 13.6 minutes than the daily study duration of a student in a household located in a village with no access to electricity (neither solar nor grid electricity). This is shown by the variable "Grid only (only grid connection exists)." The daily study duration of a student in a household located in a village with access to both grid electricity and solar will be higher by 33.2 minutes than the daily study duration of a student in household located in a village with no access to electricity (neither solar nor grid electricity). This is shown by the variable "Both grid & solar."

- How does "Per capita monthly income" affect study duration?

  Except for the variable "Per capita monthly income," if all the variables that have an effect on study duration of a student) remain unchanged, an increase in per capita monthly income by one BDT will increase daily study duration of a student by .01 minute (i.e., 0.6 seconds). Hence, per capita monthly income and daily study duration of a student are positively related.

- How does "Share of kerosene expenditure to total expenditure (per capita)" affect study duration?

  Except for the variable "Share of kerosene expenditure to total expenditure (per capita)," if all the variables that have effect on study duration of a student remain unchanged an increase in "Share of kerosene expenditure to total expenditure (per capita)" by 1 unit will increase daily study duration of a student by 0.177 minutes. Hence, "Share of kerosene expenditure to total expenditure (per capita)" and daily study duration of a student are positively related.

- How does "Student ratio in HH" affect study duration ?

  Except for the variable "Student ratio in HH," if all the variables that have effect on study duration of a student remain unchanged, an increase in "Student ratio in HH" of each household by 1 per cent will

increase daily study duration of a student by 0.30 minutes. Hence, Student ratio in HH and daily study duration of a student are positively related.

- How does "Daily lighting hours (average) using kerosene" affect study duration?

  Except for the variable "Daily lighting hours (average) using kerosene," if all the variables that have an effect on study duration of a student remain unchanged, an increase in "Daily lighting hours (average) using kerosene" of each household by one hour will increase daily study duration of a student by 4 minutes. Hence, "Daily lighting hours (average) using kerosene" and daily study duration of a student are positively related.

- How does "Distance from HH to kerosene purchase source" affect study duration?

  Except for the variable "Distance from HH to kerosene purchase source," if all the variables that have an effect on study duration of a student remain unchanged, an increase in "Distance from HH to kerosene purchase source" of each household by 1 km will decrease daily study duration of a student by 3 minutes. Hence, "Distance from HH to kerosene purchase source" and daily study duration of a student are negatively related.

- How does "Land holding" affect study duration?

  Except for the variable "Land holding," if all the variables that have an effect on study duration of a student remain unchanged, an increase in "Land holding" of each household by one decimal will increase daily study duration of a student by 0.08 minutes. Hence, "Land holding" and daily study duration of a student are positively related.

- How does "Education stipend dummy" affect study duration?

  The households were asked if any household member received any type of education stipend (government subsidy to encourage schooling). Based on their responses "yes" or "no," the regression analyses attempted to depict the effect of education stipend over daily study duration of a student.

  The receipt of at least one education stipend by any household member gave a surprising result. The students of those households that received at least one education stipend were found to actually study less at home than those households where no stipend was received by any members. Thus, a student in a household that receives at least one education stipend will study less by 9 minutes daily than the student of a household that receives no education stipend

Interpretation of Table A2.3. Determinants of duration of leisure

Table A2.3. Determinants of duration of leisure

	Coefficient	Robust Std Error	P-value
Female _ dummy	-16.86*	8.22	0.040
Female*price differential	0.54	0.62	0.389
Price differential	-1.92*	0.48	0.000
Per capita monthly income	0.002	0.00	0.247
Share of kerosene expenditure to total expenditure	11.06*	1.48	0.000
Share of energy expenditure to total expenditure	-0.56	0.47	0.234
SOLAR or GRID dummy (if solar or grid electricity exists in village, base = neither solar nor grid)			
Solar Only (only solar system exists)	11.20*	5.37	0.037
Grid Only (only grid connection exists)	9.53*	2.60	0.000
Both grid & solar	19.63*	2.99	0.000
Student ratio in HH	0.38*	0.06	0.000
Female ratio in HH	-0.04	0.06	0.558
Daily lighting hours (average) using kerosene	3.55*	1.00	0.000
Distance from HH to kerosene purchase source	-0.53	0.51	0.302
Land holding	0.05	0.04	0.182
Constant	62.34*	9.65	0.000
Number of observation	2,760		
F(14, 2745)	20.79		
Prob > F	0		
R-squared	0.0994		
Root MSE	56.665		

Duration of leisure (minutes) of household members has been used as the independent variable. As price change is the variable of interest, price differential (difference between price currently paid by each household and price fixed by the government) has been used as the key regressor. To capture the gender-differentiated effect, a gender dummy (which takes two values; 0 if the student is male and 1 if the respondent is female) and an interactive term between gender dummy and price differential have also been used as other regressors.

Control variables were: the proportion of students in HH; proportion of female in HH; per capita monthly HH income; share of kerosene expenditure to total energy expenditure; share of energy expenditure to total HH expenditure; average lighting hours; per capita kerosene consumption; distance from house to kerosene purchasing source; education level of HH head and; dummy variable denoting if solar or grid connection exists in the village.

The price differential (between the kerosene retail price and the government fixed price) is negatively related with leisure duration, in that an increase in the price differential will reduce leisure time for both males and females. Females do enjoy less leisure on average, but they are less impacted from increase in kerosene prices than their male counterparts. This can be seen by the positive sign in the interaction term (female*price differential). Hence, females are less sensitive to price changes—in terms of leisure duration—than males).

- How does an increase in price differential affect male and female differently?

  Here, actual price differential (difference between price currently paid by each household and price fixed by the government) had been used. No hypothetical price increase had been considered in the regression analyses. The results imply that price differential (between the kerosene retail price and the government fixed price) is negatively related with leisure duration. That means, an increase in the price differential will reduce leisure duration for both males and females. The coefficient of the variable "Female _ dummy" shows that females do enjoy leisure less on average, but they are less impacted from increase in kerosene prices than their male counterparts. This can be seen by the positive sign in the interaction term "female*price differential." Both "female_dummy" and "female*price differential" came up as statistically significant.

  What does the coefficient value of "female_dummy" and coefficient value of "female*price differential" imply?

  If all the variables that have an effect on leisure duration of a student remain unchanged, (which means all the variables in Table A2.3 neither increase nor decrease), then on average, a female enjoys leisure by 16.9 minutes fewer (around 17 minutes) than a male. This is denoted by the coefficient value of "female_dummy."

  Except for price differential, if all the variables that have an effect on leisure duration of a student remain unchanged an increase of price differential by one BDT will reduce daily leisure duration of a male by 1.92 minutes. An increase of price differential by one BDT will reduce daily leisure duration of a female by 1.38 minutes. Hence, females are less sensitive to price changes—in terms of enjoying leisure—than males.

- How does existence of solar or grid electricity in village affect leisure duration?

  No households interviewed had access to electricity, but the villages where households were located had access to either grid electricity or solar or both. There are also some villages which had neither grid nor solar. The variable "SOLAR or GRID dummy" had been used in the regression to examine the effect of existence or non-existence of electricity in the villages (where households are located) over leisure duration of each member.

  Except for the variable "SOLAR or GRID dummy," if all the variables that have an effect on leisure duration of a member) remain unchanged, the daily leisure duration of a member of a household located in a village with access to a solar system will be higher by 11.2 minutes than the daily leisure duration of a member of a household located in the village with no access to electricity (neither solar nor grid electricity). This is shown by the variable "Solar only (only solar system exists)" in Table A2.3. Similarly, the daily leisure duration of a member of households located in villages with access to grid electricity will be higher by 9.5 minutes than the daily leisure duration of a member of a household located in a village with no access to electricity (neither solar nor grid electricity). This is shown by the variable "Grid only (only grid connection exists)." The daily leisure duration of a member of a household located in a village with access to both grid electricity and solar will be higher by 19.6 minutes than the daily leisure duration of a member of a household located in a village with no access to electricity (neither solar nor grid electricity). This is shown by the variable "Both grid & solar."

- How does "Share of kerosene expenditure to total expenditure (per capita)" affect leisure duration?

  Except for the variable "Share of kerosene expenditure to total expenditure (per capita)," if all the variables that have an effect on leisure duration of a member remain unchanged, an increase in "Share of kerosene expenditure to total expenditure (per capita)" by 1 per cent will increase daily leisure duration of a member by 11.1 minutes. Hence, "Share of kerosene expenditure to total expenditure (per capita)" and daily leisure duration of a member are positively related.

- How does “Student ratio in HH” affect leisure duration?

  Except for the variable “Student ratio in HH,” if all the variables that have an effect on leisure duration of a member remain unchanged, an increase in “Student ratio in HH” of each household by 1 per cent will increase daily leisure duration of a member by 0.38 minutes. Hence, “Student ratio in HH” and daily leisure duration of a member are positively related.

- How does “Daily lighting hours (average) using kerosene affect leisure duration?”

  Except for the variable “Daily lighting hours (average) using kerosene,” if all the variables that have an effect on leisure duration of a member remain unchanged an increase in “Daily lighting hours (average) using kerosene” of each household by one hour will increase daily leisure duration of a member by 3.55 minutes. Hence, “Daily lighting hours (average) using kerosene” and daily leisure duration of a member are positively related.

Interpretation of Table A2.4. Determinants of Mode of Decision-Making Authority

Table A2.4. Determinants of Mode of Decision-Making Authority

	Coefficient	Robust Std Error	P-value
Jointly_with_family_members (base outcome)			
Outcome 2: Solely_by_husband_father			
Price differential	0.115*	0.026	0
Per capita monthly income	0*	0	0.049
Proportion of kerosene-using households in the village	0.007	0.004	0.059
Student ratio in HH	0.011*	0.005	0.024
Female ratio in HH	0	0.006	0.929
Daily lighting hours (average) using kerosene	-0.156*	0.078	0.046
Distance from HH to kerosene purchase source	-0.064	0.055	0.245
Share of kerosene expenditure to total expenditure	-1.002*	0.142	0
Share of energy expenditure to total expenditure	-0.057	0.044	0.19
Per capita kerosene consumption	4.812*	0.762	0
Constant	0.012	0.739	0.987
Outcome 3: Self_by_female_member			
Price differential	0.098*	0.042	0.021
Per capita monthly income	-0.001*	0	0.015
Proportion of kerosene-using households in the village	0.011*	0.006	0.054
Student ratio in HH	0.015	0.008	0.06
Female ratio in HH	0.015	0.008	0.058
Daily lighting hours (average) using kerosene	-0.668*	0.197	0.001
Distance from HH to kerosene purchase source	-0.315*	0.14	0.025
Share of kerosene expenditure to total expenditure	-0.765*	0.249	0.002
Share of energy expenditure to total expenditure	-0.13	0.087	0.136
Per capita kerosene consumption	4.156*	1.277	0.001
Constant	1.23	1.383	0.374
Number of observations	630		
LR chi2(20)	160.35		
Prob > chi2	0		
Pseudo R^2	0.133		
Log likelihood	-524.52		

Multinomial logit regression had been used to depict the effect of price differential over the decision-making authority in using lighting fuel across different family members. The dependent variable is the mode of decision which takes three values; if decision is made solely by father/husband of family; or solely by female members or jointly by family members. A multinomial logit regression was run to explore the effect of price differential over the mode of decision-making authority.

Results:

A one-unit increase in price differential is associated with a 0.12 increase in the likelihood (relative log odds) of decision-making authority by husband/father vs. decision-making authority jointly with other family members. A one-unit increase in price differential is associated with a 0.10 increase in the likelihood (relative log odds) of decision-making authority solely by female members vs. decision-making authority jointly with other family members. Hence, the likelihood of decision-making authority over using lighting fuel by husband/father and by female members is almost the same when compared to likelihood of the authority by other family members (base category).

A one-unit increase in per capita monthly income is associated with a 0.0003 decrease in the likelihood (relative log odds) of decision-making authority by husband/father vs. decision-making authority jointly with other family members. In the same way, a one-unit increase in per capita monthly income is associated with a 0.001 decrease in the relative log odds of decision-making authority solely by female members vs. decision-making authority jointly with other family members.

Therefore, mode of decision-making authority (solely by female member/ solely by male member/jointly by family members) does not vary across different level of price paid and income of the family.

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