



Women's empowerment and electricity access: How do grid and off-grid systems enhance or restrict gender equality?

7 January 2019

This publication has been realized within the scope of ENERGIA's Gender and Energy Research Programme, funded by the UK Department for International Development (DFID). ENERGIA, the International Network on Gender and Sustainable Energy is hosted by Hivos, an international organisation that seeks new solutions to persistent issues.

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Citation: University of Oslo, TERI, Seacrester Consulting and Dunamai Energy (2019). Women's empowerment and electricity access: How do grid and off-grid systems enhance or restrict gender equality? Research report RA1, ENERGIA

Cover photo: [Rose and her family at home, using solar light. Kenya, Homa Bay County, Gwasssi Division, Magunga. April 2018. Photographer: Sven Torfinn/ENERGIA](#)

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Contents

Contributing organisations and authors	8
Executive summary	9
Acknowledgements	31
List of abbreviations	32
Glossary	33
List of tables	35
List of figures	35
1. Background, objectives and methodology	38
1.1. Results from scoping study: existing evidence and policies	39
1.1.1. Literature review	39
1.1.2. Policy frameworks	39
1.2. Research methodology	40
1.2.1. Objective and research questions	40
1.2.2. Analytical framework	41
1.2.3. Empirical material: case study sites and methods	43
1.3. Outline of the report	45
2. Gendered study contexts and 14 gendered systems of supply	47
2.1. Three contexts	47
2.2. Planning and setting up 14 gendered systems for electricity provision	48
3. Wider implications of women’s recruitment in local supply	52
3.1. Implications of the two women-targeted interventions	52
3.2. Perceived implications of observing women staff in the villages	53
4. Electricity: failing to improve the quality of public services	56
4.1. Schools	56

4.1.1.	Nepal	56
4.1.2.	Kenya	58
4.1.3.	India	59
4.2.	Water supply and health care services	61
4.2.1.	Water supply	61
4.2.2.	Health care services	62
4.3.	Mobile phone diffusion and internet connectivity	63
5.	The gendered access to electricity	65
5.1.	Availability, costs, capacity and reliability	65
5.1.1.	Cost of connection and consumption	65
5.1.2.	Capacity, duration and reliability of supply	67
5.2.	What kinds of households have access?	67
5.3.	Financing access and subscribing to electricity supply	69
6.	The location of lights in people's homes	74
7.	Acquiring, controlling and using appliances	75
7.1.	Appliances kept in the three survey areas	76
7.2.	The appliances' gendered connotations	77
7.3.	Summary	80
8.	Electricity's uses for productive activities	81
8.1.	Household use of electricity for productive activities	81
8.2.	Businesses and market activities	82
9.	How and why did electricity access affect women's and girls' empowerment?	85
9.1.	Nepal	85
9.2.	Kenya	88
9.3.	India	92
9.4.	Overall effects on women's empowerment	94
9.5.	Discussion of the factors and mechanisms influencing women's empowerment through access to electricity	96
10.	Discussion of the impact of women's involvement in supply	101
10.1.	Nepal: Promising micro-hydro initiative failed to deliver	101
10.2.	Kenya: Two examples of best practice to empower women and communities	103
10.3.	India: Electricity introduced as a realm for men	105
10.4.	Summary and discussion	106

11. Reflections on the analytical framework developed and suggestions for further research	108
11.1. A framework for capturing the complexity and explaining the mechanisms for electricity's gendered impacts	108
11.2. Difficulty in establishing causality	108
11.3. The danger of too many data points: flexible use	109
11.4. Recommendations for further research	110
12. Conclusions and recommendations	112
12.1. Conclusions	112
12.2. Recommendations	113
12.3. Suggestions for Policy and Practice	115
References	121
Annex 1 Case study information	125
Annex 2 Maps of study sites	128
Annex 3 List of interviews in villages	130
Annex 4 Appliances per access types	131
Annex 5 Appliances: gendered connotations and uses with various systems of supply	134
Annex 6 List of 25 interviewed stakeholders in energy sector	136
Annex 7 Reported duration of homework (EFEWEE SURVEY)	138
Annex 8 Socio-cultural and material contexts, three study areas	140
8.1 Socio-economic profile and livelihoods	140
8.2 The women's level of income compared to the men	143
8.3 Household composition	144
8.4 Gendered assets and decision making patterns	144
8.5 Daily routines, division of work and drudgery chores	148
8.6 Gender ideologies, norms and women and men's social position	150
8.7 Violence	154
8.8 Food scarcity	154

Annex 9 National energy- and gender policies	155
9.1 Nepal	155
9.2 Kenya	155
9.3 India	156
Annex 10 Survey Methodology: Limitations	158

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International research consortium

This independent research project was conducted by an international team of researchers and practitioners, which constituted Research Area 1 'Electrification through the grid and decentralised systems' in the Gender and Energy Research Programme coordinated by ENERGIA, funded by the Department for International Development, UK (DFID). The project was entitled "Exploring factors that Enhance and restrict Women's Empowerment through Electrification" (EFEWEE). For further information, see <http://www.efewee.org/>

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EXECUTIVE SUMMARY

1. Introduction

This report presents the results from a four-year independent research project exploring women's empowerment through electricity access, with particular attention to comparing the effects of electricity provided by the grid and off-grid systems. The work was commissioned by ENERGIA's Gender and Energy Research Programme and funded by the UK's Department for International Development (DFID). The research was carried out in three countries where a relatively large share of the rural populations lack access to electricity: Nepal, Kenya and India.

In the current discourse on energy and gender, three paths to women's empowerment are often highlighted: First, it is assumed that electricity interventions would enhance women's empowerment if women were included in the systems of supply. Second, the Sustainable Development Goal number 5 identifies improved infrastructure as one of its targets for ending discrimination against women. Third, it is anticipated that women's access to using electricity and time-saving appliances would help them reduce the time and hardship they spend doing drudgery tasks (e.g. fetching firewood). Implicit in this thesis are the expectations that women would use their resulting freed-up time to pursue income-generating activities and thereby become economically empowered. Also implicit is that, with access to electricity as a given, women have the power and means to decide on and use the appliances they desire.

This study sets out to empirically examine these and other potential paths to women's empowerment through electricity in a limited number of geographical contexts. Building on this material, we aim to identify conditional factors for electricity's gendered impact. By employing a novel framework for analysis, the study aims to demonstrate how success criteria and hindrances for women's empowerment through electricity may be studied. The results will inform the project's overall goal which is to propose recommendations for policy and practice on how electricity access in the rural South most effectively can enhance women's and girls' empowerment.

This report considers women's empowerment as a process towards gender equality, hence a concept that requires analytic attention to women, men, girls and boys. The project asks four main research questions:

- RQ 1: With respect to electricity access and use, what factors affect women's and girl's empowerment? Sub-questions:
- i. To what extent and how is electricity used for public services in ways that enhance women's empowerment?
 - ii. To what extent and how do women and men have access to electricity at home, decide on and use electrical appliances?
 - iii. To what extent and how do productive uses of electricity enhance women's empowerment?
- RQ 2: What are the potentials and limitations of grid and off-grid (decentralised) systems in terms of enhancing women's empowerment?

RQ 3: To what extent and how does women’s involvement in electricity supply empower them as individuals and what is the impact of women’s inclusion in supply on the empowerment of women and girls in the wider community?

RQ 4: How may empowerment in the realm of electricity be conceptualised and measured?

Methodology

The team started by reviewing the empirical literature on women’s empowerment through electrification and electricity access and examining to what extent gender issues and women’s needs were addressed in national electricity policies in the three selected countries and also international initiatives. The reviewed literature shows that whilst electrification has often positively affected women’s (and men’s) wellbeing, very few studies have looked at the gender relational aspects (e.g. effects on women versus effects on men), and what evidence does exist is fragmented (Winther et al. 2017). In the recent past, electricity policies in the three countries mainly focused on providing electricity access, making services affordable to the poor and enhancing the availability and reliability of supply (University of Oslo et al. 2016). More recently, steps have been made to make electricity policies also become gender aware. However, as indicated through the studied cases in this report, these efforts appear to have had a limited bearing so far on the development of the electricity sector at the meso and micro levels.

In preparation of the empirical study, and addressing the conceptual research question “How may empowerment in the realm of electricity be conceptualised and measured?” (RQ4), the team developed a framework for analysing women’s empowerment through electricity (Winther et al. 2017). The first part of the framework is based on a causal chain put forward by ENERGIA/DFID, and adapted to include a focus on four conditioning factors that are important in terms of electricity’s gendered effects: i) the socio-cultural and material context; ii) the socio-technical design of the electricity system; iii) the process of implementation and management, staffing and ownership; and iv) policy, regulations, financing schemes and the role of international actors. The second part of the framework builds on Nabila Kabeer’s (1999, 2001) work on empowerment and general social theory to identify three generic empowerment dimensions: i) rights, norms and social position; ii) access to resources; and iii) influence over decisions (agency). Taken at large, the framework, which informs the analysis presented in this report, brings analytical attention to the underlying mechanisms for electricity’s gendered effects.

Empirical Research Methods

The analysis is based on empirical material collected in selected geographical contexts in rural Nepal, Kenya and India. In each country, we selected two rural sites in which different systems of supply were available: central grid as well as various types of off-grid supply (six case study areas including a total of 14 systems of supply). Through qualitative methods and with the purpose of understanding the electricity-gender nexus, we examined the socio-technical systems of supply as well as the situation of various types of end-users (households, public institutions, and commercial enterprises). The research adopts a comparative case study methodology which allows for the comparison of the gender implications of various types of electricity provision systems and processes of implementation. We also looked into the situation of people and institutions that lacked

access to electricity. Furthermore, with the purpose of understanding how the issue of gender and various types of electricity access is regarded from the perspective of policymakers and national stakeholders, we interviewed 25 individuals holding this kind of positions in a variety of organisations, including national ministries; electricity utilities; off-grid electricity companies and NGOs. Three of the interviewees in Kenya were visited twice (Annex 7).

Subsequently, we returned to one rural site in each country to conduct a household survey, selected to reflect and compare households with various types of electricity access. The total material includes 245 qualitative interviews, 28 focus group discussions and 642 household survey interviews.

The survey data provide a novel type of findings regarding the gendered organisation, control and use of electricity and appliances. Statistical tests were run to check whether results comparing women and men's situation are statistically significant. We found that there is a significant difference between men and women in most key variables. The results also form an important basis for comparing the gendered contexts in which electricity was introduced. The survey results are representative of the respective case study areas (with two restrictions related to sampling, see below), but not of the whole country or state in which they were retrieved. The results do not prove causality statistically (i.e. the impact of electricity access) within or across the three countries.

Compared with realities in the study contexts, the survey sample is skewed in two ways. The share of households with access to electricity (whether grid, mini-grid, solar home systems) in the survey study sites differed considerably, spanning from 96% in Mahadevsthan (Nepal) to 87% in Chhattisgarh (India) and 41% in Homa Bay (Kenya). To enhance the possibility to compare households with and without access, we decided to include a fair share of each type in the survey samples. This means that the samples are skewed compared to the national statistics on electricity access rates in each country: a higher share of households without access in Mahadevsthan; a lower share of households with access in Homa Bay in Kenya. In Chhattisgarh, the sample was similar to the Chhattisgarh (state) average. Furthermore, to understand women's experiences thoroughly, the survey was purposively designed to include more women than men. As a result, 72% of the survey interviewees were women and 28% were men and the total sample is skewed towards women's responses. However, irrespective of the gender of the respondent, many survey questions related to information about women, men and other members in the households (e.g. 'Is the woman in this household member of a woman's self-help group?'). Therefore, a substantial part of the material concerns both women's and men's situations as reported largely by women. However, in the Kenyan site (Homa Bay) the women skewed recruitment strategy may have slightly affected the type of households that were recruited. Among the women who participated, a relatively high share (35%) were widows. However, we have reason to believe that the share of widows in Homa Bay is generally high and linked to the high prevalence of HIV in the area, which is at 26%, almost 4.5 times higher than the national average (National AIDS Control Council 2018). The relatively high share of widows in the Kenyan sample may thus be slightly higher than in reality, but it provides the study with a unique possibility to compare the situation of these women who tend to live without a male partner with the situation of other types of households.

We provide further elaboration on the survey's limitations in Section 1.2.3, Chapter 11 and Annex 11 to this report. This includes how the high diffusion of solar home systems – and householders keeping several types of access – contributed to making it problematic to quantify electricity's gendered impact in a statistically robust way. However, the data are statistically strong in terms of documenting women and men's different situations. In other publications (Winther and colleagues, in progress; TERI et al., in press), we describe the overall sequence of data collection activities and the survey sampling design, respectively.

2. Gendered Contexts and Gendered Systems of Supply

A central feature of this research is to explore how different characteristics of the socio-cultural and material contexts conditioned electricity's gendered outcomes in the studied sites. Annex 9 provides an elaboration of the studied gendered contexts. In line with the study's overall objective, the purpose of examining contextual aspects is to identify criteria for success and suggest measures that can help policymakers and practitioners overcome some of the barriers to women's empowerment through electricity.

Across the three country case sites, there are several obstacles to women's empowerment that are rooted in patriarchal structures. First, women have limited power to make major decisions and there is an unequal distribution of long-term assets (land and houses primarily owned by men) as well as income levels: women in the Kenyan and Indian samples earn on average only 40% of men's income. People's existing livelihoods condition the extent to which electricity is used for productive purposes. Farming is the most common source of livelihood in the studied rural locations in Nepal, Kenya and India, though in Homa Bay (Kenya), fishing and business activities imply more diversified livelihoods. In the study sites, 70% of the Nepali women are engaged in small-scale production; 41% of the Kenyan women-run businesses; while Indian women have few other options for livelihood than agriculture and casual labour (69%). Second, in all three country sites, women have had limited education opportunities among the adult segment. Third, across the sample, women are severely hindered in making changes in their lives due to the heavy burden of drudgery and dependence on men for decision making. Fourth, women in the study area in Kenya face serious hazards such as their high likelihood of experiencing violence when outside the home, or hunger during food shortages. 43% of the Kenyan respondents confirmed that women members of their households have been victim to violence when going to fetch firewood. Among 70 Kenyan households who reported to have experienced food shortage, 70% said that in such cases, the woman is the person who is the least likely to get something to eat.

In general, poor groups of women and men, who are the majority of people in both study areas, live a much harder life than the wealthiest minority, not only in terms of lack of money and material resources but also in terms of a heavy workload. A key question in this research is how and to what extent private homes and public institutions have benefitted from electricity and to what extent such access has helped reduce women's workload in particular.

The studied grid and off-grid systems

In the three study countries, initiatives have been made at the national level to make electricity policies become gender aware (elaborated in 1.1.2 and Annex 10). Another key

question in this research is whether there are signs of gender awareness on the ground level, i.e. in the implemented electricity systems in the study villages. Moreover, the literature indicates that off-grid systems are more likely to adopt gender inclusive approaches than do grid systems and extensions. We now examine these issues for the studied systems of supply.

In most of the study sites, particularly in India and Kenya, conventional grid electrification programmes had been implemented through a top-down process with little participation of users or communities, whether women or men. Despite broader gender mainstreaming efforts at the national level in the three countries, the studied interventions were mainly gender blind. The 14 systems of supply that were studied (Table A below), ranged from grids to various types of off-grid systems including mini-grids and other systems organised on the local level such as solar home systems (SHS) and an energy centre offering lantern renting and other services. The overall picture is that both in the cases of grid extensions and mini-grid initiatives (off-grid), efforts to include gender in energy on the macro/national level had not been effective on the meso/supplier and micro/village levels: these interventions resulted in that it was mostly men, and not women, become involved in supply at the local level. Moreover, only two out of four studied off-grid initiatives that *aimed* to include women in supply had the intended effect. The remaining two interventions adopting a gender approach did not succeed in recruiting women, which was partly due to the process and partly to existing gender norms that were not actively addressed. The picture is more mixed on solar home systems offered commercially by the private sector (Kenya only), where both women and men are involved as sales agents.

In the Nepal study sites, men had sometimes played an active role in bringing the grid or a decentralised system to their area of residence. Women did not take a strong part of these initiatives, with their roles limited to the erection of poles. However, the AEPC micro-hydro project in Mahadevsthan (System 2, Table A), specifically aimed to include women in construction, installation and supply. There was distinct technical training organised for women for the supply side, but despite this, no women ended up being involved in supply: beyond short-term technical training, no other resources or support were provided to effect the changes in existing attitudes, structures or practices.

Table A: The 14 studied systems for electricity supply (EFEWEE Project)

Sl no	Country	State/ District/ County	Village/ VDC	Type of system	TIER	Implementatio n approach	Gendered involvement in practice
1	Nepal	Dhading	Mahadev – sthan	Grid (7 years)	4-5	Gender-blind	Only men involved
2	Nepal	Dhading	Mahadev – sthan	Micro- hydro/ mini-grid, SHS	2-3	Gender balanced committees	Only men involved (2 men from the 24 member committee)
3	Nepal	Dhading	Mahadev – sthan	SHS	1	Gender-blind, top- down	Only men involved
4	Nepal	Tanahun	Ghiring	Grid (14 years, Govt./ Pvt.)	1-4	Gender-blind, top- down	Only men involved (as technicians, for meter reading and billing)
5	Nepal	Tanahun	Ghiring, Chapakot	SHS (15 years)	1-3	Gender – blind	Only men involved (as technicians, local salesman)
6	Kenya	Homa Bay	God Bura	Grid	3-4	Gender-blind, top-down	Only men involved as field technicians
7	Kenya	Homa Bay	Kiwa Island	Micro-grid (Pvt.)	3-4	Gender – blind, top-down	Mainly men involved
8	Kenya	Homa Bay	God Liech	SHS	1-2	Women targeted, local participation	Mainly women involved
9	Kenya	Kitui	Endau	Grid	0-4	Gender – blind top-down	Only men involved as field technicians
10	Kenya	Kitui	Ikisaya	Energy Centre	0-1	Gender balanced local participation	Both women and men involved, gradually only women recruited
11	India	Chhattisgarh	Kacchardih	Grid	3-4	Gender-blind, top-down	Men involved in technical work, women: Admin staff in central areas
12	India	Chhattisgarh	Mohda, Rawan	Solar, mini-grid (CREDA)	1-2	Gender-blind, top-down	Men: technical work, women: Admin staff
13	India	Bihar	Mogalia Purandaha	Grid (8-9 years)	2-4	Gender-blind, top-down	Men: technicians, women: Admin and tech staff in central areas
14	India	Bihar	Purani Garail, Rustumpur	SHS (JEEVIKA)	1	Women’s groups targeted, local participation	Systems registered in women’s names, but not involved as staff

Also in the studied grid villages in Kenya, men dominated the installation, operation and maintenance, with women’s involvement predominantly in central office based jobs. In contrast, some women residing in the villages became deeply involved in management and supply in two decentralised initiatives (Systems 8 and 10). These were both small community initiatives which were also attuned towards meeting the needs of women

end-users. International actors played a key role in the two projects which took place in villages where there was no pre-existing electricity system available.

Again, in India, the process of providing grid electricity to the study village involved only men on both the provision and user sides. Whilst there were women engineers and technicians, family life and women's preferences were reported to make women avoid taking up field based responsibilities. These were exacerbated by difficulties in travelling to remote locations or unfavourable working conditions through the lack of facilities (such as health clinics) in those rural areas. It was a similar case in a mini-grid site in Chhattisgarh: no women were involved in supply in the villages, though some women did have desk-based administrative work in the central CREDA office.

3. Wider Implications of Women's Recruitment in Local Supply

Based on the study of the gendered set-up and organisation of various types of electricity access, we then examine the implications for women's empowerment. As noted, of the 14 systems that were studied, 12 brought employment to men in the villages rather than to women. This provides an illustration from the ground as to how and why electricity supply tends to be a realm dominated by men. In 2011, female employment in the electricity, gas and steam, and water sectors was half the level of male employment (WDR 2012). Regarding the two exceptional Kenyan projects that successfully included women in supply, an interesting question is whether these initiatives had a positive effect on women's empowerment in the wider community. To examine this question we draw on the adopted framework and look at gender norms and women's social position to assess if there are signs of changes deriving from women's involvement in electricity interventions.

The findings show that the two Kenyan projects adopting a gender approach positively affected men's beliefs in what a woman can do. It can, therefore, be argued that women's involvement in supply had the effect of challenging existing gender norms, which implies some degree of empowerment to all women and girls living within those communities. Furthermore, because the women staff at the energy centre (System 10) were said to be patient and willing to treat customers in a flexible way (e.g. when not being able to pay for the service due to seasonal variation in income), poor customers, of whom many were women, had continuous access to the service despite their shifting level of affordability. Women's inclusion in supply thus increased the chances that women (and men) struggling with finances would have enduring access. There was a perceived effect about improvement in the quality of services provided and therefore an increase in system viability. This added value of including women in supply tends to be omitted in implementation processes that follow a gender-blind approach.

The survey included questions on whether people had observed women being involved in supply at the local level and the effects of such observations with respect to how the respondents think about women and what women can do. The results from Nepal and Kenya were highly positive. A significant share of the respondents (both women and men) answered in the affirmative and provided elaborated answers to an open-ended question on this point. This positive effect might reflect that gender norms have been modified, though the context of the interview might also have influenced people's answers.

The failed attempts to include women in supply also provide important lessons for learning. In the Nepalese and Indian cases that attempted to include women, the initiatives failed because the attempts were too weakly designed, implemented and followed up to make a lasting effect on the existing practices that ascribe 'appropriate' roles to women and men. When we probed into the reasons for women's non-participation, barriers that appeared were women's need to move to her husband's place when getting married (Nepal) and that women's mobility is (socially) hindered as are their (social) possibilities to do technical tasks (India). In relation to the mentioned success cases in Kenya, there are two key points of difference. First, in Kenya, the gender approach was 'strong' in small de-centralised systems as it was instructed from the external implementers who also undertook steps to ensure in-depth training and follow-up over time in the years after implementation. Secondly, though some staff involved noted challenges with women's participation, the existing business practices in rural Kenya where women have participated for a long time, implied that the barrier for women to enter the realm of electricity was much lower than in Nepal and India. Nonetheless, Standal's (2008) thesis from Afghanistan (Solar Mama project), where gender norms are no less restricting than in the Nepalese and Indian cases, proves that women in such constraining contexts can be trained, recruited and take part in supply in successful ways.

Our results indicate that women who become successfully involved in supply gained increased self-esteem. As shown in previous studies, when women get involved in technical/managerial positions in the electricity projects or in the electricity supply system they are more often likely to be listened to in their community, which may help overcome traditional social barriers (Khan 2001). When women take up leadership positions, this may positively affect women's position, status and role in the society (Bryce and Soo 2004, Khuller 2001). Our findings confirm that such engagement may transform the view of women in the local community when the process of including them is based on insights into socio-cultural factors and include measures to overcome their barriers. Policy makers and implementers in the public, voluntary and commercial sectors can directly promote a gender perspective in planning, management and organisation of supply.

4. Electricity Failing to Improve the Quality of Public Services

Improved infrastructure is considered as one of the important means for ending discrimination against women (SDG 5). Numerous studies on rural electrification (e.g. IEG 2008, Winther 2008, Matinga 2010) have documented a positive effect of electrified public services on women's and girls' empowerment in terms of increased human resources (health, drudgery, opportunities for learning). The study set out to examine to what extent public services in the study locations actually had access to functioning supply and for what purposes electricity was needed and used. We look at schools, water supply and health services, and mobile phone diffusion and internet connectivity.

4.1 Schools

Electrification of schools, whether through the grid or off-grid systems has only led to a better learning environment in some cases where certain conditions are met: First of all, reliable supply is needed, which was not the case in the Kenyan study areas and partly not in the Nepali contexts. An important consequence of unreliable grid supply is that the

high cost of backup energy sources becomes the responsibility of the individual school or parents, and in some cases, the school goes without power. Secondly, equipment and appliances for better teaching and learning opportunities are required and it is contextually dependent what purposes are desired (apart from teachers needs to charge their mobile phones): In Chhattisgarh, India, where there is a hot season, fans were considered necessary. In Nepal and India, sound equipment and projectors were desired, while in Kenya, the teaching of IT as a subject and access to digital content was an expressed demand. As to the impact on children's enrolment and performance, the teachers we interviewed in Nepal and India perceived that household electricity access increased study time, but did not think there was a connection between enrolment rates and school electrification. In a Kenyan case, electricity impacted upon the ability of a secondary school to offer boarding facilities for students in the major exam-going years. There is a documented impact of these boarding facilities on children's and particularly girls' performance (marks), which resulted from increased study time, extra teaching, and less time use on household chores. We retrieved accounts of the importance of electricity for providing these boarding facilities, but with unreliable and/or costly supply, this kind of effort to improve children's performance was abandoned and ambitions were scaled down. The boarding facility had also helped mitigate a problem that is serious in rural Kenya: children's safety and the risk of violence (including by wildlife) if walking outdoors at night time. In our survey, 12% of the Kenyan respondents said that girls in the household had been a victim of violence when walking to/from school, while 9% reported that boys in their household have experienced the same. Based on our material from the Kenyan site, the provision of boarding schools, which are conditioned by well-functioning electricity supply, appears as an effective way to enhancing children's learning and reducing their risk of violence.

4.2 Water and Health

A striking finding across the three countries is that electricity has not brought significant improvements in peoples' access to water services. In most cases, the water supply was not targeted for electrification. When it was, the failure to improve services did not derive from limited capacity in the electrical systems, but from irregular and poor quality supply together with a lack of investment in water infrastructure. Water collections remain the main type of drudgery for women (and some men and children) in the study contexts. For example, in the Kenyan study sites, households spend up to two hours a day collecting water either from centralised water points (typically boreholes) or directly from open water sources such as shallow wells or Lake Victoria.

Health services varied both within the in-country sites and across the three countries. Electrification of health facilities has partly occurred in Mahadevsthan (Nepal) and Chhattisgarh (India), but in the other sites in the two countries is either non-functional (Ghiring, Nepal) or health facilities were absent (Bihar, India). In Kenya, there is also a stark picture of either unreliable supply with clinics having to improvise by using solar lanterns (Homa Bay); or there being no public dispensaries available (Ikisaya, Kalungu), with health workers having to improvise.

In sum, the material shows that electricity has not improved the studied rural population's access to and quality of water supply which could have reduced women's drudgery and improved people's health. Nor has electricity helped improve other public services to any significant extent. Health workers we interviewed were eager to explain

the benefits of using electricity (e.g. examination light during labour, cold storage of medicine). However, they pointed to lack of reliable supply, including (in Kenya) in grid contexts. This observed failure to provide good quality services facilitated by electricity constitutes a missed opportunity for women's empowerment because it negatively affects their time use, health and safety. Such services do not only depend on electricity but when supporting infrastructures are also in place, reliable electricity access can make water supply systems and health clinics dramatically improve the quality (IEG 2008, Winther 2008, Matinga 2010).

4.3 Mobile Phone Diffusion and Internet Connectivity

Not surprisingly, access to electricity enhances the use of mobile phones. In the study sites, mobiles have almost become universal, widely used by both women and men. The phone is a significant communication resource for people living in rural areas, which enhances their access to social networks. Also, in the study site in Nepal, network connectivity and internet access were widely available, impacting upon peoples' use of social media in addition to telephone and video calling. In Kenya, the mobile phone was used extensively for mobile banking services, which have been very important in extending the reach of financial inclusion. In India, network availability varied amongst the study sites, impacting upon whether internet services were in use or not in addition to phone communications.

5. Gendered Access to Electricity's Services and Uses

To unpack the assumption that women's access to electricity and time-saving appliances at home provides empowerment, Chapters 5–7 document how the 'gender' of electricity is shaped. From house ownership through to electricity subscriptions, the findings show that men's higher involvement in electricity both on the supply and customer side, as well as their higher level of income and status as family providers, have a bearing on decision making on appliances. Adding to this picture are gender norms guiding the long-term control of assets. In the Nepal study context, such norms imply that a woman has enduring rights to property (endowments), which in part explains the relatively high occurrence of rice cookers. In contrast, in Kenya and particularly in India, gender norms more strongly hinder women in accumulating wealth and thereby also investing in appliances of their choice. Further below we provide some suggestions as to how this male bias may be compensated in practice.

Despite electricity being primarily a male realm of responsibility and influence, some women have pursued convenience technologies related to cooking (e.g. rice cookers, kettles and blenders) – mostly in Nepal, and to a more limited extent amongst wealthier rural women in Kenya. In India, some women have enhanced their possibility to do tailoring (sewing machines). Irons and fridges have mixed gender connotations, depending on the context. For the remaining items observed, some are almost universal with individual ownership (mobile phones), while others are purchased and controlled by men but widely shared, both in terms of ownership and use (colour television). Quite a few appliances (e.g. electric saw, water pumps, and loudspeakers) are not found in large numbers but are interesting because the scope for electricity's uses is expanded. All these additional items were found to be controlled by men.

By and large, in all three countries, electricity has enabled longer working hours or more efficiency in production rather than allowing women and men to open up new businesses - which would require additional support mechanisms such as access to capital.

6. Impact of Electricity on Women's (and Girl's) Empowerment; Underlying Factors and Mechanisms for Electricity's Gendered Effects

Based on the material deriving from this research, we conclude with respect to three main questions: to what extent did electricity access in the selected contexts bring empowerment to women and girls; what were the underlying mechanisms; and to what extent and how did grid and off-grid systems provide empowerment?

From an overall development perspective, the households which gained access to electricity experienced increased well-being, convenience, time savings and access to communication and information. This was also the case in particular to the majority of women who work in their homes and, as in Kenya, run shops, businesses and use mobile money services. From a gender equality perspective, in which women's position vis-à-vis men in terms of their rights, agency and access to resources are of key interest according to the adopted framework, electricity access has only had a modest impact, if at all (varies between the studied cases). For example, men's higher likelihood of obtaining paid work within emerging and expanding electricity systems on the local level works against a process towards more gender equality.

Nonetheless, the potential impacts in the long term of having access to light, communication and new media should not be underestimated, as such changes may impact gender norms in the long term (Winther et al. 2017). Moreover, particularly in the Nepalese case, women explained that they experienced reduced time on drudgery through the uptake and use of electric rice cookers. Across the cases, women report saving time when avoiding to walk by foot to procure kerosene or charge their mobiles. In Kenya, the reduced need to walk also outside enhances safety, as the risk of violence outdoors in the study areas was reported to be high. The survey data are not suited for documenting how much time women with various types of access save by using electric light and rice stoves (e.g. there were relatively few households in the Nepal sample without access to electricity and many households kept more than one system).

With respect to the differences between the grid and off-grid systems, we found that systems with fixed connections, together with socio-cultural norms and customs for distribution of wealth (men being house owners), resulted in the limited agency for women in terms of deciding on which appliances to obtain and use. In contrast, when the socio-technical design of the electricity provision allowed for flexible services, this appears to have enhanced women's agency in relation to electricity. For example, women who rent portable lanterns for a few shillings a day have more direct access and autonomy to decide to get a lamp and where to use it, resembling their traditional power to decide on kerosene lamps. Because basic electricity services are needed and flexible systems enhance women's agency, it is, therefore, promising that both private agents and other lantern renting projects in Kenya, India and Nepal provide similar, flexible solutions both in terms of technologies and payment models.

At the same time, small systems limit the potential uses of electricity because they are unable to support high consuming appliances and equipment. However, the "problem"

with capacity turned out not to be a most immediate hindrance for extended usage and potential prosperity. In grid areas in all three countries, grid electricity was rarely used for running larger machines (mills, welding and carpentry being exceptions in some areas and primarily controlled by men). From this, we conclude that additional, supportive mechanisms for stimulating women's (and men's) economic activity are required to tap into the potential for women's economic activities through electrification. The findings also show that appliances have context specific, gendered connotations. Therefore, insight into how traditional objects and new appliances become gendered – and the social practices of which they form part – is likely to enhance the understanding of what kind of appliances, measures and extended activities are desired by women and likely to be taken in use to enhance their empowerment.

Rather than finding that one type of system provides more empowerment than the other, our study has demonstrated that in areas with grid electricity access, the question of *reliability of electricity supply* for public and private consumption is a key conditional factor to purposeful use of electricity in general and women's empowerment in particular. Unreliable supply means that expensive alternatives (including backup solutions or going without electricity) are necessary. Also, there are costs to brownouts which have negative impacts on appliances and equipment. So not only is there a high cost, but there's also the prospect of electricity not delivering on "promises" of better healthcare services; security lighting; better lighting in households etc. Reliability forms part of the socio-technical design and is also linked to the political economy¹ and the management of electricity systems. Indeed, as in the case of the national grid in the study areas in Kenya and parts of the Nepalese cases, poor reliability is a fundamental barrier.

Furthermore, comparison of the Nepalese and Indian contexts on the one hand and the Kenyan on the other demonstrates the significance of affordability and, in Kenya, the gendered implications of high connection/subscription costs. In India, upfront connection subsidies make the quest for universal access within reach (being at 86% in our Indian study site in Chhattisgarh). In Nepal, subsidies for micro-hydro production have contributed to an electrification rate at 96% in the study context (Mahadevsthan). In contrast, in Kenya (with only 6% grid connection rate in the study area) not only are grid connections many times more expensive but even decentralised systems offering pay-as-you-go systems with instalments are beyond reach to a large part of the population. The many widows in Homa Bay are most likely not to have electricity access. To balance this tendency that the poorest households do not obtain access, one may look to India where subsidies ensure that the poorest segments (below the poverty line -BPL) are provided with free electricity.

Regulations for subscriptions also determine gendered outcomes. We found that two regulations had contrasting effects. First, restricting women's agency in electricity; Nepalese and Indian customer regulations require that the subscriber is the person registered as the owner of the premises (normally a man). This hinders married women from being the subscriber and it hinders people in rented houses from subscribing. Secondly, also in Nepal and India, but this time with a positive effect, installers of electricity in people's houses often followed a predefined procedure of including light in the kitchen. The Indian households in our sample often have light in the kitchens where

¹ This study acknowledges, but does not adopt a political economy framework. For a study adopting this approach to energy and gender, see RA3.

women normally work in the evenings, and it, therefore, appears that women have benefitted from the installers' influence.

A repeated theme in the country-specific discussions above is the importance of the socio-cultural context, structures of which constitute the problem of gender inequality (before electricity's arrival). This study shows how gender ideologies, social norms and the gendered distribution of wealth are not much affected by – but rather condition – the gendered outcomes of electricity access. Again, this tells us that electricity alone is not a sufficiently strong mechanism for bringing social change and that other drivers are more important than electricity for more equality between the genders. Electricity is nevertheless important and plays a role for women's empowerment, and below we provide concrete suggestions on how empowerment could be further enhanced.

In terms of overall policies and international actors and whether these may positively affect the gendered outcomes of electricity, we first make an observation of the counterfactual. Our review of national policies in the three countries showed that general goals for gender mainstreaming and gender equality are in place. We also noted that the electricity sector at the national level (e.g. Kenya) increasingly put emphasis on gender issues. However, the impact of these policies on implementation and operation practices on the local level is yet to be seen. This report documents that this lack of attention to gender in practice has led to gender-blind interventions, in which only men became recruited as staff on the local level. On the other hand, other types of policies did result in a relatively low cost of connection/subscription in Nepal and India (here including free access for BPL), which have been effective in ensuring universal access. This is observably not the case in Kenya, where the government policy of reaching the last mile does not match realities and is obfuscated by differing ways of measuring and reporting "access". Across our Kenyan study areas, not even governmental rural schools and clinics have reliable electricity supply, and the government is also not supplying its population with easily accessible clean water. In forthcoming rural electricity interventions, targeting water supply and upgrading public services and making supply function over time, would be a very effective way to empower women and improve the quality of education for girls and boys.

7. Conclusions

Our empirical research confirms that there may be several paths to women's empowerment through electricity, but, as also shown in our literature review (Winther et al. 2017), a considerable share of the potential is often left untapped. Based on the studied cases, women's involvement in supply is the most directly observable pathway for transforming gender ideology and discriminating norms. Both the manner in which women's inclusion was planned and practised and the socio-cultural context played a large role in the extent to which such outcomes were realised.

The report has shown that the provision of affordable and reliable electricity access to householders and businesses contributed to women's empowerment through modified social practices that enhanced daily life for women in rural areas in crucial ways. Nonetheless, universal access has not yet been realised, hence access is not for all, and in Kenya, widows and single/divorced women householders were the least likely to have access. Also, across the country cases, because married women's access to using appliances tended to be controlled by her husband and sometimes her extended family

(Nepal, India), this path appeared to be a slower and more unpredictable road (barrier) compared to the one mentioned above.

The Nepalese women's uses of rice cookers and the arrival of mills for grinding spices have implied important reductions in women's drudgery, which has contributed to increasing their human resources and their *potential* to pursue income-generating activities and have more leisure time (i.e. empowerment dimension 2). In Kenya, women operating businesses benefit from light, mobiles and mobile banking facilities, potentially increasing their economic empowerment. Nevertheless, in all three study contexts, and in India in particular, the immediate effect of using electricity primarily enhanced women's *performance of their traditional roles as caregivers*. Discriminating structures remained, as observed elsewhere (Standal and Winther 2016). Had electricity access significantly reduced women's immense burden of drudgery, the picture might have looked different. Rather, based on the research on electricity's *uses* in our study areas, we are not able to observe structural changes such as gender ideologies and norms (empowerment dimension 1) or increased ability to influence life decisions (empowerment dimension 3), which constitutes empowerment's strongest indicators according to our framework. In contrast, the two interventions that put women in leadership roles in supply directly affected gender norms, as noted above. With respect to women's drudgery tasks, the findings from this study suggest that the provision of functioning electricity supply in public services (and supply of equipment) would have been a more effective means, as are the more incremental but important reductions in drudgery deriving from women's access to using electricity, appliances and mobile phones.

Our study has contributed to understanding how the organisation of electricity supply may come into play in shaping the gendered outcomes of electricity access. The material from selected parts of rural Nepal, Kenya and India demonstrate that gender blind interventions, together with local norms and practices, hinder women's empowerment in that the provision of access is tacitly designed to become a realm largely dominated and controlled by men. This finding strengthens our previous recommendation (Winther et al. 2017) that women should be ensured of – and organise themselves to demand (c.f. RA3) – full participation in the planning, managing and operating of energy programmes and projects. This kind of strategy would comply with a central target in the SDG 5 on gender equality which highlights women's equal opportunity to be included in leadership on all levels. SDG 7 does not include this target.

The study sheds light on what impact effective electricity policy could have on the ground if it grants women opportunities to participate in supply. When women are given privileges, it often triggers initial reactions from men, but because the need for electricity, connectivity and charging capacity is high, and given time, it is likely, as in the studied cases where we observed 'double transformations' (i.e. a shift in technology and a shift in gender norms), that such barriers would be overcome.

In conclusion, this study shows that the issue of access and the realised benefits of access are not only, or even mainly, a question of technology, but policies, processes of implementation and organisation of supply, and end-users needs, social positions and aspirations.

8. Recommendations

This study adds to the literature on how electricity access may empower women and contribute to gender equality by presenting findings on underlying factors and mechanisms that influence the gendered outcomes. Thus, when providing recommendations, we not only highlight the reasons for the effects of electricity access on women's empowerment but also the reasons for "lack of" effects.

Our work has demonstrated that obtaining electricity access matters to women and men, but that the choices and opportunities for deciding and using electricity are gendered and contextually dependent. Gender-blind programmes and projects are likely to reinforce a particular set of ideas about end users: men doing productive work and women occupying households, apparently benefitting from electricity through a trickle-down process. Part of what is missed in this perception of the user side is insights into the needs, social positions and negotiating power of various groups of women and men. In particular, our study shows a need for supporting investments both for improving the quality of public services and enhancing women's economic enterprises.

In the study areas in Nepal and India, subsidies have resulted in almost universal access. This is far from the situation in rural Kenya, where the grid is not only costly but often dysfunctional. In response, many Kenyans living in rural areas purchase solar systems through private actors. However, private actors do not address the situation of the poorest, those living at a distance from central places and the need to provide electricity access to enhance the quality of public and communal services. This is where the governments, together with private and public partners, should strengthen their current efforts to provide gender equitable grid extensions and decentralised systems of supply.

In our study, we compared various systems of supply spanning from grids to portable lanterns, and a key question was how various systems empower women. Rather than finding that one type of system provides more empowerment than the other, our material demonstrated that reliability and affordability (access and consumption) are much more important than the choice of system. Governments have committed themselves to 'reaching the last mile' and providing access to all by 2030, hence in only 12 years' time from now (2018). As a result, there appears to be a strong emphasis on fast growth in the number of households with access, typically measured through (somewhat unclear) measures such as "connections". However, there is a lack of focus on how the supply of electricity functions in practice after installation and upon ensuring enduring, predictable services over time. Our research shows that both of these are significant constraints that diminish the potential of electricity to bring empowerment, social and economic effects.

In addition, we highlight that an effective mechanism for enhancing women's human resources and thereby empowerment (dimension 2) is potentially through ensuring the enduring provision of reliable and electricity to public services (water supply, health clinics, boarding schools), which reduces women's drudgery, increases safety and advance children's learning – given that other supportive infrastructures and equipment are in place. In the studied cases, this potential remains largely untapped. Illustrative of the significance of well-functioning public services to women's empowerment, this aspect constitutes a separate target in the SDG 5 on gender equality. In comparison, the SDG 7 is focused on providing universal access to clean energy (measured through 'share of the

population' with access, i.e. households) and does not (yet) address electrification of public services as a target.

Capacity building is often interpreted in an instrumental way as technical training of women to participate in electricity supply (e.g. engineering and business activities), thereby opening up spaces for women to participate in the realm of electricity and beyond. The presented research, especially from Nepal, has shown that this instrumental path may not be adequate in itself. Electricity providers including policy-makers and rural electrification agencies should engage women and men in a consistent manner for an appreciable length of time (throughout project cycles and value chains), focusing on dialogue on gender norms and ideologies in order to co-identify how to address and overcome socio-cultural barriers (e.g. marriages, work uniforms that are inconsistent with traditional values etc.). There is a need for continuous development and updating of tools and practical guidance on how to recruit and retain women in energy supply. While guidelines about understanding gender inequities in the energy sector exist, there is a need to update them by paying particular attention to addressing women's social conditions beyond education and financing. These social conditions lead to women's exclusion in energy supply and use, hence emphasis should be put on how the heavily patriarchal electricity supply space could be modified to accommodate women's needs, rather than just focusing on trying to make women fit in patriarchal energy and social space. Because men dominated energy spaces constitute the main problem, this is what should be addressed.

Policy and practice need to provide for reliable access as well as equipment for public services to effectively use electricity to provide services. Similar types of public services may have different priorities/ needs depending on the local context. For example, in the studied Indian schools, fans were desired to making learning comfortable, while in Kenya, teachers put emphasis on lighting for studying and security, as well as power for laptops. Thus, related to electrification of public services, there is need to develop frameworks/tools that help policymakers and planners define what kind of access, electricity services, associated equipment, and maintenance packages are required in different settings. Such tools should not just allow for technical and generalised definitions of needs and priorities but should also value and allow for local viewpoints.

There is now increased funding for electrification, but inter-ministerial and interdepartmental planning of infrastructure and services need to be strengthened to ensure that electricity services are planned into infrastructure development in a gender responsive manner. Such integrated planning should be linked to gender equality performance. In Kenya, there is a discrepancy between the need for Kenya Power (distribution utility) to answer to its shareholders (i.e. profit motive) versus non-profitable operations such as maintenance in rural areas. This discrepancy needs to be recognised by the government. Also, as private sector actors become more involved in electrification, such planning appears particularly important because such actors will only target women when it serves their commercial interests (Matly 2005) and they do not typically bear responsibility for gender equality issues, unless through their own voluntary corporate policies. The private sector, often in partnership with governments, is increasingly taking on the role of electricity providers (from national, government-owned utilities), especially in African settings. They, therefore, play a role in structuring gender benefits and their influence will likely increase over the next few years. Public financing, as well as

regulations, could, therefore, be used to leverage and motivate a gender transformative approach to service provision.

The current slogan of “leaving no one behind” (2030 Agenda) will not be fully achieved without such measures to increase social justice in general. These measures would also make it possible for ordinary women and men (the majority of the rural population) to move beyond the basic levels of electricity use (tier 1-2). Financial support to households, either through cash transfers, general redistribution of wealth in society or subsidised prices for electricity provision (grid and off-grid) is necessary to achieve electricity access for all, including single women households.

As to the SDGs and SE4ALL, we recommend gender-specific strategies and targets for electrification of public services specifically health care, education and water facilities. The SDG 7 should look to several of the targets identified in the gender goal (SDG5), such as measuring the share of women involvement in energy leadership and management. The SDG5 also identifies improved infrastructures and enabling digital technologies as key strategies to end discrimination, and to these ends, electricity is a key enabling factor.

9. Suggestions for Policy and Practice

Based on comprehensive research conducted in six case study areas in rural Nepal, Kenya and India, this report proposes to:

1. Consult and consider measures to make electricity subscriptions gender inclusive

Addressing: energy ministries and regulators at the national levels and private/voluntary actors who plan and implement electricity systems (grid/off-grid).

Possible options:

a. Allow other individuals than house owners to obtain subscription (grid and off-grid)

- Problem: In many contexts, only the formally registered owner of a house can subscribe, and this person tends to be a man.
- Effect: women depend on husbands or other men for obtaining access to electricity. This hinders women’s agency and access to electricity
- What can be done? Modify regulations for a subscription so that a person registered at a certain address (citizenship card/ID) can obtain a subscription
- What will be the result: Women living in houses they do not formally own, will get the possibility to access electricity and get access to using electricity’s services.

b. Ensure that instalment guidelines for house wiring give priority to the kitchen area

- Problem: In Homa Bay, Kenya, 39% of the households with a subscription to electricity do not have electric lights in the kitchen. On an average, they keep 5 light points. In areas with systems offering portable systems in Kenya, women regularly use lanterns in the kitchen, indicating the need for light in kitchens.
- Effect: Every evening after darkness a female member of the household (female head, daughter, other women or a servant) cooks a meal. Performing this activity with only kerosene, the light of mobiles or the light from the fire is inconvenient and more time consuming than when cooking with electric lights.
- Promising models: In Chhattisgarh, India (where more people than in Kenya say that men decide on lights and appliances), the homes are 20 percentage points more likely than in Kenya to have lights in the kitchen, even when there is only one light point in the house. In Chhattisgarh (and Nepal), installers advice people to put up light in the kitchen, which has resulted in electrified kitchens.
- What can be done? Modify prescriptions/regulations in Kenya so that installers of electric equipment/light as default advice householders to put lights in the kitchen.
- What will be the result: Kenyan women will get an improved working environment and increased efficiency. Symbolic implication: It is possible that the electric light in the cooking place would contribute to increasing the value of women's work.

c. *Make electricity subscriptions affordable*

- Problem: Homa Bay, Kenya: 74% of widows do not have access to either grid or off-grid electricity. For other types of households where also men reside, a lower share (ca 40 %) does not have access. The high connection/subscription fee to the grid and SHS makes electricity access out of reach to the widows due to a high level of poverty, partly resulting from HIV epidemic in the area. In comparison, the cost of grid connection is more than 3.7 times higher in Kenya than Nepal and 37 times higher than in India, where universal access to either grid or off-grid electricity is almost achieved in the study areas.
- Effect: The high cost of connection/subscription to grid/off-grid supply particularly hinders women's agency and their access to electricity and adhering services
- What can be done? Investigate what mix of solutions (grid/off-grid) would work under what conditions in rural Kenya and make electricity connections/subscriptions (grid and off-grid) affordable to all. Consider lowering connections fees for marginalised groups and further improvement of the social tariffs ('the lifeline tariff') (e.g. make it into a Free Basic Energy Tariff with free access up to 50 units/month).

- What will be the result: The poorest segment of the population would get access to electricity and to using electricity's services. This would enhance their convenience, reduce drudgery and time use (making mobile charging possible at home and eliminating need to buy kerosene), improve the indoor environment, which would ease their lives and enhance communication. This would also imply less social exclusion and dependency on others.

d. *Improve women's access to adopting appliances and machines powered by electricity*

- Problem: Across the three countries, most of the appliances observed in people's homes were either controlled and used jointly by household members or decided on/controlled/owned by a man. This results from women's income being ca 40% lower than men's and because men tend to own the house and are the electricity subscriber.
- Effect: Women have limited decision making power to obtain appliances and equipment that fulfil their needs, including time-saving appliances and machinery for productive activities (e.g. mills).
- What can be done? Adopt a systemic approach (e.g. appliance supply chains, financing, credit schemes) and work with local groups and communities to identify suited schemes (rental, instalments etc.) for making appliances and machines that women want available and affordable.
- What will be the result: Women would get a higher likelihood of adopting appliances that could help reduce the time spent on drudgery tasks and/or make productive activities become more convenient and effective.

2. Consult and consider measures to make electricity systems gender responsive

Addressing: energy ministries, regulators, rural electrification authorities, electricity suppliers and private/voluntary actors who plan, implement and operate electricity systems

Possible options:

e. *Ensure a minimum degree of reliability*

- Problem: The grid in many rural areas counties is highly unreliable.
- Effect: This negatively affects private households, forcing people who wish to have access to electricity to also keep solar systems, not only as a back-up but in effect as their main type of supply (Nepal, Bihar, Kenya). Unreliability also negatively affects businesses and the quality of public services (see also below).

- What can be done? In the process of creating access for all, governments need to invest sufficiently in ensuring at least a minimum degree of reliability by emphasizing maintenance, monitoring and sustainability of existing grid systems and networks (lines etc.) as well as off-grid systems of supply.
- What will be the result? People and institutions who have already paid a high cost for obtaining access would get the service they have paid for. It would make the share of the population with access appear real and not only intended/potential, which is in line with the Global Tracking Framework that accounts for reliability and affordability.

f. *Provide enabling conditions for the involvement of women and men in supply to ensure gender equitable outcomes*

- Problem: Conventional, gender-blind electricity interventions (whether grid or off grid), are male-biased in that mainly men are recruited and get paid jobs in the systems of supply on the local level. In centralized systems, some women are recruited for administrative jobs in central areas. In contrast, two cases of localized electricity systems (Kenya), both supported by external donors, represent best practice in that the adopted gender approach resulted in women becoming key players in the supply system. This had the additional effects that gender norms were modified and that customers were handled in a way that sustained their enduring access to services (e.g. in case of non-payment, the female staff suggested a schedule for repaying debts while maintaining access).
- Effect: The male-biased systems increase the gender income gap, serve to reinforce stereotyped gender roles, and lead to missed opportunities in terms of influencing gender norms that discriminate women.
- What can be done? Spot possibilities for ‘double transformation’ (electricity access and transformed gender relations) when setting up localised systems of electricity supply:
 - i. stating in the project strategy that women’s inclusion in supply is a goal (33%, or 50% of staff, and, in a series of interventions, ensure an equal number of women and men leaders); that they should have equal pay as men; and that the degree to which these goals are realised will be monitored and reported
 - ii. working in collaboration with women’s groups in the local community to find champions and leaders who can take part in the planning of the intervention and in the recruitment and training process (e.g. ensure that the training is substantial so as to reduce the need for technical pre-qualifications) and ensure that the project accommodates women staff’s particular needs and creates conducive working conditions

including in the field (e.g. kindergarten, separate toilets, work hours, buildings and infrastructure, security)

- iii. include a budget that accommodates for women's inclusion
 - iv. expect resistance (silent or open) from men, and include men actively in the gender-sensitive planning to get them on board regarding the wider benefits of including women
- What will be the result: Women's inclusion in supply would:
 - i. empower the individual women involved who will get increased psychological power and economic autonomy and become role models for young girls
 - ii. contribute to changing stereotyped gender roles and expanding the expectations for what women can do
 - iii. enhance the local system's financial viability (based on two case studies and involved people's assessment)
 - iv. reduce the barriers to field work and operations for women technical staff
 - v. contribute to making poor segments maintain access to electricity (such groups are at times are unable to pay the fees, for example, due to seasonal variation in income, and in the case of Ikisaya, customers highlighted the female staff's flexibility, politeness and willingness to negotiate ways to pay back in the near future.

3. Consider measures to strengthen public services

Addressing: energy-, health-, education and water ministries and planning agencies

Possible options:

g. Ensure that public services are provided with reliable electricity access and necessary equipment

- Problem: The study observed that water provision systems had rarely been targeted for electricity, and this negatively affects women in particular (time use). Clinics were often targeted and connected, but supply tended to be non-functional which implies that electricity could not be used and the quality of services remains poor. Because electricity in the study areas does not improve the quality of such services, the high amount of women's drudgery work continues. There are also serious impacts on health (e.g. no capacity to store medicines needed quickly after a snake bite, lack of examination light when giving birth, poor quality of drinking water taken from lakes etc.). Another problem is the lack of equipment to facilitate the use of electricity (e.g. pumps,

pipes, fridges, lamps). Schools more often have a subscription, but the reliability of electricity supply is relatively low, and equipment for labs, computers etc. are lacking. Boarding school facilities have a documented positive effect on girls' performance in particular, and such services depend on electricity for being able to operate. However, the situation with unreliable supply hinders the operation of boarding facilities. A milling facility (Nepalese site, owned by men) reduced women's drudgery but was only observed in one single site/village.

- Effects: Drudgery tasks remain, health problems remain, girls' education opportunities remain limited
- What can be done? Electricity, water and health sectors should work together (e.g. in inter-ministerial action groups addressing specific problems) to ensure that village infrastructure is improved in key public services that women in particular depend on. In particular, water supply should be targeted for electrification / included in electrification plans for an area. In health clinics and schools, the reliability of supply should be ensured and monitored (e.g. yearly, which tier), as should the provision of equipment/appliances that are needed to provide needed services (e.g. milling).
- What will be the result: Women's drudgery tasks would be reduced, allowing them to spend more of their time on productive activities (if other conditions are in place) and for leisure (having today a working day from 12-16 hours). Improved health and improved quality of education.

ACKNOWLEDGEMENTS

This empirical research would not have materialised without the support of the many women and men we met in the chosen study countries, Nepal, Kenya and India, who generously shared their time, experiences and insights with us. We also thank our research assistants and colleagues for their dedicated efforts to assist us during qualitative fieldwork: In Nepal, we were assisted by Ms Srijana Giri, Ms Priyanka Choudhary, Mr Parbat Bastola and Mr Rajan Thapa. In Kenya, we were assisted by Mr Nicholas Wasonga Mumo, Ms Laura Asawo and Mr Victor Ndiege (Homa Bay County) and Ms Lillian Syumbu Ivutha, Ms Beatrice Mbai Mutuku, Ms Winnie Muli and Mr Nicolas Kivunzi (Kitui County). In India, we were assisted by Ms Sangeeta Malhotra (Chhattisgarh) and Mr Arun Kumar (Bihar).

For the cross-country survey, we were assisted by the following enumerators: In Nepal (Mahadevsthan): Srijan Bhattarai and Sameer Panjuln; Kenya (Homa Bay): Peter Macharia, Justus O. Anyoso, Elias Waindi Mgaka, Ouke Kenox Juma, Joseph Oluoch, Mourine Akoth, Phoebe Okeya Adoyo and Otieno Elvice Ogallo. In India (Chhattisgarh): Mr Krishnapada Sasmal, Kaustuv Mukhopadhyay, Gajanan Ray, Chandra Shekhar, Saurabh Verma and Jogindra Singh Thakur.

For stimulating discussions and support over the years since the Gender and Energy Research Programme was initiated in 2015, we are indebted to Sheila Oparaocha, Annemarije Kooijmann and other staff at the ENERGIA secretariat, the Principal Investigator, Professor Joy Clancy, the members of the Technical Advisory Board: Elizabeth Cecelski, Mumbi Machera, Andrew Barnett and Youba Sokona, and the members of the other Research Areas in the Programme.

Finally, we thank the Department for International Development (DFID), UK, for their financial support.

Though all authors contributed to writing this report, the following distribution reflects the distribution of responsibility for collecting and analysing the country-specific material: Margaret Matinga, Bigsna Gill, and Rashmi Murali conducted the research in Nepal; Kirsten Ulsrud, Anjali Saini, Kirsten Wanyama, Henry Gichungi and Tanja Winther conducted the research in Kenya; and Mini Govindan, Debajit Palit, Bigsna Gill and Rashmi Murali conducted the research in India. Deborshi Brahmachari led the work with the survey.

LIST OF ABBREVIATIONS

ADB	Asian Development Bank
AEPC	Alternate Energy Promotion Centre
BPC	Butwal Power company
BPL	Below Poverty Line
BRLPS	Bihar Rural Livelihood Promotion Society
CREDA	Chhattisgarh State Renewable Energy Development Agency
CREP	Community Rural Electrification Program
CSPDCL	Chhattisgarh State Power Distribution Company Limited
DFID	Department for International Development, UK
DLP	Digital Literacy Project
EFEWEE	Exploring Factors that Enhance and restrict Women's Empowerment through Electrification (RA1 under the Gender and Energy Research Programme)
GESI	Gender Equality and Social Inclusion
Govt	Government
HIV	Human Immunodeficiency Virus
ICT	Information and Communication Technology
IPP	Independent Power Producer
IT	Information Technology
JICA	Japan International Cooperation Agency
JNNSM	Jawaharlal Nehru National Solar Mission
KfW	Kreditanstalt für Wiederaufbau
LaBL	Lighting a Billion Lives
LPG	Liquefied petroleum gas
MTF	Multi-Tier Framework
NBPDCL	North Bihar Power Distribution Company Limited
NEA	Nepal Electricity Authority
NGO	Non-governmental organisation
PFC	Power Finance Corporation
PHC	Primary Health Centre
PV	Photovoltaic
REA	Rural Electrification Authority
RGGVY	Rajiv Gandhi Grameen Vidyutikaran Yojana
RQ	Research Question
RVEP	Remote Village Electrification Programme
SDG	Sustainable Development Goal
SE4All	Sustainable Energy for All
SHG	Self Help Group
SHS	Solar Home System
SLC	School Leaving Certificate
TV	Television
UK	United Kingdom
USAID	United States Agency for International Development
USD	United States Dollar
VDC	Village Development Committee
VESP	Village Energy Security Programme

GLOSSARY

Access to electricity:	Pertains to usability including affordability of supply, rather than actual use of electricity (cf. SE4All, GTF).
Empowerment:	The process in which individuals, groups or societies move from being marginalised, through poverty, ethnicity, gender or other discriminating relations and markers, to a state of equality. See also Women's empowerment.
Gender:	Refers to a system of socially defined roles, privileges, attributes, and relationships between women and men, which are learned and not biologically determined.
Gender analysis:	Gender analysis is the examination of differences in the roles, activities, positions, experiences, needs, opportunities, and endowments of women and men in order to identify gender issues which need to be taken into account and addressed for any given initiative.
Gender equality:	Women and men's equal rights, access to, and control over resources and power to influence matters that concern or affect them. This draws on Kabeer (1999 and 2001).
Gender inclusive:	Speaking or acting in a way that does not discriminate against a particular sex, social gender or gender identity, and does not perpetuate gender stereotypes.
Gender mainstreaming:	The systematic integration of the different needs, interests, and experiences of women and men in all policies and activities of an institution at all levels.
Gender relations:	The socially constructed form of relations between women and men in a given socio-cultural context. Gender relations often involve a hierarchical power relation in which women are considered as subordinate to men, though this can vary according to age, caste, and other social indicators.
Gender-responsive:	Implementing a policy or carrying out a practice in ways that contribute to advancing gender equality and women's empowerment
Gender roles:	Gender roles refer to women's and men's different, ascribed roles in a given socio-cultural context. They are informed by norms and ideologies about what women and men are and how they should behave. Gender roles are learned from childhood but are also dynamic, and they are variable within and across societies. The gendered division of work is the delegation of different tasks between men and women.
Gender-blind:	The failure in policies and interventions to recognise that women's and men's positions and needs are often different.
Gender neutral:	The presumption that (energy) policies and projects benefit women and men equally.
Gender-aware:	Policies and projects which recognise that women's and men's needs are different, that they have different capacities to engage in and respond to interventions, and that they are likely

	to experience and be impacted by interventions in distinct ways.
Gender sensitivity:	Gender sensitivity is to approach a given problem or perform a given task in a way that acknowledges women and men may have different positions, experiences, and needs.
Human resources:	Access to information, education, knowledge, training, the degree of drudgery (time use), comfort and convenience, health, safety, psychological, and negotiating power.
Material opportunities:	Short-term access to food, income, and using assets.
Material endowments:	Long-term access to and control over investments, savings, long-term financial security, ownership and accumulation of assets (includes economic empowerment).
Social resources:	Access to communication and socialising, social and business-related networks, the degree of social inclusion.
Women's economic empowerment:	Women's increased ability to participate in, contribute to, and benefit from the economy on equal terms with men. Involves an increase in women's long-term material endowments.
Women's empowerment:	The process towards gender equality in terms of women and men's equal rights, access to, and control over resources and power to influence matters that concern or affect them.
Women's political empowerment:	Women's increased decision making power and their ability to participate in and influence political processes at all levels.
Women's social empowerment:	Women's increased ability to act to enhance their social relations, including their engagement in institutional interactions necessary for their well-being, productivity and decision making power.

LIST OF TABLES

Table 1: A framework for analysing women’s empowerment through electricity access	42
Table 2: Case Study Areas: Villages included in the qualitative research and survey.	43
Table 3: Marital status of respondents, EFEWEE Survey	45
Table 4: The 14 studied systems for electricity supply	51
Table 5: Share of girls and boys aged 13-17 attending school (EFEWEE Survey)	56
Table 6: Characteristics of supply in schools (Nepal)	57
Table 7: Characteristics of supply in schools (Kenya)	58
Table 8: Test results, Class 8, Endau Primary School, 2016	59
Table 9: Characteristics of supply in schools (India)	60
Table 10: Occurrences to mobile phones and gendered ownership (EFEWEE Survey)	63
Table 11: Appliances kept by surveyed HHs with access	76
Table 12: Summary of effects of electricity access on women's empowerment	99
Table 13: Daily schedule of a woman and her husband, Ikisaya village, October 2016	148
Table 14: Time spent weekly collecting firewood and water (EFEWEE Survey)	149

LIST OF FIGURES

Figure 1: Conditional factors for electricity’s gendered impact	41
Figure 2 Shares of populations in the study sites – versus households in the sample – with subscriptions to various types of electricity systems (Nepal, Kenya and India)	Error! Bookmark not defined.
Figure 3 Answers to survey question (Nepal and Kenya): “Was this the first time you witnessed women holding this kind of position/responsibility?”	54
Figure 4 Answers to survey question (Nepal and Kenya): “Has observing women in supply changed the way you think about women and what women can do?”	54
Figure 5 Reported costs of connection/subscription, USD, averages (EFEWEE Survey)	66
Figure 6 Reported costs of electricity consumption (EFEWEE Survey)	66

Figure 7 Access per type of house ownership, Nepal sample.	68
Figure 8 Access per type of house ownership, Kenya sample	68
Figure 9 Access per type of house ownership, Indian sample	69
Figure 10 In whose name is the electricity subscription?	70
Figure 11 Households with grid connection, Nepal: Paying, subscribing to and servicing bills	70
Figure 12 Who paid for the system and in whose name is the subscription? (Nepal)	71
Figure 13 Households with grid connection, Kenya: Paying, subscribing to and servicing bills	72
Figure 14 Households with SHS, Kenya: Paying, subscribing to and servicing bills/instalments	72
Figure 15 Households with grid connection, India: Paying, subscribing to and servicing bills	73
Figure 16 Rooms in which lights are kept (grid, mini-grid, SHS), for all countries. Multiple responses, EFEWEE Survey.	74
Figure 17 Decisions regarding the position of light (three countries)	75
Figure 18 Decisions regarding and ownership of rice cookers in Nepal	77
Figure 19 Decisions regarding and ownership of iron in Kenya	78
Figure 20 Decisions regarding and ownership of iron in India	79
Figure 21 Householders using electricity for income generation and/or other productive activities	81
Figure 22 Usage of mobile banking facilities	83
Figure 23 Answer to the question 'Who keeps a bank account?'	84
Figure 24 Respondents' level of education (Nepal)	140
Figure 25 Women and men's types of income, Nepal sample, N=220 (EFEWEE Survey)	141
Figure 26 Respondents' level of education (Kenya)	142
Figure 27 Women and men's types of income, Kenya sample, N=207 (EFEWEE Survey)	142
Figure 28 Respondents' level of education (India)	143

Figure 29 Women and men’s types of income, India sample, N=215 (EFEWEE Survey)	143
Figure 30 House ownership in the study sites in Nepal, Kenya and India (EFEWEE Survey)	145
Figure 31 Women and men’s views on a woman’s likelihood/right to keep a traditional item in the case of divorce or widowhood (EFEWEE Survey)	145
Figure 32 Women and men’s views on a woman’s likelihood/right to keep a modern item/appliance in the case of divorce or widowhood (EFEWEE Survey)	146
Figure 33 Women and men’s answers to who in the households tends to decide on how the money you have earned should be spent? Three study sites. (EFEWEE Survey)	147
Figure 34 Who in the household tends to fetch the firewood? (EFEWEE Survey)	149
Figure 35 Women’s reporting on who in the household tends to collect the water (EFEWEE Survey)	150
Figure 36 Women’s reporting on who in the household tends to collect the water (EFEWEE Survey)	150

1. BACKGROUND, OBJECTIVES AND METHODOLOGY

The provision of electricity access and modern energy services is considered crucial for human well-being and economic development. Electricity provision is also increasingly regarded as a means of improving gender equality in developing contexts where women in particular often experience harsh living conditions, including discriminating norms. There is increased international attention to gender in electrification. Three paths to women's empowerment are specifically highlighted in the current debate: First, it is assumed that electricity interventions would enhance women's empowerment if women were included in the systems of supply, as observed in some studies (Matly 2005, Standal 2008, Sovacool et al. 2013). Second, the Sustainable Development Goal number 5 identifies improved infrastructure as one of its targets for ending discrimination against women. Third, it is anticipated that women's access to using electricity and time-saving appliances would help them reduce the time and hardship they initially spend doing drudgery tasks such as fetching firewood (UNDP/ESMAP 2004, van de Walle et al. 2015, Dinkelman 2011). Implicit in this third thesis is both the expectation that women would use their freed time to pursue income-generating activities and thereby become economically empowered, and that the women actually have access to electricity and the power and means to decide on and use the appliances they desire.

This study sets out to empirically examine these and other potential paths to women's empowerment through electricity in a limited number of geographical contexts. Building on this material, we aim to identify conditional factors for electricity's gendered impact in the selected sites which may also have relevance elsewhere. By employing a novel framework for analysis, the study aims to demonstrate how success criteria and hindrances for women's empowerment through electricity may be revealed. This will inform the project's overall goal which is to propose recommendations for policy and practice on how electricity access in the rural South most effectively can enhance women's and girls' empowerment.

The report presents the results from a four-year research project (2015-2018) on women's empowerment through the provision of electricity access and uses of electricity's services. The project is entitled 'Exploring factors that Enhance and restrict Women's Empowerment through Electrification – EFEWEE'. The task as originally framed was to examine and compare the gendered effects of electrification through the grid and decentralised systems. Hence, a comparison of various types of electricity supply for electrification was a key element in this work. After project initiation, we came to realise that the notion of 'electrification' tends to be associated solely with grid systems and not decentralised systems, thus we shifted the terminology from 'electrification' to 'electricity access'. We presume that access has two main components: the provision side and the user side. Both sides may be gendered, and we anticipate that the resulting 'gendered access to electricity' affects women and men's relative influence on decisions regarding electricity and appliances – and their benefits from using such services. To obtain geographical spread and a potential to examine and highlight the role of

contextual factors, we decided to focus on rural areas in three Southern countries: Nepal, Kenya and India.²

1.1. Results from scoping study: existing evidence and policies

1.1.1. Literature review

We started by reviewing the empirical literature on women's empowerment through electrification and electricity access (University of Oslo et al. 2016). In short, the reviewed studies show that electrification has often positively affected women's (and men's) wellbeing. However, very few studies have looked at relational aspects (e.g. effects on women versus effects on men) and the evidence is fragmented in that statistical studies have mainly examined grid systems and studied single indicators for wellbeing, and sometimes employment, while qualitative studies have analysed processes and relations in single case studies (both centralised and decentralised systems). This finding inspired us to develop the EFEWEE framework for analysing women's empowerment through electricity access (Winther et al. 2017) which informs this study.

1.1.2. Policy frameworks

In Nepal, energy policies at the national level do attempt to address women (along with children and marginalised groups) as targeted beneficiary groups, with the intention of implementing programmes that lead to positive impacts on women, create opportunities towards their employment, and focus on delivering energy to reduce drudgery. Women's participation and their proactive inclusion in the planning and development of renewable energy initiatives are also encouraged (Govt. of Nepal 2016 and 2013). At the regional level, Nepal's nodal agency promoting renewable energy based electrification, AEPC,³ has a more specific gender inclusion policy and has developed a Gender Equality and Social Inclusion (GESI) plan and toolkit, which is built into AEPC's overall planning, implementation, monitoring and evaluation processes.

Gender equality is enshrined within the Constitution of Kenya. With new draft energy policy and legislation awaiting parliamentary assent, the country still operates under the existing policy framework which focuses on providing electricity access, making services affordable to the poor, and enhancing the availability and reliability of electricity supply. Gender issues are not systematically addressed, however, the influence of the Constitution of Kenya has been significant in pushing some progress towards equality in the sector, through the establishment of targets and performance indicators that show women inclusion in employment in Government institutions related to energy. In addition, there have been several initiatives by local NGOs, including the ENERGIA-Kenya network established with Practical Action, with the purpose of influencing gender mainstreaming in energy planning and delivery.

² By 2016, the share of the population living in rural areas with access to electricity in Nepal, Kenya and India were 85%, 39% and 78%, respectively (IEA 2018:113-14)

³ Alternate Energy Promotion Centre.

In India, the national energy policies recognise that in the absence of electricity access, women and girls bear most of the burden of drudgery; and also acknowledge the importance of women's participation in meeting rural energy needs, suggesting their representation in district-level committees. Moreover, the ongoing SAUBHAGYA scheme provides 100% connection subsidies to single women households that are being electrified under the scheme. The only national-level policy that explicitly address gender issues is the PMUY Scheme launched in 2016. This exclusively targets women beneficiaries and provides LPG connections at an upfront subsidy.

As can be seen, until recently electricity policies in the three countries mainly focused on providing electricity access, making services affordable to the poor and enhancing the availability and reliability of supply. International initiatives such as the Sustainable Development Goal (SDG) number 7 on Clean Energy and Sustainable Energy for All (SE4All) highlight universal access as the primary goal, and their strategies and targets sometimes mention gender explicitly in terms of different needs of women and men as end-users of electricity. Overall goals for gender mainstreaming have been developed both nationally and by international actors (e.g. World Bank, ENERGIA) in which governments have committed themselves to promote gender equality and other social goals. Also, steps have been made on the national levels to make electricity policies become gender aware. However, as this report will show, these efforts have had a limited bearing on the development of the electricity sector at the meso and micro levels.

1.2. Research methodology

1.2.1. Objective and research questions

The overall objective of this independent research is to propose recommendations for policy and practice on how electricity interventions and access most effectively can enhance women's and girls' empowerment in rural areas in the South. We consider women's empowerment as a process towards gender equality, hence a concept that requires analytic attention to women, men, girls and boys. To address the overall objective, we identify four main research questions (RQ):

RQ1 With respect to electricity access and use, what factors affect women's and girls' empowerment?

Sub-questions:

- i. To what extent and how is electricity used for public services in ways that enhance women's empowerment?
- ii. To what extent and how do women and men have access to electricity at home, decide on and use electrical appliances?
- iii. To what extent and how do productive uses of electricity enhance women's empowerment?

RQ2 What are the potentials and limitations of centralised and decentralised systems in terms of enhancing women's empowerment?

RQ3 To what extent and how does women's involvement in electricity supply empower women as individuals and what is the impact of women's

inclusion in supply on the empowerment of women and girls in the wider community?

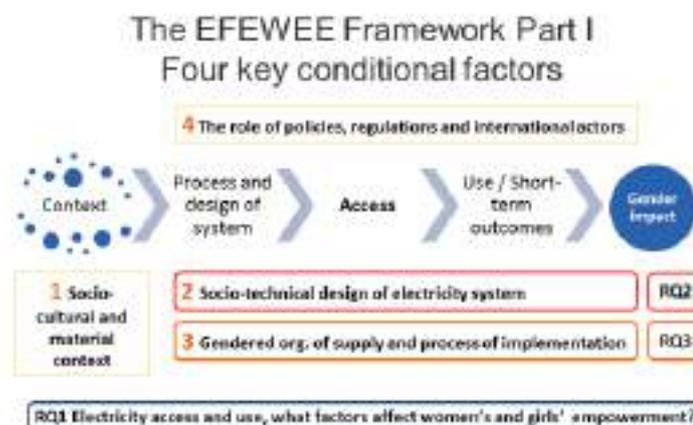
RQ4 How empowerment through electricity access may be conceptualised and measured?

1.2.2. Analytical framework

The framework that informs the analysis is rooted in social practice theory and socio-technical system theory. This implies that we put emphasis on examining the existing social practices (contextual conditions) into which electricity is introduced as well as the human-technology relationship both on the provision side and among end-users. Figure 1 outlines the first part of the framework, which largely complies with ENERGIA/DFID’s ‘causal chain’,⁴ except that we also scrutinise the socio-cultural context in the analysis. The emphasis on contextual conditions was motivated by team members’ previous experiences from ethnographic and qualitative work on electricity, and further strengthened through the work with the literature review (Winther et al. 2017). Based on our knowledge of the literature and previous ethnographic work, we then identified the hypothesis that four factors are particularly important in terms of electricity’s gendered effects (Figure 1):

- 1) the socio-cultural and material context;
- 2) the socio-technical design of the electricity system;
- 3) the process of implementation & management, staffing and ownership; and
- 4) policies, regulations, financing schemes and the role of international actors

Figure 1 Conditional factors for electricity’s gendered impact



The next part of the framework is how to analyse and measure the gendered impacts and women’s empowerment. We regard women’s empowerment as the process towards gender equality and our framework for analyses builds on Naila Kabeer’s work on

⁴ The five steps in the ‘causal chain between energy supply and impact’: (i) The organisation of energy supply (institutional organisation, design, technology), (ii) Supply of energy forms (availability, costs, reliability, quality), (iii) Access to energy services (energy and appliances), (iv) Use of energy services (productive and other purposes) and (v) Impacts of energy services on livelihoods and quality of life.

empowerment (1999, 2001) and more general social theory.⁵ The framework identifies three generic empowerment dimensions (Table 1): i) *overarching issues* such as rights, norms and social position, ii) access to *resources* and iii) *agency* (influence over decisions). In the rural contexts in question, women and men tend to have unequal access to such privileges, and we seek to understand whether electricity access in any way changed the situation by providing empowerment for women. In addition to the mentioned conditional factors, the framework also invites attention to negative effects as a result of the intervention, and women and men’s degree of involvement and agency in the realm of the intervention, both on the supply side and on the demand side (through their role as subscribers and end-users). It should be noted that women’s degree of inclusion in supply is regarded both as a possible conditional factor for women’s general empowerment (measured through the three generic dimensions) and as a separate criterion for measuring empowerment through an intervention. This follows from the presumption that women, and not only men, have a right to participate in the supply side.

Table 1 A framework for analysing women’s empowerment through electricity access (Retrieved from Winther et al. 2017, p.395)

Dimensions	Sub-dimensions	Conditional factors
Overarching issues Empowerment 1	Women’s and men’s rights	1 The material and socio-cultural context
	Gender ideologies and norms	
	Social positions	
Resources Empowerment 2	Material short-term opportunities	2 The socio-technical design of the system of supply
	Material long-term endowments	
	Social resources	
	Human resources	
Agency Empowerment 3	Influence over life decisions	3 The gendered organisation of supply and process of implementation
	Influence over everyday decisions	
Negative events	Negative effects of the intervention	
Agency in the realm of the intervention (electricity)	Influence over decisions regarding household electricity access	4 The role of policies, regulations and international actors
	Involvement in and influence over the system of supply	

Taken at large, the framework brings analytical attention to the underlying mechanisms for electricity’s gendered effects. To obtain good readability and avoid a schematic treatment of each of the elements embedded in the framework, the presentation of empirical results will follow the ‘causal chain’ from the supply through access and end-use. However, in the discussion chapters (9 and 10) we combine the framework’s central elements when discussing women’s empowerment through electricity in the selected contexts. For an elaborated treatment of how the framework was developed, which also answers RQ4 ‘How may empowerment through electricity access be conceptualised and measured?’, see Winther et al. 2017. In Chapter 11 of this report, we provide some reflections on its uses in the current work and in possible future research.

⁵ General social theory includes practice theory (e.g. Ortner 2006) and socio-technical systems theory (e.g. Rohracher 2006).

1.2.3. Empirical material: case study sites and methods

The empirical material was collected in selected geographical contexts in rural Nepal, Kenya and India. We selected two rural sites in each country, each with different systems of supply: central grid as well as various types of off-grid supply. Table 2 shows an overview of the six case study areas of which three were also included in a household survey (see below). Maps of the study sites are shown in Annex 3.

We adopt a comparative case study methodology, which is suited for producing contextualised, process-oriented and generalizable knowledge about how and why interventions produce a given set of outcomes (Goodrick 2014). The in-depth case studies in the three countries allow for comparison across countries, electricity provision systems and processes of implementation. In total, we studied 14 systems of supply in the three countries (Chapter 2). In addition, with the purpose of understanding how the issue of gender and various types of electricity access is regarded from the perspective of policymakers and national stakeholders, we conducted 25 interviews with national stakeholders (ministries, energy suppliers, NGOs), of whom three were met twice (Annex 7).

Subsequently, we returned to one rural site in each country to conduct a household survey: Dhading, Mahadhevsthan (Nepal), Homa Bay (Kenya) and Chhattisgarh (India). Again, the main criterion for selecting sites was to include areas with both grid and off-grid solutions with similar characteristics.

The total material comprises 245 qualitative interviews, 28 focus group discussions and 642 household survey interviews (Nepal: 220, Kenya: 207 and India: 215).

Table 2 Case Study Areas: Villages included in the qualitative research and survey.⁶

Country	District/county	Villages visited for qualitative research	Household survey
Nepal	Dhading	Mahadevsthan	Yes
Nepal	Tanahun	Ghiring, Chapakot	No
Kenya	Homa Bay	God-Bura, God Liech, Kiwa Island, Ligongo*	Yes
Kenya	Kitui	Endau, Ikisaya, Kalungu*	No
India	Chhattisgarh	Kacchardih, Mohda, Rawan, Bar*	Yes
India	Bihar	Mogalia Purandaha, Purani Garail, Rustampur, Laukahi*	No

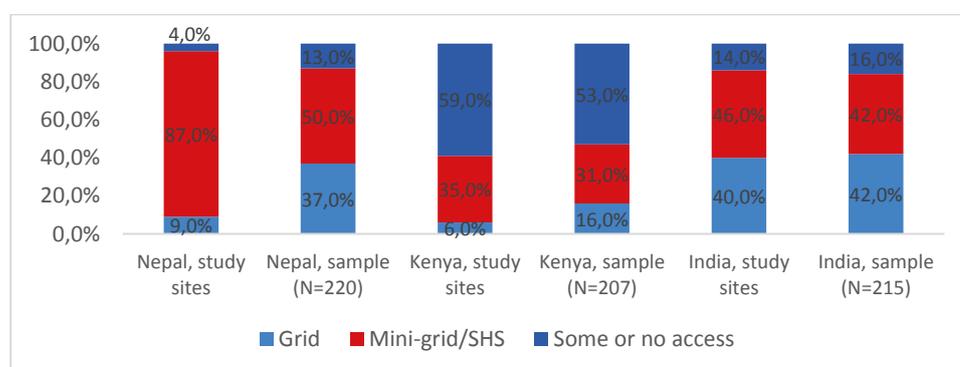
The survey data provide key findings of the study regarding the gendered organisation, control and use of electricity and appliances. Statistical tests were run to check for the statistically significant differences between groups, for variables where we compare men and women. We found that there is a significant difference between men and women in most key variables. The results also form an important basis for comparing the gendered

⁶ The sign * denotes villages with no form of organised electricity supply where most households have no access

contexts in which electricity was introduced. Apart from two restrictions (see below), *the survey results are representative of the respective case study areas but not of the whole country or state in which they were retrieved*. In the text, we nonetheless sometimes refer to the samples by country name for ease of reference. The results do not prove causality statistically (i.e. the impact of electricity access) within or across the three countries.

The survey samples are skewed in two ways. First, as shown in Figure 2, the share of households with access to electricity (whether grid, mini-grid or solar home systems - SHS) in the survey study sites differed considerably, spanning from 96% in Mahadevsthan (Nepal⁷) to 87% in Chhattisgarh (India⁸) and 41% in Homa Bay (Kenya⁹). Because we wished to compare households both with and without access in the survey, we decided to include a fair share of each type in the survey samples. This means that the sample is skewed in that, compared to the real situation, it includes a higher share of households without access in Mahadevsthan and a higher share of households with access in Homa Bay. In the Chhattisgarh sample, the shares with access in reality and in the sample were similar. The differing electricity access rates (slightly compensated by our inclusion of more households without access in Nepal) is reflected in that among 130 households without any kind of access in our total sample (642), 77% are found in Kenya, 18.5% are in India and only 4.5% derive from Nepal. This empirical finding also contributed to the revision of the initial ambition to compare households with various types of access (and no-access) for proving causality regarding electricity's gendered impact on a range of indicators. We discuss this in more detail in Chapter 11.¹⁰

Figure 2 Shares of populations in the study sites – versus households in the sample – with subscriptions to various types of electricity systems (Nepal, Kenya and India)¹¹



Secondly, to understand women's experiences thoroughly, the survey was purposively designed to include more women than men. As a result, 72% of the survey interviewees were women and 28% were men, and the sample is skewed towards women's responses. However, irrespective of the gender of the respondent, many survey questions related to information about women, men and other members in the households (e.g. 'Is the

⁷ This is higher than the Nepalese national average access rate (rural and urban) of 85% (IEA 2018).

⁸ This is higher than the national average (78%).

⁹ In the study location in Homa Bay, Kenya, 41% of the population have some form of electricity access (grid, SHS and, in a few cases, mini-grid connections). However, only 6% of the Kenyan households are registered with a grid connection, which is much lower than the national rural grid access rate (16%) reported in 2015-16 (IEA 2018:140).

¹⁰ Also, Annex 11 elaborates on the survey's limitations including how the high diffusion of solar home systems – and householders keeping several types of access – contributed to making it problematic to quantify electricity's gendered impact in a statistically robust way (prove causality). In other publications (Winther and colleagues, in progress, TERI et al., in press), we describe the overall sequence of data collection activities and the survey sampling design, respectively.

¹¹ The category 'Some or no access' includes 40 cases with batteries or solar lanterns, 4 cases in Kenya with standalone generator, and 130 cases, mostly in Kenya, with no electricity access at all.

woman in this household member of a woman’s self-help group?’). Therefore, a substantial part of the material concerns both women’s and men’s situations as reported largely by women. However, it should be noted that among the women who participated in the survey in Homa Bay (Kenya), a relatively high share (35%) were widows. This may slightly be influenced by our strategy to include more women than men in the sample. However, we have reason to believe that the share of widows in Homa Bay¹² is generally high and linked to the high prevalence of HIV in the area, which is at 26%, almost 4.5 times higher than the national average (National AIDS Control Council 2018). The relatively high share of widows in the Kenyan sample may thus be slightly higher than in reality, but it provides the study with a unique possibility to compare the situation of these women who tend to live without a male partner with the situation of other types of households. The women skewed aspect of the material will otherwise be discussed when relevant. Table 3 shows an overview of the gender of survey respondents and their marital status.

Table 3 Marital status of respondents, EFEWEE Survey

Marital status of respondents	Nepali sample		Kenyan sample		Indian sample		Total
	Women	Men	Women	Men	Women	Men	
Married	143 89%	53 90%	94 62%	49 88%	124 82%	58 91%	521 81%
Unmarried, widowed, divorced	18 11%	6 10%	57 ¹³ 38%	7 12%	27 18%	6 9%	121 19%
Total	161 100%	59 100%	151 100%	56 100%	151 100%	64 100%	642 100%

1.3. Outline of the report

Chapter 2 discusses the study contexts and how the 14 systems of supply were planned and set up. We focus in particular on the gender dimension and the extent to which women and men were involved in the process. Chapter 3 analyses the wider implications of two interventions which succeeded in including women in supply. Taken together, these chapters respond to the thesis that women’s inclusion in supply leads to women’s empowerment more broadly. The analysis of the material offers insights into the implications of conventional gender-neutral processes and the hindrances and success criteria for initiatives that result in women’s enduring involvement.

¹² We have not found statistics to document the general rate of widows in Homa Bay, Kenya.

¹³ Among these 57 Kenyan women, 4 were divorced and 53 were widowed, hence 35% of the 151 Kenyan women were widows.

Chapter 4 addresses another expectation, as articulated in one of the targets identified in Sustainable Development Goal number five on Gender Equality, that ending discrimination of women may be reached through improved infrastructures. The chapter maps the extent to which public services in the study areas were electrified and how and to what extent women and girls benefitted from improved services.

In Chapters 5 – 7 we turn to electricity access and use in people’s homes. We critically explore the assumption that the benefits of electricity access trickle down to women, lead to the uptake of time-saving appliances, reduce the time women spend on drudgery tasks and thereby result in their empowerment. For this purpose, we first analyse the gendered access to electricity (Chapter 5), the decision making process and location of electric light in people’s homes (Chapter 6) and decision making processes regarding the choice, acquisition and uses of various types of appliances (Chapter 7). Chapter 8 specifically investigates electricity’s uses for productive purposes, whether they are administered from people’s homes or through enterprises in the local communities and compares how women and men benefit economically by the use of electricity.

Chapter 9 takes an overall approach to answer the question (RQ1) on which factors enhanced and hindered women’s empowerment through electricity and how grid and off-grid systems fared in this respect (RQ2). Chapter 10 provides an overall discussion of the impact of women’s inclusion in supply (RQ3). Chapter 11 reflects on the application of the analytical framework and the study’s methodological limitations (RQ4), and Chapter 12 provides the study’s conclusions, recommendations and suggestions for policy and practice.

2. GENDERED STUDY CONTEXTS AND 14 GENDERED SYSTEMS OF SUPPLY

2.1. Three contexts

A central feature of this research is to explore how different characteristics of the socio-cultural and material contexts conditioned electricity's gendered outcomes in the studied sites. In line with the overall objective of the report, the purpose of scrutinising contextual aspects is to identify criteria for success and suggest measures that can help policymakers and practitioners overcome some of the barriers to women's empowerment through electricity. Details of the contextual analysis are provided in Annex 9, while the present discussion provides an overall summarised account.

The selected rural contexts in the three study countries have many shared characteristics but also differences. Farming is the most common source of livelihood in the studied rural locations in Nepal, Kenya and India, though in Homa Bay (Kenya), fishing and business activities imply more diversified livelihoods. In addition to agriculture, Nepali women in Mahadevsthan are often (70%) engaged in small-scale production and sales, and 57% of men in the area do the same). In Kenya, 51% of women in Homa Bay run small shops or registered shops/businesses and 14% produce and sell small things. Kenyan men are engaged in fishing (30%), employed (22%) and/or work as casual labours (20%). In the Indian sample (Chhattisgarh), both women and men tend to have casual jobs (69%). In the two Nepali sites, many men out-migrate to foreign countries, and in Bihar (India) it is relatively common for men to migrate to urban areas for work.

Across the three country case sites, there are several obstacles to women's empowerment that are rooted in patriarchal structures. First women have limited power to make major decisions (Annex 9.3), and there is an unequal distribution of long-term assets (land and houses) and income levels. Women in the Kenyan and Indian samples earn approximately 40% of men's income (insufficient data from Nepal). Also, in Nepal and India, younger women tend to have less decision making power than the older women do. Secondly, the women have had limited education opportunities among the adult segment. Looking at the differences between countries and the survey participant's level of education, a relatively high share of the Kenyan women (29%) and the Kenyan men (57%) have received education beyond primary school. The corresponding figures for Nepal are 8% for both women and men, and for India, 28% and 41%, respectively. Thirdly, across the sample, women are severely hindered in making changes in their lives due to the heavy burden of drudgery. Fourth, women in the study areas in Kenya face serious hazards such as food shortages and violence. Among 70 Kenyan households who reported to have experienced food shortage, 70% said that in such cases, the woman is the person who is the least likely to get something to eat. As many as 43% of the Kenyan respondents confirmed that women members of their households have been experienced physical risks when going to fetch firewood.

In general, poor groups of women and men, who are the majority of people in the study areas, live a much harder life than the wealthiest minority, not only in terms of lack of money and material resources but also the heavy workload that they bear.

When we asked interviewees what they associate with empowerment, people in all three contexts said they consider children's education as a tool for empowerment. They generally conceive empowerment as a process towards increased awareness and understanding, with some differences in the emphasis: awareness and understanding of one's rights (Nepal), agency and fight for rights as well as owning durable assets (India) and a combination of awareness, economic independence and the ability to become leaders and contribute to society (Kenya).

2.2. Planning and setting up 14 gendered systems for electricity provision

Overall energy policies addressing gender issues (Section 1.1.2 and Annex 10) barely affected the studied interventions, though international partners did have an impact on the gendered processes of implementation in two study villages. In total, we studied 14 systems of supply (Table 4 below). The overall picture is that in the case of grid extensions and mini-grid initiatives, gender-neutral policies led to male-biased interventions in that mainly men became involved in supply on the local level. Hence, our findings show that gender policies at the macro (and sometimes meso) level do not reach the micro level. Two out of four decentralised initiatives aiming to include women in supply had the intended effect. In Kenya, the picture is mixed when considering solar systems and microgrids offered by commercial players. We elaborate and discuss these results below.

In the Nepal study sites, men often played an active role in bringing the grid or a decentralised system to their areas of residence. In Mahadevsthan, a group of local men got together to start electrifying their homes after the authorities failed to support them. They arranged for poles to be installed, bought wires from the market and then requested the NEA to extend the electricity connection from the nearest grid transformer to their households. Households who could afford to pay for the poles and wiring paid the money and received connections. In Ghiring and Chapakot, men living in different wards formed a delegation and approached NEA in an attempt to get their wards electrified. Some wards, as a result, received grid electricity. Others were left out. One ward chose to approach BPC, a private provider, and others decided to wait because BPC electricity is more expensive than that provided by the NEA. Women were not a part of these delegations, but some were involved in the erection of poles.

The micro-hydro project in Mahadevsthan was initiated by AEPC through interactions with the community and a needs assessment exercise, resulting in the development of four micro-hydro projects in the area. AEPC financed the technical equipment and both women and men participated in the construction and installation work. The project's design specifically aimed to include women in supply so women were trained in the technical aspects of micro-hydro power through two lots of training: one in which only women were trained, and another which both women and men participated (50:50). Despite this, no women became involved in the supply in meaningful ways. The only occasion when women were involved in related work was when some women – who were not part of the two training cohorts – assisted with carrying poles, sand and other construction equipment during the construction work. In Chapter 10 we discuss possible reasons for the women's withdrawal/lack of inclusion despite the project's objectives. It

should also be noted that although the micro-hydro system in Mahadevsthan was designed to be owned and managed by the local community, this was barely realised. Of the 24 men and women chosen in the management committee, only two men now run operations and maintenance.

SHS was promoted in Ghiring through AEPC in line with the government's efforts to electrify rural areas. Different agencies such as Lotus Energy (a private firm), who was active in the study site, were mandated to complete this task. Lotus Energy trained and certified local men (but not women) to become technicians able to install and manage the systems.

Overall, in the Nepali study sites, men were much more present and involved in the implementation and operation of the electricity system, at least at the start. When women were involved in supply, it was primarily because their participation/representation was mandatory, as per AEPC policy.

In Kenya, in the grid villages in Homa Bay and Kitui, only men are involved in installations, operation and maintenance. There are women employed in Kenya Power but reportedly, for reasons of security, most of them work in offices in central places, not in the field doing the installation and maintenance work. Among the private systems offered, men seemed to be in the majority. However, both men and women were involved in the sales of private solar home systems in Homa Bay, especially in the sale of BBOXX and M-KOPA products (a range of pay-as-you-go solar home systems) of which some sales agents are women. The BBOXX retail supervisor for the area and the Kenya Managing Director are women.

The solar projects in God Liech (SHS, Solar Mamas) and Ikisaya Energy Centre were set up with an explicit purpose to include women in the supply. The systems also differ from the grids and mini-grids in that they engaged local people as staff. International actors played a key role in these initiatives. In God Liech, the project was set up by Green Forest, an NGO with Dutch support based in Magunga, following the Barefoot College model where only middle-aged or older women from a village were recruited and trained for six months as solar engineers at the Barefoot College in India. The Ikisaya Energy Centre was set up in collaboration between the village and the University of Oslo (including members of our research team). Here, women gradually came to take a more active role, leading the Board (with 50% representation of women and men) to hire a woman Manager. In recent years, the Centre has only hired female candidates for vacant positions.

In Chhattisgarh, India, the process of providing grid electricity to the study village only included men, both on the provision side and on the user side (men attended meetings and obtained subscriptions). Both women and men reported that women who qualify as engineers and technicians prefer desk jobs and look for postings in urban or semi-urban areas, not villages because they would have difficulties balancing work in rural areas with their own household responsibilities. Hence, family life and women's preferences were said to make women avoid taking up such field roles. In Mogaliya Purandaha, the studied grid village in Bihar, the role of women in supply was also limited to administrative jobs. A female junior engineer and a female messenger were working at the district level office. However, they said they did not wish to be employed as field staff due to the difficulties in commuting to the sites, and lack proper of facilities like health and education in rural areas, which they perceived to be unfavourable working conditions.

When a village in Chhattisgarh is selected for electrification through a mini-grid, a (male) engineer from CREDA engages with the community and surveys the village to assess the load demand and finalise a suitable location. Companies are employed by CREDA to install the mini-grid. During community mobilisation at the villages visited, only male officers from CREDA had been involved and they interacted only with the men in the villages. The installation work was also solely carried out by CREDA without the involvement of men (or women) from the village up to when the mini-grid reaches the door-step. The operator of the system and the technicians and helpers who were employed by CREDA, were also men, as were the technical staff in the (central) CREDA office, where women were only involved in administrative jobs.

In contrast, the systems for providing electricity through SHS in Bihar were designed to include women. Only women members of self-help groups (SHG) could purchase the SHS system, and the women received a loan referred to as an 'Energy Security Credit' through the JEEViKA project. A list of interested women consumers was prepared, after which the system was designed and installed by a male technician. Some women had been offered technical training to engage in installations of the systems, but the prevalent cultural norms prevented them from taking up such electricity/technical related jobs.

Table 4: The 14 studied systems for electricity supply

	Country	State/ District/ County	Village/ VDC	Type of system	TIER	Implement. approach	Gendered involvement in practice
1	Nepal	Dhading	Mahadev – sthan	Grid (7 years)	4-5	Gender-blind	Only men involved
2	Nepal	Dhading	Mahadev – sthan	Micro- hydro/ mini-grid, SHS	2-3	Gender balanced committees	Only men involved (2 men from the 24 member committee)
3	Nepal	Dhading	Mahadev – sthan	SHS	1	Gender-blind, top- down	Only men involved
4	Nepal	Tanahun	Ghiring	Grid (14 years, Govt./ Pvt.	1-4	Gender-blind, top- down	Only men involved (as technicians, for meter reading and billing)
5	Nepal	Tanahun	Ghiring, Chapakot	SHS (15 years)	1-3	Gender – blind	Only men involved (as technicians, local salesman)
6	Kenya	Homa Bay	God Bura	Grid	3-4	Gender-blind, top-down	Only men involved as field technicians
7	Kenya	Homa Bay	Kiwa Island	Micro- grid (Pvt.)	3-4	Gender – blind top- down	Mainly men involved
8	Kenya	Homa Bay	God Liech	SHS	1-2	Women targeted, local participation	Mainly women involved
9	Kenya	Kitui	Endau	Grid	0-4	Gender – blind, top- down	Only men involved as field technicians
10	Kenya	Kitui	Ikisaya	Energy Centre	0-1	Gender balance local participation	Both women and men involved, gradually only women recruited
11	India	Chhattis- garh	Kacchardih	Grid	3-4	Gender-blind, top-down	Men involved in technical work, women: Admin staff in central areas
12	India	Chhattis- garh	Mohda, Rawan	Solar, mini-grid (CREDA)	1-2	Gender-blind, top-down	Men: technical work, women: Admin staff
13	India	Bihar	Mogalia Purandaha	Grid (8-9 years)	2-4	Gender blind, top-down	Men: technicians, women: Admin and tech. staff in central areas
14	India	Bihar	Purani Garail, Rustumpur	SHS (JEEVIKA)	1	Women’s groups targeted, local participation	Systems registered in women’s names, but not involved as staff

3. WIDER IMPLICATIONS OF WOMEN'S RECRUITMENT IN LOCAL SUPPLY

3.1. Implications of the two women-targeted interventions

We now take a closer look at the two Kenyan decentralised initiatives in which women became involved in management and supply. These interventions were also attuned towards women end-users.

It was an important premise for the socially smooth implementation and the wider effects of women's involvement in the supply that there were no existing electricity systems available in the village. When the Solar Mama project was introduced in God-Liech (and Olando), some community members had been sceptical towards the focus on women, but the leaders supported the project because they wanted to get access to the electricity the project would provide. We were told that the husbands of these women were positive because it provided them with experience and income opportunities. As far as we know, there were minor complaints from men that just women were being provided with such an opportunity.¹⁴ Only women were recruited in the project.

According to a woman 'Mary' (all names provided are pseudonyms), a wider effect of the project was that perceptions of a woman's capabilities changed in the village:

Mary: [Women's] contributions in [village] forums have been very rare. Even in politics, people tend to concentrate on men rather than women. But after we initiated our project here, many now believe that women can do it. The women climb the roof, they put the solars, they do the connections, and they do the repairs within the system.

In a similar way, Paul, a resident in the village, told us how he had personally changed his views on women because of the intervention:

Paul: I did not believe in this project. I could not even believe that the women would go to India and become engineers. Further, I could not even believe it when the materials were brought in parts and the women who went to India were to assemble the parts, but later I realised that even women can do this, and the work has been going on up to now.

On their side, women involved in supply said they consider themselves as role models, changing people's perceptions of what women can do, as explained by Elizabeth:

Elizabeth: Yes, it has changed the thinking of the community, men respect women and women feel proud of themselves. I have managed to fix a fridge that uses solar in my house and the community is wondering about this.

Interviewer: Do you sometimes help customers with other electric equipment?

¹⁴ One participant from God-Liech withdrew from the plan to go to India in the last minute, but her reasons for doing so are unclear.

Elizabeth: Yes, so many do call us to help them and give advice.

Interviewer: Do you sometimes move outside God-Liech village to work elsewhere?

Elizabeth: Yes, in school, homes and centres.

In this sequence, it is significant that she mentions her ability to fix the fridge to exemplify why men's respect for women has increased. According to her, being an expert in matters of importance is key to changing gender norms.

The two Kenyan projects recruiting women positively affected men's beliefs in what a woman can do, hence existing gender norms were challenged and changed. Women's involvement also had the perceived effect that the quality of services improved (less theft, more efficient revenue collection) with the effect that the system's viability increased. However, these two systems initially aimed to create economically self-sustaining systems and were set up in collaboration with external organisations (rather than forming part of established organisations). Also due to increased competition from private solar companies, there is a risk that these initiatives, despite 5-8 years of enduring supply, will cease to exist in the future.

3.2. Perceived implications of observing women staff in the villages

During the household survey, we asked respondents in Nepal and India (but not in Kenya)¹⁵ *whether* they had (ever) observed women and men being involved in electricity supply in their village – the systems spanning from grid and mini-grid to the provision of SHS and other small-scale systems. It is likely that people associated such involvement with both technical and administrative staff. In the Indian study villages, nobody had observed women involved in supply. In Nepal, 28% (n=220) confirmed, and the majority of these were located in the mini-grid area in Mahadevsthan (following AEPC's partly successful gender approach), who 65% (n=49) said they had seen women involved in supply. In the grid area in Mahadevsthan, 17% (n=171) had observed women in supply.

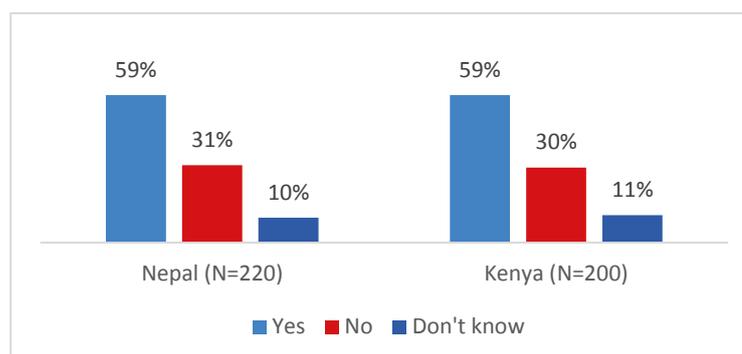
In all three countries, respondents were asked whether their observation of women in supply was the *first time they had ever witnessed women holding this kind of position* or responsibility. Both in Nepal and Kenya, almost 60% confirmed (Figure 3).¹⁶ These results may reflect a mix of hypothetical and experience-based answers, particularly in the case of Nepal.¹⁷ In Kenya, the presence of women vendors of SHS (including the Solar Mama project in God-Liech) and other solar services contribute to this relatively high share of observations of female staff.

¹⁵ This question was not asked in Kenya because it was not included in the questionnaire. In Nepal and India, enumerators explicitly asked this question and registered people's answers. However a follow on question about whether this "was the first time" they observed women being involved was asked in all three country contexts.

¹⁶ Based on the many Kenyan responses to the question of this "was the first time" they observed women in this kind of position, we deduce that seeing women involved in supply is equally common.

¹⁷ For Nepal, it seems strange that more people answered confirmative to the second question ("was this the first time you witnessed", Nepal: 130 responses confirmed) than the first question ("have you ever witnessed women in supply", Nepal: 61 confirmed). This indicates that (some) people might have responded hypothetically to the question regarding "first time", possibly having witnessed women in supply in other places. Alternatively, they were influenced by the enumerator mentioning the possibility of women being included, which may have increased the number of confirming answers.

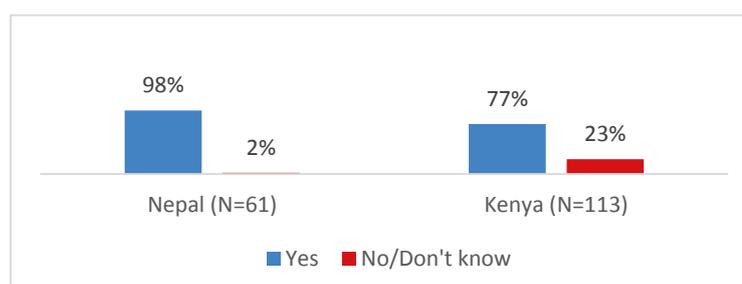
Figure 3 Answers to survey question (Nepal and Kenya): “Was this the first time you witnessed women holding this kind of position/responsibility?”



Similarly, when in need of assistance from the energy company/agency, Nepalese grid customers said they only receive assistance from male staff. Conversely, among 119 mini-grid customers (i.e. in areas where AEPC’s gender policy applies), 35.5% reported being assisted by a woman.¹⁸ In Kenya, men dominate customer support services, though 41% of grid customers say they receive assistance both from women and men, while 10% of the SHS homes are uniquely assisted by women staff.¹⁹

In terms of the potential effects of women’s inclusion in supply, Nepali and Kenyan survey participants were enthusiastic, and women and men’s answers were similar (Figure 4). In Nepal, 98% (60) of the 61 who responded, i.e. 27% of the total sample, confirmed that women’s involvement in supply has changed the way they think about women. In Kenya, 54% (113) of the total sample responded. Among these, 77% (87, i.e. 42% of the total Kenyan sample) confirmed that they have come to think about women in a different way. In God-Liech, the village with the Solar Mama project, 11 of 13 responding (84%) said the same.

Figure 4 Answers to survey question (Nepal and Kenya): “Has observing women in supply changed the way you think about women and what women can do?”



One may critique this result by saying that we posed the question in a leading manner. However, all the confirming Kenyan respondents (87) provided supplementary answers about women’s capacities: some pointing to gender equality, for example, “women nowadays are equally capable as men”, and others indicating how this can be achieved (e.g. importance of education for all children). Some mentioned electricity specifically,

¹⁸ 47.7% mini-grid customers are assisted by a man. In the whole Nepali sample (n=190 responses), 17.4% said they do not receive assistance.

¹⁹ Among 29 Kenyan households with grid connection responding to the question, 41% (12) receive help from both women and men staff, while 58.6% (17) only get assistance from a man. Among 52 households with SHS and mini-grid connection (only 6 cases), 9.6% are uniquely assisted by women, 56% by men and 17% by both women and men.

saying women can do electricity-related work. In Nepal, 34 respondents (25 women and 9 men) elaborated on this question, most of them giving general declarations/normative statements about women capabilities being the same as men. Moreover, the qualitative interviews and observations over many years in the Kitui case support the same point.

We also asked whether women's involvement in supply has affected their aspirations for girls. In Nepal 64% (39) of those responding (n=61) were positive, thus 17% of the total sample (n=220). In Kenya, 85% (96) of the 113 responding confirmed, which represents 45% of the total Kenyan sample (n=207). Again, female and male respondents expressed similar views.

We take these results to show that in communities where women have been included in electricity supply on the local (micro) level, this engagement has been noted by their co-villagers. Furthermore, a significant share of the studied populations in Nepal (ca 20%) and Kenya (ca 40%) confirm that women's inclusion has impacted the way they think about women and/or the aspirations they have for their daughters.

4. ELECTRICITY: FAILING TO IMPROVE THE QUALITY OF PUBLIC SERVICES

The Sustainable Development Goal number 5 identifies improved infrastructure as one of its targets for ending discrimination against women. Numerous studies on rural electrification (e.g. IEG 2008, Winther 2008, Matinga 2010), have documented a positive effect of electrified public services, particularly on women and girls. For example, investments in electric water pumps, water pipes and village taps in rural Zanzibar had the immediate outcome of significantly reducing women and girl's drudgery (no need to fetch water from wells located outside the village). Secondly, because girls no longer needed to help their mothers fetching water, they were instead sent to school to the same extent as boys (Winther 2008). Similarly, examination light, cooling of medicine and water boilers for sterilizing equipment led to improved health facilities in the villages (ibid.). In both cases, the changes enhanced by electrified public services increased the human resources of female community members, in particular, contributing to their empowerment.

This chapter sets out to examine to what extent public services in the studied locations had access to functioning supply and for what purposes electricity was needed and used. We treat schools, water supply and health services, and mobile phone diffusion and internet connectivity.

4.1. Schools

Across the studied villages in the three countries, there are numerous government primary schools and a few secondary schools.

In our survey material, Kenyan children are most likely to attend secondary school, with Nepal coming second and India third, see Table 5. In all places, girls attend school to a slightly lesser extent than boys. Below we present and discuss the schools' level of access to electricity and the impacts on the quality of the education facilities.

Table 5 Share of girls and boys aged 13-17 attending school (EFWEE Survey)

Share attending school	Nepal sample	Kenya sample	India sample
Girls 13-17 years old	79.2%	93.2%	86%
Boys 13-17 years old	65.6%	92.2%	82.1%

4.1.1. Nepal

In Nepal, the utilisation of electricity in schools, whether supplied through the grid or through off-grid sources, differed. In Ghiring which also hosts a private boarding school and a Sanskrit teaching school, parents complained about the quality of the education and said that those who can afford it prefer to send their children (most often boys) to better schools in nearby towns or cities. Because there are no options for higher education at the village level after Grade 12, many children, especially girls, abandon their studies at this point, and only a few (boys) pursue higher studies in cities such as Kathmandu or Pokhara.

The grid-connected school in Mahadevsthan barely used electricity for educational purposes as they had no electronic equipment except a sound system that was just used occasionally. Bulbs and fans were not necessary for classrooms as they had ample natural light during daytime and were already well ventilated. There were no evening classes. Teachers used electricity for charging their mobiles but students did not have access to electricity within the school. However, due to the availability of lights and mobile charging services, the school premises were regularly used as accommodation for visitors. Conversely, the grid-connected school in Ghiring made use of grid electricity to run fans in classrooms and a computer for students. It also had plans to add more computers and other appliances eventually, if the supply would become more reliable over time.

One of the schools we visited in Ghiring had a solar PV system that was initially used to run computers in addition to lights and a sound system for extra-curricular activities. However, the solar system worked well only in its first year and has more recently not been used for any purposes except by teachers to charge their mobile phones.

In both study areas, teachers reported that the enrolment rates and student performance (marks) were unaffected by electricity access (both in the schools and in the children's homes). Teachers in the Nepal study areas claimed that students with access at home tend to do their homework more regularly than those without access and spent less time doing house-work. Our survey results show that girls spend more time than boys doing homework when they are in primary school, while in secondary school, boys study more.²⁰

Table 6 Characteristics of supply in schools (Nepal)

Nepal	Grid-connected schools	Schools with SHS or other decentralised
No of schools visited	2	2
Reliability of supply	Good in Mahadevsthan (MDV) Below average in Ghiring – frequent transformer failures	- Poor (SHS only worked for a year), only mobile charging possible - Good for micro-hydro but only one bulb is available
Night classes	No	No
Boarding facilities	No	No
Electricity's applications	<u>School 1 (Mahadevsthan)</u> Sound system (no other equipment available) Teachers charging mobiles Light and mobile charging: accommodation for visitors <u>School 2 (Ghiring)</u> Fans in classrooms Computer	<u>School 4 (Ghiring)</u> Computers, light, sound system. More lately (poorly functioning): only for teachers charging mobile <u>School 3 (MDV micro-hydro)</u> has light in head teacher's office, but hardly used because work is during day hours when daylight is sufficient
Teachers' assessment of enrolment (incl el access at home)	No impact	Not stated
Teachers' assessment of student performance (in el access at home)	Without el at home and long distance: less study time. But similar performance	With el at home, children study more, but the impact on performance not stated

²⁰ In the age group 7-12 in Nepal, 86% of girls and 79% of boys do homework up to 1 hour per day. In the age group 13-18, 47% of girls and 49% of boys do homework for 1-2 hours. Annex 8 provides details.

4.1.2. Kenya

In schools with a connection to the grid in the two study sites in Kenya, the reliability of supply was a general problem. The table below gives an overview of the situation.

Table 7 Characteristics of supply in schools (Kenya)

Kenya	Grid-connected schools	Schools with small SHS or no access
No of schools visited	5	3
Reliability of supply	<p><u>School 1 (God Bura Prim. & Sec.)</u> Not functioning. Back-up: diesel generator (costly)</p> <p><u>School 2 (God-Liech Prim.)</u> Stopped functioning after 11 months. Back-up: SHS (small system)</p> <p><u>School 3 (Endau Prim.)</u> Not functioning (only 2 months' supply in 2016). Back-up: solar lanterns (paid for by parents)</p> <p><u>School 4 (Ikisaya Prim)</u> Poor, only supports mobile charging. Back-up: used to rent lanterns from Energy Centre, and continues to use their photocopy services.</p>	<p><u>School 5 (Ligongo Prim.)</u> Transformer installed in May 2015 close to school, but school (and households) not yet connected (2016 October).</p> <p><u>School 6 Endau Sec.)</u> Waiting for connection</p> <p><u>School 7 (Kalungu Prim.)</u> Small SHS (Grid did not reach village)</p>
Night classes	No	
Boarding facilities	Was tried in Endau Primary; God Bura Secondary	

Where the grid proximate schools do not have access, it is either because there has been some sort of electrical fault (with an uncertain timeframe and pathway to resolution) or simply that the last few metres (e.g. from the transformer to the school) have not been connected. Only in one case (Kalungu) is the grid too far away for the school to be connected. Implicit in all of these situations are the high cost burdens to the schools, the education system and to rural electrification – whether to school budgets (expensive diesel generators; seeking additional funds to their existing budgets for back-up solutions) or the opportunity costs and social costs incurred to education targets by having no or inadequate sources of electricity.

Teachers highlighted the potential impacts of the available (though limited) supply in terms of student performance, often in combination with an expected positive impact of having electricity access at home. The ability to offer boarding facilities is negatively affected by a lack of electricity. These facilities are seen as important especially for the exam years that impact upon whether students proceed to higher schooling.

The effects of introducing boarding facilities in Endau Primary School (Kenya) constitutes our most concrete evidence on electricity's positive effect on children's performance. The school started to provide boarding facilities for Class 8 in 2010 in order to enhance children's performance before applying for Secondary school. The parents were supposed to pay for the extra expenses. The cost of lighting was perceived to be substantial (they were using "gas cylinders").²¹ In 2013 the parents felt that the economic burden became

²¹ The teachers receive a symbolic payment and he described the boarding as voluntary work.

too much, and the boarding programme was stopped in 2014 and 2015. With the expectation that they would receive free electric light from the government through the grid, they re-started the programme for Class 8 in the second term 2016. Supply lasted for just two months. When the power went off, they rented two solar-charged lanterns from the energy centre (agent in Endau) and used these for a few weeks.²² However, the parents thought that hiring lanterns was too expensive. So for the third term, the teacher reported that there was no boarding programme. He had noticed that the children performed better when the school provided boarding facilities and was worried that the marks would go down again, and this would negatively influence their chances of proceeding to Secondary school. He provided the figures from the school records (Table 8), which show the changes in the children’s performance from term 1 to term 2 for this particular cohort 2016, i.e. the same children included in each term. Out of maximum 500 points, 250 was considered to be the required level of the score to be able to enter Secondary School.

Table 8 Test results, Class 8, Endau Primary School, 2016

Total number of students class 8: 51	Term 1 2016 Jan.- April No boarding	Term 2 2016 May-August Boarding (grid el + lanterns)
Students above 250 points (max 500 points)	14	37
Girls above 250 points	8 (of 19 girls)	19 (all the girls)
Boys above 250 points	6 (of 32 boys)	18 (of 32 boys)

To explain this improved performance, particularly among the girls, the teacher said that having a boarding school allows the teachers to give the pupils extra coaching and improve their performance. It enables the teachers to finish the new content earlier in the term so that the pupils get more time for revision before the exams. It is also likely that boarding school allows girls to focus on studying as they do not have to engage in domestic chores after classes, which they would have to do if they commuted daily from home.

4.1.3. India

In the study areas, the visited schools used electricity for light and for running electrical appliances like projectors, computers and fans.

²² The first term lasts from January – April and the third and last term started August 29th in 2016 and goes on until Christmas.

Table 9 Characteristics of supply in schools (India)

India	Grid-connected schools	Schools with SHS or other decentralised
No of schools visited	1 (Chhattisgarh) 2 (Bihar)	2 (Chhattisgarh)
Reliability of supply	School 2 (Bihar): poor School 3 (Bihar): Lacked wiring, no supply	
Night classes	No	No
Boarding facilities	No	No
Electricity's applications	<u>School 1 (Chhattisgarh)</u> Light and computer (plans for projector, TV) <u>School 2 (Bihar)</u> Lights to keep dogs away at night and during festivals	<u>School 4 (Chhattisgarh)</u> Fans, projector <u>School 5 (Chhattisgarh)</u> Occasionally borrowed SHS from Panchayat office to run lights and fans
Teachers' assessment of enrolment	No impact	No impact
Teachers' assessment of student performance	No impact (but electricity access at home has a positive effect on study time)	No impact (but electricity access at home has a positive effect on study time)

The teachers across both study sites said that electricity at home helps students devote more time to homework. It has also enabled mothers to sit with their children, even if they themselves were not educated, and ensured that they paid attention to studies. Students from senior classes also reported that they find lights particularly comforting during exams where they have to spend more hours on preparations. However, the teachers in both the states noted that electricity at school had no bearing on the enrolment or retention rate of boys and girls. The teachers further noted that the motivational levels of girls were higher than boys and they fared better in schools. Yet, we found that parents did not encourage their girls to pursue higher education as their priority was to get the girls married by the age of 20 to the groom of the parents' choice. Teachers we interviewed had the same impression.

In sum, these results show that electrification of schools, whether through the grid or off-grid systems may lead to a better learning environment, but a key condition for this is reliable supply. With unreliable supply, the cost of complementary energy sources (back-up) becomes the responsibility of the individual school or parents. Another condition is that equipment and appliances for enacting the possibilities are available, and it seems to be partly contextually dependent what purposes are desired. In Chhattisgarh, India, where there is a hot season, fans were considered necessary. In Nepal and India, sound equipment and projectors were called for, while in Kenya, access to digital content was an expressed demand. As to the impact on children's enrolment and performance, the teachers we interviewed perceived that household electricity access increased study time, but nobody thought there was a connection between enrolment rates and school electrification. In addition, boarding facilities can impact on children's performance and possibly help reduce a serious problem in rural Kenya: children's risk of violence when walking outdoors at night time.

4.2. Water supply and health care services

4.2.1. Water supply

The water supply systems in the Nepali and Indian study areas are much more developed than the ones observed in Kenya. In Nepal, both sites are located close to natural water sources, and the extraction of water is facilitated through various types of electricity supply. In Mahadevsthan, relatively well-off households have private hand pumps while the poorer fetch water from community boreholes or wells. The earthquake of 2015 damaged some water supply systems, which significantly affected water access. In Ghiring households in the grid-connected wards of Chapakot had access to piped water and supply driven by electric water pumps. Here, two or three homes shared one tap and paid a monthly fee to the landowner. In the wards of Ghiring located on the upper belts (where SHS was provided to households), the water supply had been facilitated by a solar-powered pumping (water-lifting) plant, but the plant had broken down forcing villagers to walk long distances to fetch water.

In the Indian study areas, water supply is managed (without electricity) through hand-pumps. In Bihar, hand-pumps were present in almost every household, located in their front yard and were accessible to all the family members. In the grid village (in Bihar) some of the households, who could afford it, had installed diesel-run motors to supply water. Generally, the sources of water were within the household premises; women did not have to spend much time travelling to fetch water. In contrast, in the villages of Chhattisgarh, the stand posts (i.e. public hand-pumps used for drawing water manually, free of cost) were located at different points in the village, from where women and girls would fetch water (see Annex 9.5).

In contrast to these relatively well-functioning systems for water supply in Nepal and India, the Kenyan water supply and reticulation infrastructure in Homa Bay and Kitui have severe shortcomings. In addition, many people have to pay for water consumption. Households collect water either from centralised water points (boreholes with sometimes limited/rationed piped water in market centres, water tanks in clinics, schools or other public facilities) or directly from water sources such as lake Victoria or shallow wells. There is some water infrastructure in place in Homa Bay, such as the Gwasssi water project running from the hill to the lake, supplying institutions such as the schools along the way. However, the systems are not always functional. Similarly, in Ikisaya village, Kitui County, there are two water points run by a diesel generator and water pump located outside the village. This system provides some water to people who live far from the main water point, where pipes from a hill leading to a village tap. However, the generator suffers from unreliability issues, which limit supply. In addition, water is often rationed (20 litres per day for a typically sized household).²³

A striking finding across the three country sites is that electricity has not brought significant improvements in people's access to water services. In most cases, the water supply was not targeted for electrification. When it was, the failure to improve services

²³ In another publication (Winther et al. in progress) we describe how a woman, when coming to collect water from a river in Kitui, Kenya, must always wait until the cows of the male owner of the spot have finished drinking. This triples the time she spends collecting water (from one hour to three hours per turn).

did not derive from limited capacity in the electrical systems, but from irregular and poor quality supply together with a lack of investment in water infrastructure.

4.2.2. Health care services

In the Nepal case study areas, the government provides basic health care services through ward-level health posts. The health post in Mahadevsthan is slightly better than the one in Ghiring, as it has a proper building, is electrified through a micro-hydro power plant and has a solar power backup for use in emergencies. The post caters to general outpatients, provides medication, immunisation and vaccination services. It also has a maternal health services unit with a birthing centre. In Ghiring, where the main health post is under construction, a sub-health post currently provides basic medical services like first aid for injuries, family planning information and assistance during deliveries. The sub-post was connected to the national grid in early 2017, but due to frequent and extended power cuts caused by repeated transformer breakdowns, they are unable to utilise the grid electricity.

In Kenya, there is a stark disparity between the health services available in the two study sites. In Homa Bay, there are several clinics, most of which have been connected to the grid. Due to unreliable supply, however, some have tried to meet the demand for services by adding small solar power systems or lanterns. The most important services that are hindered by the unreliable grid power are lighting (important for maternal deliveries and any medical emergencies at night) cooling facilities for storing vaccines and blood and running laboratories for bloodwork diagnostics.²⁴ In two of the villages in Kitui (Ikisaya and Kalungu), the government has not provided public dispensaries, hence health services are extremely poor and health workers must improvise.

Within the Indian sites, health services were good in Chhattisgarh but poorer in Bihar. In Chhattisgarh, a health centre established by the government offers basic services, providing consultations to outpatients, medication, and a labour room with trained staff. Trained government health workers, called *Mitanins*, are present in all the studied villages, to raise awareness about health and reproductive issues. For emergencies, patients are referred to a government hospital with better medical facilities, 10-15 km away. This hospital has a reliable grid connect the power supply and also has a power back up. In Bihar, however, the health care facilities were observably poorer, as none of the villages had an operational health centre or clinic in their vicinity, and community health workers were absent.

In sum, electrified public services, which potentially may help women reduce drudgery and access better healthcare, have only partly occurred in the case in Mahadevsthan, Nepal (water supply, health clinic), and in Chhattisgarh (health clinic), India, but not in the other sites (none of the sites in Kenya) primarily due to unreliable supply and lack of general water and health facilities.

²⁴ The health clinic in God Bura was connected to the grid in 2013 and from 2014 it also got access to solar power through a system with limited capacity supported by the Red Cross. Staff at the clinic said that the reason why they obtained the solar system was that the grid was unreliable and they needed a reliable source of electricity to keep vaccines cold. During power cuts (grid), additional measures such as kerosene and LPG lanterns are also used in the maternity wing, which attends to 13 women per month in average (K-Hom-GB-8_M).

4.3. Mobile phone diffusion and internet connectivity

Mobile phones are an extremely prominent communication resource for people living in rural areas in the three study countries. Table 10 summarises the prevalence of phones in our survey sample and the gendered reported ownership to the devices.

Table 10 Occurrences to mobile phones and gendered ownership (EFEWEE Survey)

Mobile phones and connectivity	Share of hh who keep at least one mobile	Number of phones on average ²⁵	Mobile owned by women ²⁶	Mobile owned by men ²⁴	Mobile owned jointly/by others ²⁴
Nepal (Mahadevstan)	80% (175/220)	1.70	35% (88/251)	36% (89/251)	29% (74/251)
Kenya (Homa Bay)	91% (189/207)	1.62	53% (161/306)	41% (127/306)	6% (18/306)
India (Chhattisgarh)	68% (146/215)	1.03	3% (4/146)	93% (139/146)	4% (7/146)

In rural Nepal, with the high migration rates of men moving abroad for employment, mobile phones are vital communication devices that help families remain in touch with each other. In both study sites, the penetration and use of mobile phones were widespread among women, men, youth, elderly and even children. The advent of electricity sources like the national grid, micro-hydro and solar home systems has made it possible for users to charge their mobiles at home, and this added convenience has boosted mobile usage even more. Network connectivity and internet access were available in both study sites, as people were using mobiles phones for video calling, Facebook and Youtube. Community health volunteers were also provided mobile phones to be accessible to and in constant touch with patients.

People's embracing of the mobile phone is similar in Homa Bay (Kenya), where phones have almost become universal (91%). The relatively high share of women owners (53%) should be considered in light of the high share of widows in the Kenyan material (35%) and the fact that women respondents constitute 72% of the Kenyan sample. When only considering the answers of Kenyan married respondents, the share of Kenyan women mobile owners declines to 45%, while 50% have men owners and 5% are either owned jointly or by other people. In both Kenyan study areas, women and men use their mobile phones extensively for mobile money transfer and banking services. The Kenyan sites have varying internet connectivity and the use of social media are not as yet so prevalent among adults we met, though people are aware that they can access the internet using smartphones, which youth increasingly own.

In Chhattisgarh, two-thirds of the sample keep a mobile phone. They are generally owned by men (93%) but said to be used for communication by all family members. However, poor network (mobile and internet) connectivity in the Chhattisgarh off-grid villages hindered their diversified usage. In Bihar, the grid village had good internet coverage and some of our respondents made use of their smartphones to watch news, movies, and videos. It was also reported that some farmers (mostly men) could get assistance on

²⁵ Number of phones among households who keep at least one mobile (not total sample).

²⁶ The distribution on ownership relates to the total occurrences of mobiles (sometimes more than one per household). For example, in the Nepali sample, the total number of mobiles reported was 251. Of these, 33 were owned by a woman (35%), 89 were owned by a man (36%), and 74 were said to have joint ownership (29%).

agriculture-related activities from 'farmers' helplines' on the phone. However, mobile phone-based online banking services were not in use in any of the studied Indian villages.

5. THE GENDERED ACCESS TO ELECTRICITY

It is often anticipated that household electrification will benefit all members, and particularly women, who tend to spend much of their time working at home. Current targets for increased access rates (cf. SDG 7) treat households as homogenous units, which is obviously a simplification of realities. In this and the three following chapters, we explore the 'gender' of electricity demand – from household connections and subscriptions to the location of lights in people's homes (Chapter 6), their choices of appliances (Chapter 7) and their uses of electricity for productive purposes (Chapter 8). We will pay particular attention to gendered decision making patterns, as these were reported in the three survey study contexts.

Chapter 5 starts by mapping the availability, regulations, costs and reliability of various systems of provision. Then it explores what kind of households have access to electricity and end with an analysis of who in the household becomes the subscriber and pays for consumption.

5.1. Availability, costs, capacity and reliability

The surveyed populations in Nepal and India do not have much choice in the type of supply. There is normally only one system available in a given village or ward, provided through top-down managed provision systems. In Kenya, there is a multitude of systems offered. Here, the choice of energy carrier is shaped by availability, costs and end-user financing.

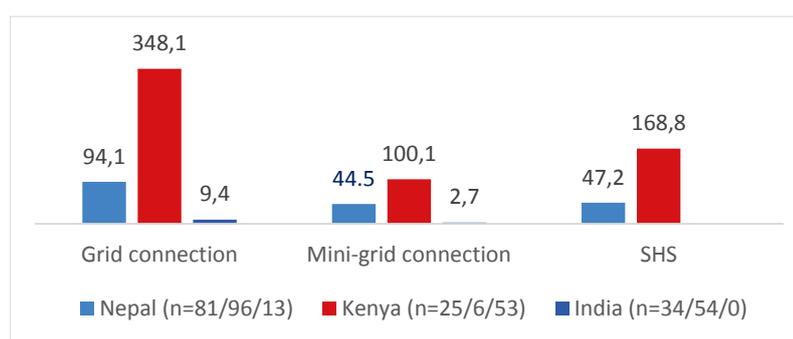
Both in Nepal and India, the generally high access rates reflect that electricity, through different types of subsidies, is made affordable to most households (in contrast to Kenya). In India, people registered as being below the poverty line (BPL) generally get a connection for free, and in the state of Bihar (System 14, Table 4) SHS were introduced at affordable prices through a planned intervention. In Nepal, the SHS schemes were sometimes subsidised, while in Kenya it is common to buy SHS in the open market (System 8 being an exception).

5.1.1. Cost of connection and consumption

Figure 5 shows the average costs of connection/subscription in USD associated with various types of access as reported by survey respondents.²⁷ In the Indian sample, none of the households kept an SHS.

²⁷ All monetary figures are converted to USD from local currency at the prevailing exchange rate as of 03/2017. 1 Nepalese Rupee= \$0.00961; 1 Kenyan Shilling = \$0.0099; 1 Indian Rupee= \$ 0.015. As indicated in the figure, we provide the number of responses for each type of cost in brackets, for example in Nepal, there numbers responding were: grid (81), mini-grid (96), SHS (13).

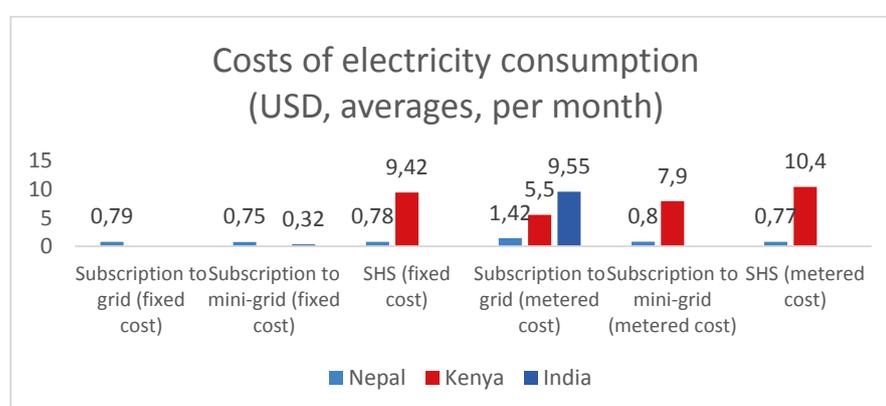
Figure 5 Reported costs of connection/subscription, USD, averages (EFEWEE Survey)



These results imply that to a farmer in Chhattisgarh (India), the cost of grid connection (9.4 USD) was only 3% of what a fisherman or a widow selling fish would pay in Homa Bay, Kenya (348.1 USD). Respondents in Nepal paid 94.1 USD for a connection, hence 27% of what Kenyan respondents paid. The reported figures vary and we do not account for inflation or levels of income, but the magnitude in the differences between the countries reflects that the women and men in Kenya face higher access barriers than those in India and Nepal. It illustrates the importance of affordability and which groups get access to electricity, in this case, excluding poorer populations from access.

Figure 6 includes two types of costs of electricity consumption: one reflecting monthly costs as a fixed price to the subscriber²⁸ and the other showing monthly costs based on metered or registered consumption.²⁹

Figure 6 Reported costs of electricity consumption (EFEWEE Survey)



Our findings imply that the monthly consumption costs of our Indian grid households are on an average of 1.7 times higher than the Kenyan households and 6.7 times higher than that of our households in Nepal. Hence, the Indian households, who pay relatively little to get access, pay more as they start to consume.³⁰ The low monthly costs in Nepal could

²⁸ The number of responses on fixed monthly cost of consumption: Nepal: grid (58), mini-grid (71), SHS (10). Kenya: grid (NB only 2, and not shown 4 USD/ month), mini-grid (NB only one, not shown: 9.2 USD/month), SHS (8). India: Grid (0), mini-grid (89), SHS (0). The Kenyan households with SHS who report that they pay for consumption are likely to be on an instalment scheme to pay down the investments.

²⁹ The number of responses on consumption-based monthly costs: Nepal: grid (23), mini-grid (25), SHS (3). Kenya: grid (28), mini-grid (6), SHS (6). India: Grid (81), mini-grid (0), SHS (0).

³⁰ The high cost paid by 52 Indian households with metered consumption may also derive from a high level of consumption (kWh) and not only a high price per unit.

hypothetically spur more use of grid electricity for high-consuming appliances, whereas people in the Kenyan and particularly in the Indian sample (as also found by Lee et al. 2018) may be more hesitant to acquire high consuming appliances and when using appliances, to keep costs down. The Kenyan monthly costs should also be understood in the context that much of the supply is provided by individual SHS.

5.1.2. Capacity, duration and reliability of supply

The 14 studied systems differ in terms of the capacities they offer and their durations of supply, which in turn has effects on the type of access customers have. Reliability and affordability (see the previous subsection) also influence access, which is captured in the 'Multi-tier Framework' (MTF) developed by international development actors (ESMAP 2015). The framework specifies various types of electricity access ranging from zero to Tier 5, the latter implying affordable access to high levels of power every hour of the week.

Table 4 indicated the type of tier associated with each studied system of supply, as seen from the user side when affordability and reliability are taken into account. It is shown that all the studied grid systems, except the one provided in Mahadevsthan, Nepal, they do not reach Tier 5 despite their theoretical potential to do so. Hence in most of the studied grid systems, customers experienced longer or shorter interruptions in supply. The mini-grid systems vary in terms of their conditions for supply (and hence access). In the off-grid villages in Chhattisgarh, electricity is only supplied for six hours daily and the system does not allow for high-demand appliances such as rice cookers. The mini-grids on Kiwa Island in Kenya provided flexible timing for electricity consumption, based on a pre-payment system. Also, the studied SHS vary considerably in size, which affects the type of appliances that can be used.

5.2. What kinds of households have access?

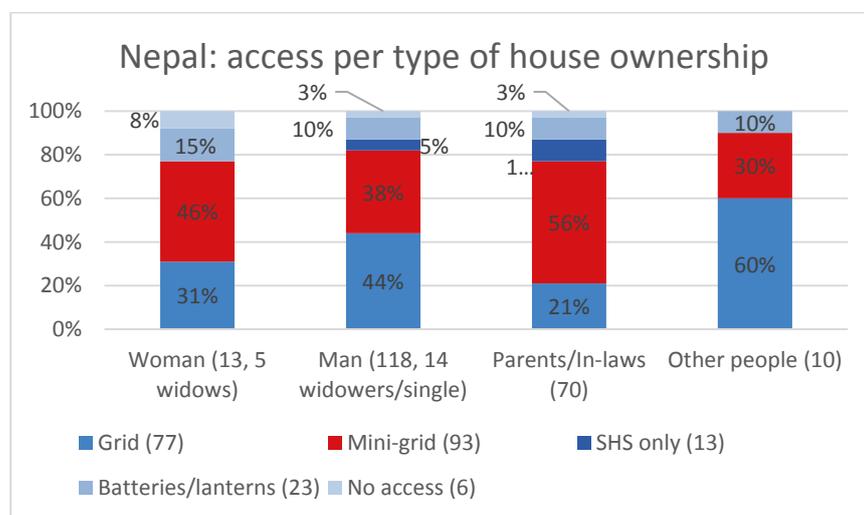
A household's economic capacity to acquire access may depend on the household composition including the number of working adults and other economic factors. Annex 9.3 documents that many Indian and Nepalese survey households practice intra-generational co-residence (a couple residing with the man's parents).

Subscriptions to grids, mini-grids and installation of SHS are usually registered in the name of the person who owns the house (Annex 9.4), who tends to be a man. Figures 7 – 9 show the distribution of house ownership according to the kind of access to which the household subscribes, starting with Nepal.³¹

³¹ The figures in brackets show the number of responses in each house owner category.

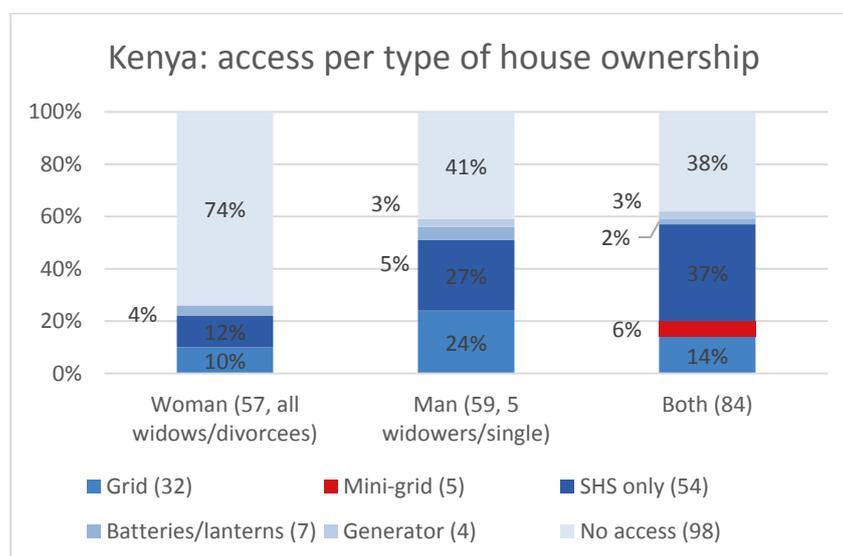
Figure 7 Access per type of house ownership, Nepal sample.

'Other people' includes parents/in-laws and individuals living outside the household



In the surveyed grid-area in Nepal, houses owned by a man alone or 'other people' (e.g. a migrated husband) most often have a connection. In the mini-grid area, houses owned by parents/in-laws are more likely to have a connection (56%). In the mini-grid area, more women are a subscriber than in grid areas and have the highest share without any kind of access, though this number is very small (only 6 cases or 8%).

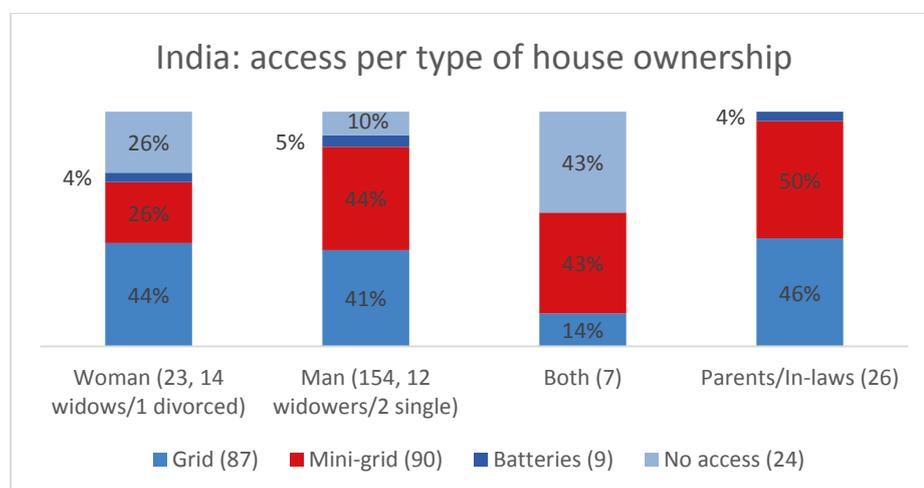
Figure 8 Access per type of house ownership, Kenya sample



In the Kenyan sample, widows and women divorcees who own the house are much more likely to not have access to electricity (74%) compared with the other groups. A likely reason is that many of them are poorer than married couples or single men: according to our data, women's income is lower than men's. The traditionally weak social position of

widows in Homa Bay most likely contributed to the poverty among them³². Men-owned houses have the highest share of grid connections while households with shared ownership are more likely to have SHS. Houses with shared ownership also have the lowest share with no access (38%).

Figure 9 Access per type of house ownership, Indian sample



In the Indian sample, all houses owned by parents/in-laws have some kind of access. Indian women-owned houses are slightly more likely not to have access than men-owned houses, but this trend is less marked than in Kenya. This is in part explained by the smaller proportions of women-owned houses in India.

Households in the Nepal sample with more adult members have a higher likelihood of having electricity access.³³ 23 Nepalese women who live without an adult man in the household, have a very high likelihood, 61% (14) of either having a connection to mini-grids or keeping SHS. Again, this should be considered in relation to their marital status; 14 Nepalese women were living without a man, but are possibly receiving remittances from out-migrated husbands. In contrast, though these cases are few, three Nepalese men who were living on their own³⁴ do not have access.

In Kenya, it is the individual couple or person residing in the house who is in charge of obtaining access, not parents, parents or parents-in-law or other people outside the household. However, through qualitative research, we learned that people with adult children who have jobs sometimes received support from their children for electricity access.

5.3. Financing access and subscribing to electricity supply

Across the three countries, subscription to electricity tends to be in the name of a man (Figure 10), though SHS are slightly more often registered as a couple's joint asset (below). Also when we asked who in the household tends to contact the supplier when in need of assistance, men tend to be the one responsible, with women being slightly more involved

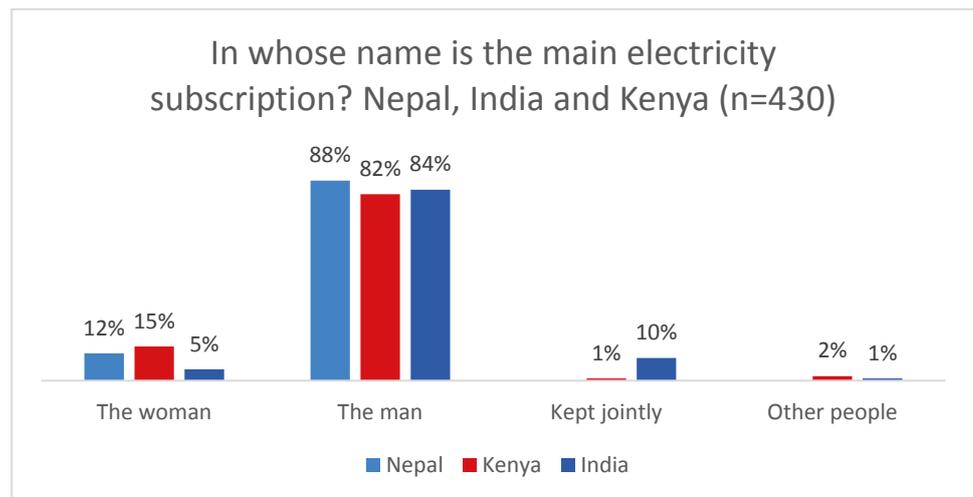
³² A few widows (in the minority) are relatively wealthy.

³³ This access rate peaks in Nepal when there are two women living in the household (64%, 39 of 61 are connected to mini-grid or keep SHS) and when there are three men living in the household (63%, 10 of 16).

³⁴ 2 were widowed and one single, they were aged between 48 and 85.

in the case of mini-grids (Nepal, micro-hydro project) and SHS (Kenya) than in the case of grid connections.³⁵ Hence, the observation that men dominate within systems of supply (Chapter 2) has a parallel in the male association with electricity access on the user side. In this section, we further scrutinise women and men's involvement on the customer side. Other than the linkage between sex of subscriber and of the house owner, it could also be that men are more likely to be the ones subscribing because they pay the bills, given that their incomes are higher than women's. This then calls for a need to be careful when suggesting subscription as an indicator (i.e. in pushing for women to be subscribers would we be burdening them with bill payments when their incomes are lower than men's).

Figure 10 In whose name is the electricity subscription?

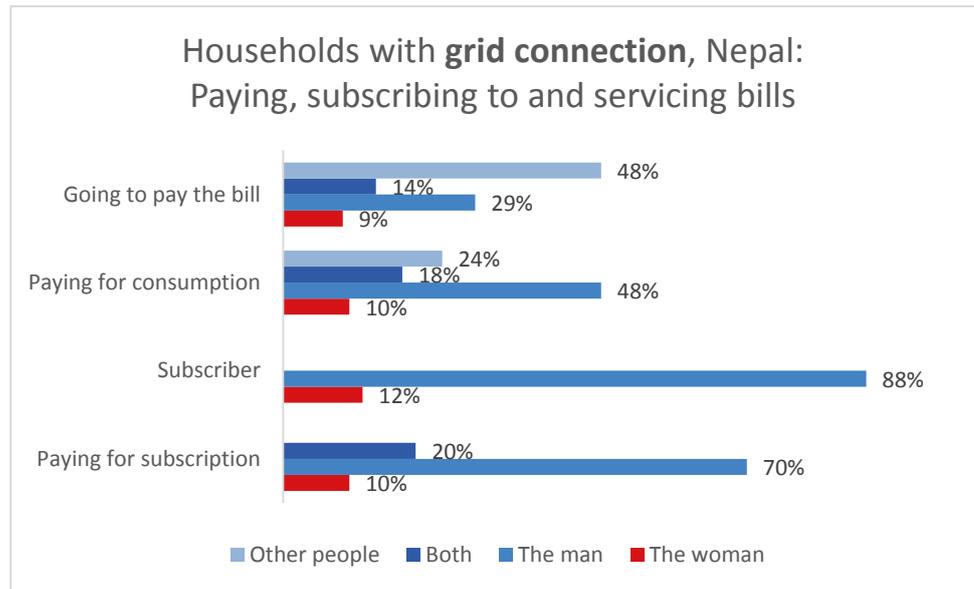


In Nepal (Figure 11), 12% say a woman is a subscriber to the grid while men subscribe in 88% of the cases. 'Other people' in Nepal sometimes play a role in servicing the bill, and some of these cases could be out-migrated husbands.³⁶

³⁵ In the grid area in Nepal, only 7% of the cases said that a woman would go for assistance. Among Nepali households with mini-grid and SHS, women would go in approximately 20% of the cases. The corresponding figures for Kenyan women going to get assistance was 13% (grid subscriptions) and 22% (SHS). In the Indian sample, only men handled problems, both for grid and mini-grids.

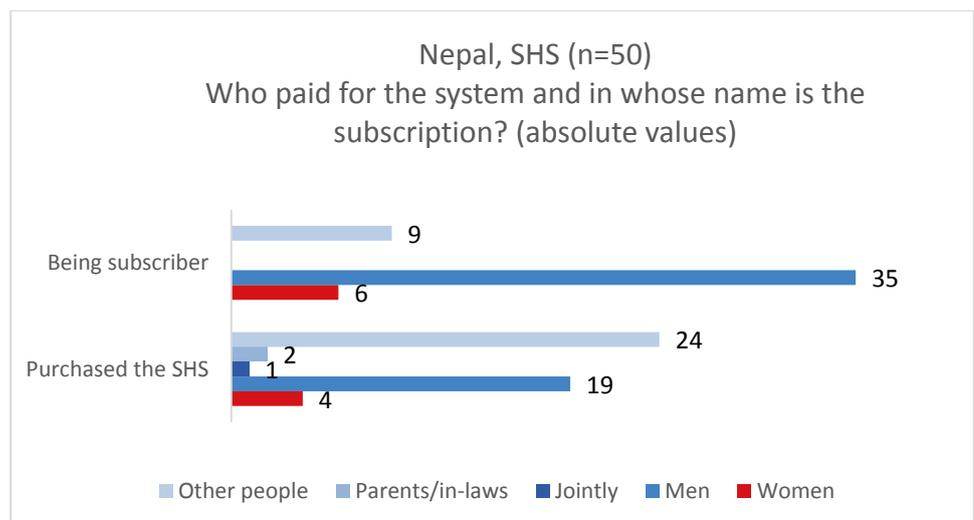
³⁶ The category parents/in-laws was also provided as an alternative answer, but was here irrelevant.

Figure 11 Households with grid connection, Nepal: Paying, subscribing to and servicing bills



For mini-grid (micro-hydro) connections in Nepal, the picture is similar (not shown in figure), but here 94% of the respondents said that “other people” go to pay the bill (or engage with money collectors visiting the households), possibly children in addition to other people who help to pay the bill. This big difference is likely because, for mini-grids, a bill collector visits homes and collects payment. 23% (50) of the Nepalese households kept SHS, often in combination with grid/mini-grid.³⁷ Figure 12 below shows that ‘other people’ often helped finance the SHS (because of low numbers, figures are given as absolute values, not percentage), but that the system tends to be registered in the man’s and not the woman’s name.

Figure 12 Who paid for the system and in whose name is the subscription? (Nepal)



³⁷ In Nepal, 25 of the hh with SHS also had grid connection, 12 also had mini-grid while 13 only had SHS.

In the Kenyan sample, women become slightly more involved as the process moves from investment (paying for a subscription to the grid) to servicing consumption (going to pay the bill). Other people also play a role in acquisition and bill servicing. We learned during fieldwork that adult children living in Nairobi sometimes initiate and help parents becoming connected, and when they come visiting, “they can’t wait to bring up their laptops and mobile phones”.

Figure 13 Households with grid connection, Kenya: Paying, subscribing to and servicing bills

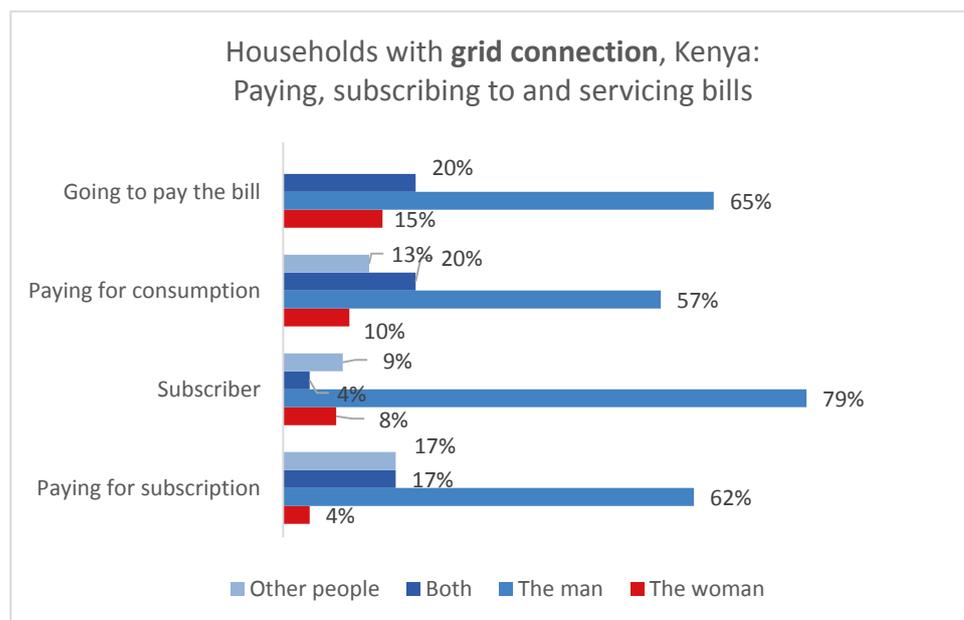
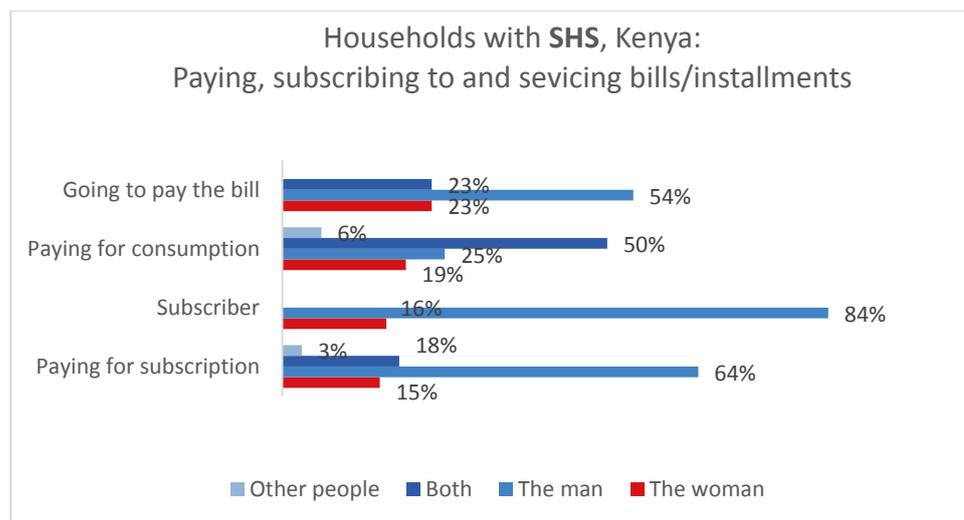


Figure 14 Households with SHS, Kenya: Paying, subscribing to and servicing bills/installments

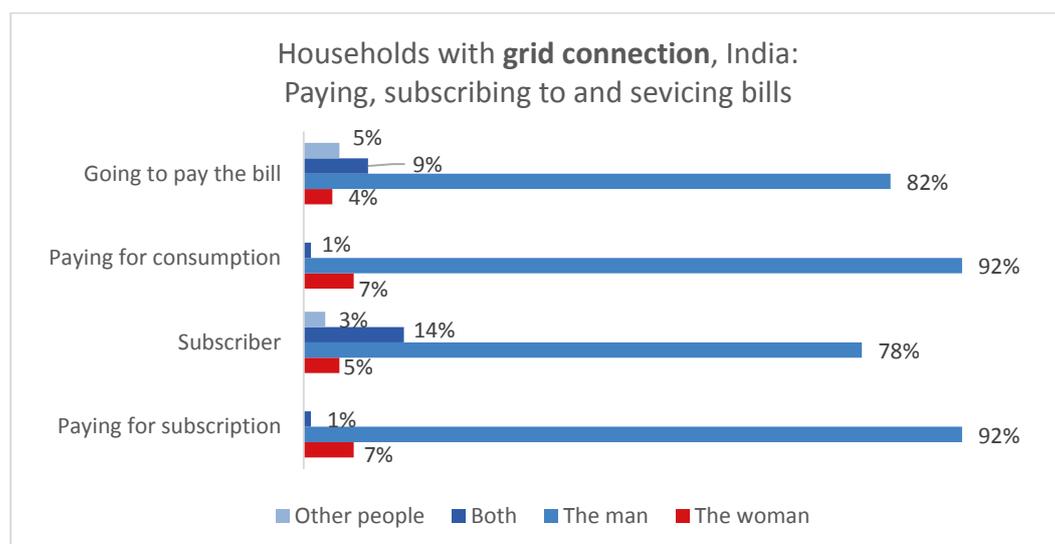


The Kenyan results show that both grid and SHS subscriptions are mainly men’s rather than women’s responsibility. The Nepalese and Kenyan results show that both in the case of grid and SHS, some women contribute to investing in access and paying for consumption but they are not necessarily the ones registered as subscribers /owners of the same. All the 21 Kenyan grid-households with married couples had a man subscriber.

Married women are slightly more involved in payments and subscription to SHS than for grid connections.³⁸

In India, men usually pay for the system, while subscriptions are slightly more often registered in the name of both spouses than in Nepal and Kenya, hence regulations appear to allow for joint subscriptions. 40 of the Indian households are in a type of system where customers are obliged to register their own consumption, and only male members of households were said to do this.

Figure 15 Households with grid connection, India: Paying, subscribing to and servicing bills



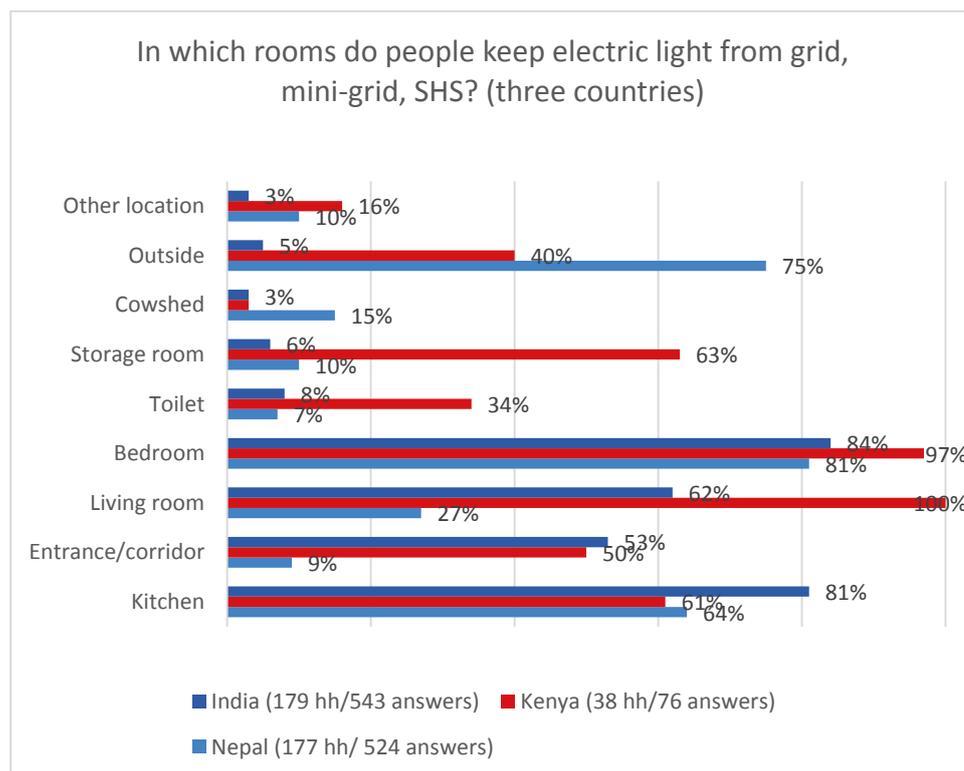
The picture for mini-grid connections in India (not shown in the figure) resembles the one for the grid in that it is largely men who handle subscriptions and payments, but here 'other people' disappear from having relevance. In mini-grid households, men almost always pay (92%), subscribe (91%), service (94%) and go to pay the bill (83%). Women's share of responsibility for mini-grid connections is even smaller than for grids, except that in 17% of households with mini-grid, people said that both the wife and the husband go to pay the bill.

³⁸ Among 43 households with SHS and married couples, the man was registered as the subscriber in 40 of the cases and the woman in three cases. In terms of paying for the system (among married couples with SHS), the man had paid in 32 cases, the woman in 4, while 10 had been paid jointly by wife and husband. Among Kenyan, married SHS homes: Covering the cost of consumption: the woman (2), the man (4), both (8). Goes to pay the bill: the woman (3), the man (3), both (2).

6. THE LOCATION OF LIGHTS IN PEOPLE'S HOMES

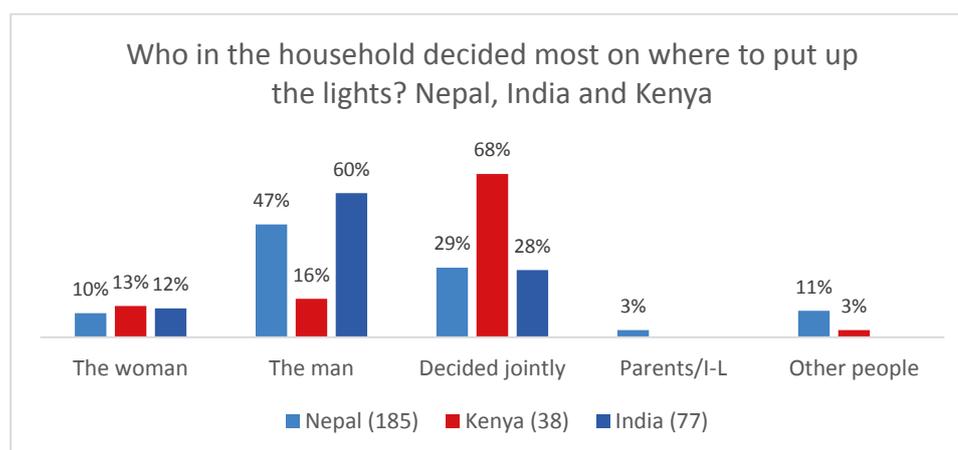
Domestic space tends to be gendered (Henning 2000, Winther 2012), and the location of lights may affect the way various household members benefit from their uses. Figure 16 shows an overview of the rooms in which survey respondents keep fixed light points.

Figure 16 Rooms in which lights are kept (grid, mini-grid, SHS), for all countries. Multiple responses, EFEWEE Survey.



The Nepali households have an average of 3.3 light points but 18 households (9% of the 190 with electricity access) only keep one light. Overall, they have given priority to the bedroom, the outside area and the kitchen which is often part of the living area or near the main entrance. One-third of the Nepalese kept lights in the living room. The surveyed Kenyan households keep 5.0 lights on average; always in the living room and usually in the bedroom (97%). The storage room (63%) and the kitchen (61%) are next in importance in Kenya, before the entrance/corridor and toilet. In relatively well-off households (e.g. who can afford grid electricity or larger SHS) it is not necessarily the wife in the house who cooks. We observed a young daughter doing the cooking, and hired household is common, and the needs of these members of lower social rank might not be the first priority for such a household. In India, where 10 of the sampled households only keep one light (mainly grid, results from state-run programmes) people prioritise having light in the bedroom, as in Nepal. Compared with the two other study contexts, the Indian respondents put most emphasis on having light in the kitchen (81%) compared with 64% in Nepal and 61% in Kenya.

Figure 17 Decisions regarding the position of light (three countries)



When responding to the question who in the household decided most on the location of light (Figure 17), many Indian and Nepali respondents said that the man decided (60% and 47%, respectively), while in Kenya, joint decision making was most commonly reported (68%). We know from qualitative fieldwork that the person installing the systems in India and Nepal often unilaterally decides or provides advice on the suited locations for light. This may explain why the light in the kitchen is most common in these two countries. In Kenya, the households kept more light points with the possibility to light up more rooms. Here it seemed more often to be up to the customer to decide, though one of the installers we interviewed said he normally gives suggestions. Nonetheless, “only” 61% of the kitchens in the Kenya case had a light point in the kitchen in which a woman or girl cooks in the evening. Because the kitchen is often a separate building with a modestly equipped structure/hut with iron sheets over it, this may contribute to explaining the lack of light. Extending lights to the kitchen might not be technically feasible, imply extra costs or simply be “forgotten” about, being a female “side” building.

Solar lanterns were kept by 36 households in the total sample: 22 in Nepal and 14 in Kenya, of which one-third used this lantern exclusively and two-thirds used it together with other types of electricity. Though we have limited data here, our results indicate that lanterns invite for more equal decision making compared to grids and mini-grids.³⁹

7. ACQUIRING, CONTROLLING AND USING APPLIANCES

After gaining access to electricity and deciding on the location of lights in the house, a next constitutive step towards using and potentially benefitting from electricity is the acquisition of appliances. This chapter presents a novel kind of material on electrical appliances and their gendered connotations. This will serve to further understand the enabling factors – and potential hindrances for – women’s empowerment through

³⁹ The results from Nepal show that among 51 cases with lantern *and/or* SHS, the woman decides most on when and where to use the light in 7 cases (14%), in 13 cases (25%) the man decides most, while joint decisions are made in 26 cases (51%), and ‘other men’ decide in 5 cases (10%). In Kenya, we only received one answer to this question in the survey. However, from qualitative research conducted in Ikisaya village, Kitui, Kenya, we learned that both women and men are subscribers to the lantern renting service and decide on the uses of lanterns.

household electricity access. In previous chapters, it was shown that men are more heavily involved in electricity both on the supply and customer side. Furthermore, our contextual research in the three study sites (Annex 9), a document that men have a higher level of income than women and that existing gender norms guide women and men's degree of control of long-term assets. These gender differences potentially have a bearing on decision making and ownership to appliances. We here observed some variation between the countries in that Nepalese respondents reported that a woman has enduring rights to the property. In contrast, in the Kenyan sample, and particularly in India, gender norms appear to restrict women's accumulation of wealth. These contextual aspects might have been at work as people responded to their investments in and degree of control over appliances.

7.1. Appliances kept in the three survey areas

Table 11 provides an overview of appliances kept in the surveyed households (Annex 5 provides details on what kind of systems the households subscribe to).

Table 11 Appliances kept by surveyed HHs with access

Appliance / Country	Nepal (n=190)	Kenya (n=100)	India (n=182)
Mobile phone	86%	99%	71%
Radio	27%	96%	7%
TV	31%	68%	55%
Iron	3%	20%	16%
Refrigerator	3%	10%	6%
Fan	3%	4%	34%
El Kettle	1%	7%	1%
Rice cooker	23%	2%	1%
Sewing machine	0%	2%	10%
Blender	2%	1%	3%
Other machines	4%	7%	0%

In the Nepal sample, 44 (23%) out of 190 households or 20% of the total sample kept an electric rice cooker. Rice cookers were kept by 27 grid households (33%, n=81), 14 with mini-grid (15%, n=96) and 3 with only SHS (20%, n=15). As to mobile phones, 80% of the Nepal sample (220) keep at least one mobile phone, and it is common to keep more than one phone.⁴⁰

Among the Kenyan households with a grid connection (n=32), everybody keeps a mobile phone⁴¹ and a radio. Among SHS homes (n=58), the share is only slightly lower (98%). All grid households and half of the SHS homes in Kenya keep a television set. Among grid households 47% keep irons and 19% keep electric water kettles, while among SHS homes 3% and 2%, respectively, do the same. In all the cases where a grid household kept an electric kettle, the household consisted of a married couple. Fridges were kept by eight

⁴⁰ Among the Nepalese who keep mobiles, they keep 1.7 mobiles in average.

⁴¹ In the total Kenyan sample, mobiles are kept by 91% of the households. Among these, there are 1.48 mobiles in average per household.

(25%) of the grid households, but not by anybody with SHS. Electric sewing machines were only kept by two homes with SHS. Two households kept electric cookers (one with a grid connection, the other SHS). In the category “Other machine/appliance”, two ‘loudspeakers’ were kept by grid-households and both were owned by men.

In the Indian sample, the main difference between grid (n=91) and mini-grid households (n=91), is a higher share of grid families keeping television (63%), fans (56%) and fridges (9%) compared with mini-grid households (48%, 11% and 3%, respectively). However, mini-grid households are more likely to keep a radio (11%) than grid families (3%). Very few among the Indian households with any type of access (n=182) keep a radio (7%) compared with Kenyan (96%, n=100) and Nepalese (27%, n=190) households with access.

In contrast to the other country samples, 10% of the Indian households with access keep a sewing machine (equally divided between the grid and mini-grid households). In the overall Indian sample, (households with and without electricity access) 71% keep at least one mobile, but the figure is lower than in Nepal (80%) and Kenya (91%).

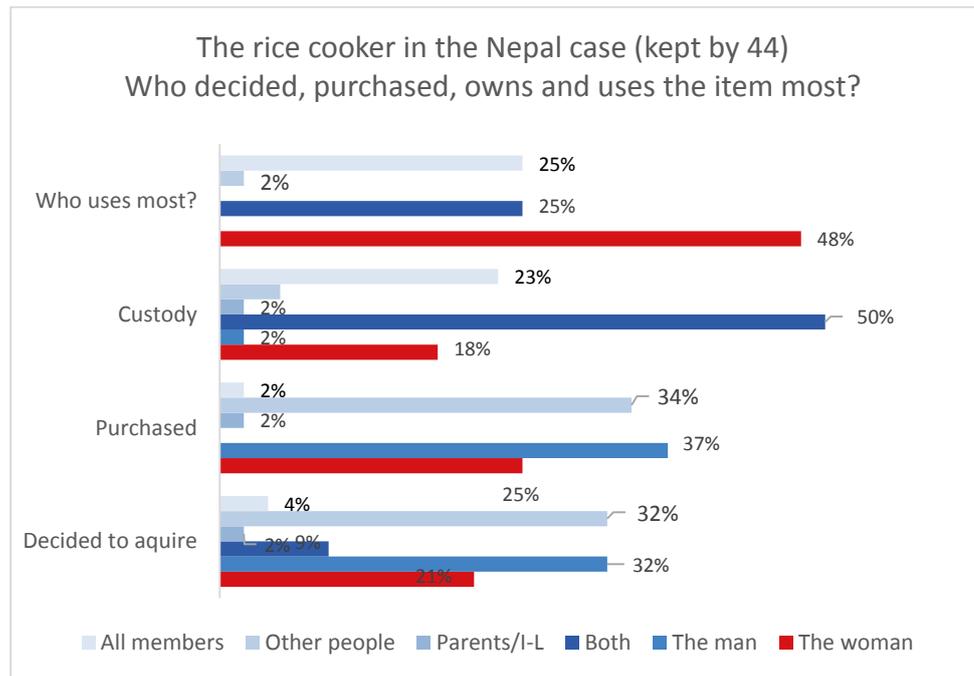
Compared with the findings from Nepal (rice stoves) and Kenya (some kettles), very few Indian households keep kettles and electric cooking devices. However, fans (either table or ceiling fans) are used by 34% of the Indian families with access and stand out as a cherished item here compared with Nepal (3%, n=190) and Kenya (4%, n=100). Fridges are rarely acquired across the three country study areas, but slightly more common in India (6%) than Nepal (3%) and Kenya (4%). Irons are more common in India (16%) than in Nepal (3%) but most common in Kenya (20%), where we were told that the electric iron implies reduced drudgery compared with the traditional one based on charcoal.

7.2. The appliances’ gendered connotations

To help examine the gendered connotations of the observed appliances (cf. Weiner 1976), we asked survey respondents who decided to purchase the item, who purchased it, who owns it and who most often uses the item. We only discuss results from three contrasting examples, though a summary of the analysis is provided in Annex 6.

First, we select the rice cooker in Nepal because this item was relatively widespread and because, in the thesis that electricity access reduces women’s burden of drudgery, it represents an important type of technology.

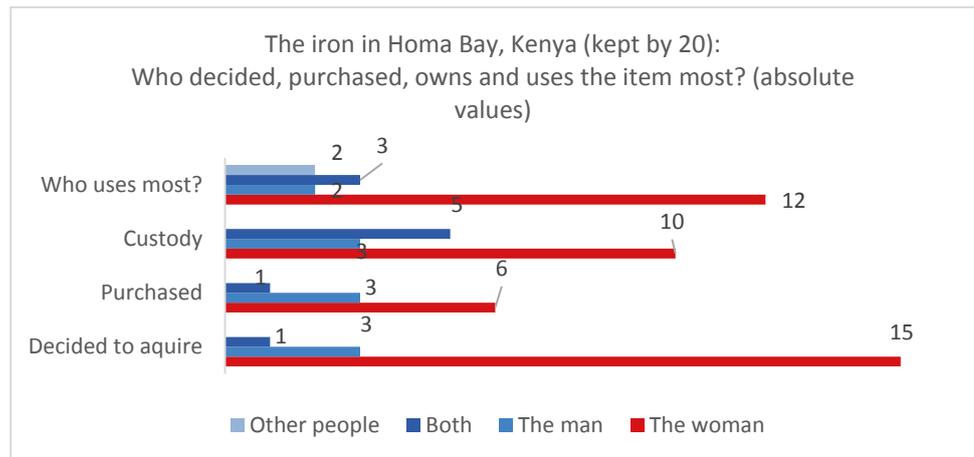
Figure 18 Decisions regarding and ownership of rice cookers in Nepal



As shown in Figure 18, the man and ‘other people’ decided equally often (32%) on the purchase of the rice cooker, while women decided in 21% of the cases. The picture is similar for the one who purchased the item. Nonetheless, when respondents were asked to assess *who owns the item*, the rice cooker is most often considered to belong to both the wife and the husband or all household members, while individual ownership (male and female) is low. Women are clearly the most important user, though in 25% of the cases the rice cooker is used by ‘all’, implying that men sometimes use it. We deduce from this that it is primarily women’s need for the stove that has initiated the acquisition, and men, who often purchased the item, is not perceived to control it after its domestication (Silverstone 1994). We, therefore, denote the rice cooker in Nepal as a female item.

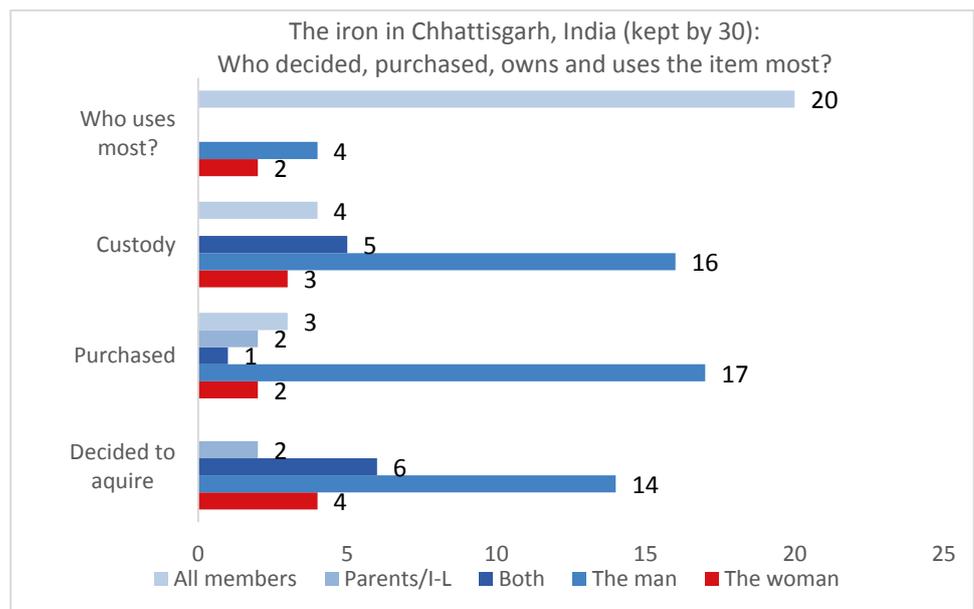
Next, we find the irons in Kenya and India to be interesting because the two cases illustrate that the gendered connotations of an object may vary contextually.

Figure 19 Decisions regarding and ownership of iron in Kenya⁴²



In Kenya, women tended to decide on the acquisition, purchase, and most often be regarded as the owner of the item, which they are also most likely to use. We deduce that irons in the studied area in Homa Bay are primarily a female object.

Figure 20 Decisions regarding and ownership of iron in India



In the Indian surveyed context, the man tends to decide, purchase and own the iron, though, in usage, the item is shared.⁴³ Because ownership is individual and associated with the man, we deduce that the irons in Chhattisgarh are male objects.

Annex 6 summarises our interpretations of the gendered status of appliances in the three contexts. The overview shows that various household members have access to using many of the services provided. However, in terms of deciding on appliances, women in India in particular, have less influence than men. In Nepal (rice cookers) and to some

⁴² Figures 19 and 20: The number of responses to each questions varied, which is why the answers on irons do not all add up to 20 (Kenya) and 30 (India), respectively.

⁴³ From qualitative research in Chhattisgarh we learned that it is mostly men's (not women's) clothes that are ironed.

extent in Kenya (water kettles, irons), female time-saving/convenience appliances are owned, and some Indian women have acquired sewing machines, but the list of most of the other types of appliances are primarily used to satiate men's needs and are bought through their decisions. Our findings indicate that there too, many women, with limited income and decision-making power, are required to convince their husbands about a given need for an appliance, rather than exercising a free choice to acquire them. Electricity connections and SHS may also be considered as equipment and assets, and in Chapter 5.3 we showed that grid and mini-grid connections primarily have male connotations, while SHS (Nepal and Kenya sites) are slightly more mixed with women sometimes being involved.

7.3. Summary

In the previous chapters, we have shown how gender plays out in decision making and ownership of electrical appliances. We started with the issue of house ownership (Annex 9.4) through to subscriptions (Chapter 5), and we have shown that men's higher involvement in electricity both on the supply and customer side, as well as their higher level of income and status as family providers, have a bearing on power relations in general (cf RA3) and decision making on appliances in particular. Adding to this picture are gender norms guiding the long-term control of assets. In the Nepal study context, such norms imply that a woman has enduring rights to property (endowments). The relatively high occurrence of rice cookers in Nepal should be understood in this context. In contrast, in Kenya and particularly in India, gender norms more strongly hinder women in accumulating wealth and thereby also investing in appliances of their choice.

Nonetheless, the material presented in this chapter shows that many women in Nepal and some women in Kenya have pursued convenience technologies related to cooking (stoves, kettles, blenders). In India, some women have enhanced their possibility to do tailoring (sewing machines). Irons and fridges have mixed gender connotations, depending on the context. For the remaining items, some are almost universal with individual custody (mobile phones), while others are purchased and controlled by men but widely shared, both in terms of custody and use (colour television). Quite a few objects (e.g. electric saw, water pumps, loudspeakers) are not found in large numbers but are interesting because the scope for electricity's uses is expanded. All these additional items are male.

8. ELECTRICITY'S USES FOR PRODUCTIVE ACTIVITIES

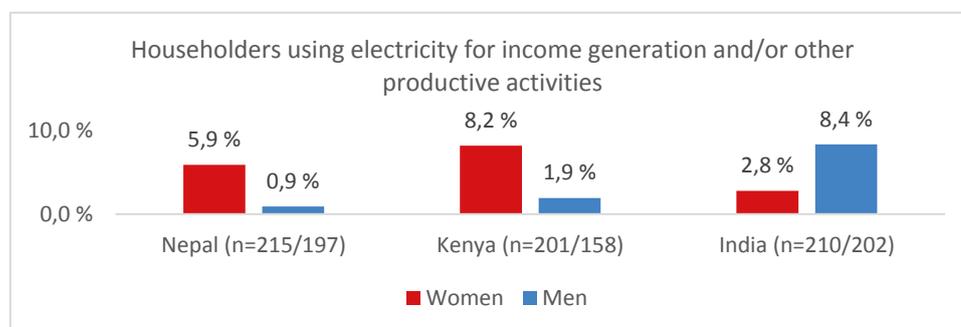
On the macro level, as highlighted in the regularly published World Energy Outlook, increased electrification is expected to enhance economic growth. Studies on energy and gender have looked at the correlation between electrification and women's likelihood of having employment, arriving at varying results (Grogan and Sadanand 2013, Dinkelman 2011, Van de Walle et al. 2015). At the micro level, mixed method studies have observed that shop owners increased their opening hours and income levels (e.g. Winther 2014, on the Sundarbans, India), while qualitative studies have shown that women (and men) use electricity to increase their incomes from productive work carried out at home (Standal and Winther 2016). The introduction of larger machinery (e.g. mills) have both increased production and helped reduce women's drudgery (Sovacool et al. 2013, on rural Mali).

Women's economic empowerment (increased access to material resources) constitutes a potential path to their overall empowerment. This chapter summarises the study's findings with respect to electricity's uses for productive activities. We start with the household level and then look at businesses and markets.

8.1. Household use of electricity for productive activities

Some survey respondents, less than 10%, said that members of their households make use of electricity for income generation and productive activities (Figure 21).⁴⁴ In Kenya and Nepal, this was more common among women than men, and the women tended to carry out these activities in their homes.⁴⁵ We did not ask about the kind of activities they undertake, but based on our observations, it is likely that some Kenyan women use electricity for running small shops from home, while the Nepalese women producing small things might use electricity for this purpose. We did not ask specifically about the use of electric light, and it is possible that people who only used light (and mobile) when generating income, did not report it.⁴⁶ In the Indian sample, more men than women use electricity for productive activities, and given the emphasis on farming and irrigation, it is likely that they used electric water pumps.

Figure 21 Householders using electricity for income generation and/or other productive activities



⁴⁴ The figures in brackets (n=) represent the number of households with at least one woman and one man member, respectively.

⁴⁵ In Nepal, 11 women carried out the income bringing work from home, while two responded "outside the home". In Kenya the corresponding numbers were 14 (home) and 3 (outside the home).

⁴⁶ We asked specifically about the use of kerosene for productive purposes and only 4 Indian respondents confirmed.

In Kenya, 17 respondents (8.2%) reported that the woman makes an income by using electricity. 14 of them responded to whether this change had affected the level of income, and all 14 confirmed that the income had increased.⁴⁷ We asked respondents to estimate the effect in monetary terms. The results, though inflation is not (necessarily) accounted for, indicate that the women's income almost doubled from 11 USD per month before using electricity to 21 USD after electrification (median values, n=16).

In the Nepal sample, women used electricity for income in 13 households (5.9%). Here an equal share of respondents said that the woman's income had increased (5) and stayed the same (5), while three said they did not know). All 13 attempted to quantify the impact on the income, and also here the income doubled (from 38 USD to 76 USD per month, median values, n=13).

In India, all the six (2.8%) women with income generation through electricity said that the change had not affected income.

In terms of men's income, the few survey participants confirming such activities in Nepal (2) and Kenya (4) also said that the income had increased.⁴⁸ In India, however, 15 of the 18 (83%) men using electricity for income said this has not affected the level of income. As we have observed in previous research in the Sundarbans, India, it is possible that these men switched from using diesel to electricity for pumping water, hence productivity stayed the same. We did not ask if electrification influenced the costs of operation, but these might have decreased.

An important finding from our qualitative research is that access to electricity is more likely to allow women and men to make improvements in their existing livelihoods than starting new types of income-bringing activities. For example, in Nepal, we met a number of women with previous tailoring skills who had installed electric motors in their sewing machines. They also used an electric iron, having switched from a charcoal iron, to enhance their clothing business. The electric iron makes tailors save time walking back and forth to refill it with charcoal and is also appreciated for making the process more efficient and less risky (reduced risk of burning clothes).

8.2. Businesses and market activities

Nepal: Men in the grid and mini-grid areas were using electricity to power machinery in physically intensive activities like carpentry, irrigation and grinding (milling grain). Electricity also enabled the initiation of a few new livelihood streams that required electricity as a necessary input, such as photocopying and a photo studio. Women rarely engaged in such activities outside the home but did manage shops and run poultry businesses which used electric lighting and warming chicks. In areas with solar home systems, the limited size of these systems hindered the use of appliances and machinery, and electricity mainly supported lighting and mobile charging. Only a few shops (some run by women, possibly owned by their husbands) and homes who could afford to invest in larger SHS systems, were able to use refrigerators, fans and televisions. About half of

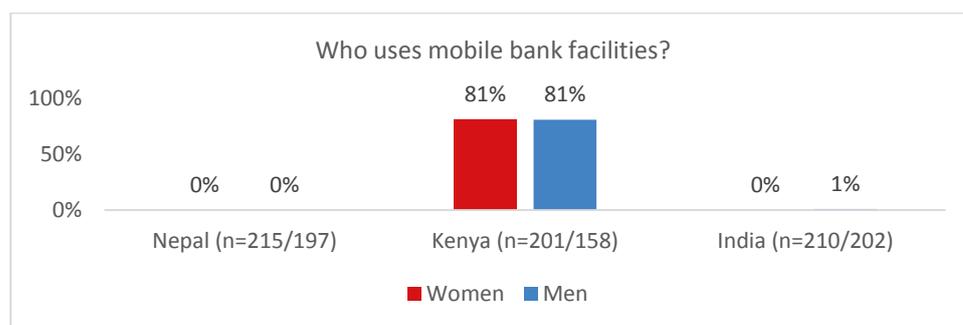
⁴⁷ Other options for answers provided: the income decreased, no change, don't know.

⁴⁸ Though the number of responses is very low: Two Nepalese men were said to have increased their income from 134 to 216 USD per month, and two Kenyan men increased from 124 to 158 USD per month.

our Nepalese sample (49%) reported that mobile phone coverage was good.⁴⁹ Only 5% of both women (12) and men (13) keep a bank account and nobody uses mobile banking.

Kenya: The studied villages in Homa Bay had a higher level of economic activity than those studied in Kitui. All the businesses we visited in God-Bura village were owned by men, though women, often the wife of the owner, tended to play an important role in its operation. Our survey showed that more than half of the women in Homa Bay are involved in running shops and businesses. Workshops for carpentry, welding, and repair of motorbike and boats (including engines) are run by men. These enterprises tend to be concentrated around the key market centres and are connected to the grid. The unreliability of the grid is a problem for businesses, and many of them use solar PV and diesel generators as back-up. Solar agents constitute a part of the business segment, where mostly men but also some women are engaged. The mobile phone is important to people’s economic activities in this area. In our survey, 85% of respondents (n=206) reported that the mobile phone coverage was good in the area.⁵⁰ In addition to communication, mobile phones are extensively used (81%)⁵¹ to access mobile money and banking facilities both among women and men.

Figure 22 Usage of mobile banking facilities



In the Kitui area, Endau village has a vibrant market compared with its neighbouring villages, with approximately 20–30 shops and workshops. These enterprises are hosted in permanent structures owned by other people (probably men) who rent out the premises and who have had electricity installed. The businesses use electricity and make up the majority of the total grid connections in Endau (ca 30–40). Shops and service providers are mostly run by women and include hair salons (some offering TV and video shows), IT services, kiosks with fridges (e.g. selling soft drinks), phone charging, and hotels/restaurants. Men run workshop enterprises (e.g. carpentry). Ikisaya and Kalungu are significantly smaller villages. In Ikisaya the availability of solar charged lanterns for rental allows people (both women and men) to keep their businesses open for longer hours than before electricity. The lanterns are also used to enable activities such as brick production (men) and rope production (women) at night.

India: In the studied grid village in Chhattisgarh, where electricity supply was regular, productive uses of electricity were found in a few home-based enterprises engaged in mobile charging or photocopying. Men tended to operate these businesses, while women

⁴⁹ 35% said it was good in some places, and 13% said it was not good. 4% did not know (n=220).

⁵⁰ The alternative answers were: only in some places, not good, don't know.

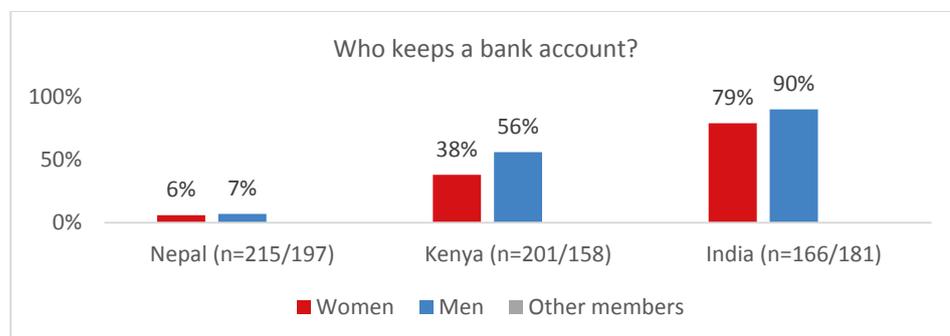
⁵¹ 205 households reported on women and men’s use of mobile banking services, 162 confirming that women use mobile banking and 128 confirming that men do. To arrive at the shares shown, we take the ratio of these numbers to the number of households with at least one woman (201) and one man (158), respectively.

appeared to fill in for the men in their absence. In Chhattisgarh off-grid villages there are petty shops and grocery stores taking advantage of the improved illumination, but these activities did not increase profits since the operating hours of these shops (from around 8 am to 6 pm) have remained almost the same as before electricity. The income generated from these businesses seemed to be managed by the men, as they were the ones engaged in taking decisions regarding the spending of the income for household expenses as well as purchasing goods for the shop. Women had some level of freedom to spend parts of the profit on household expenditures. We came across one case of an enterprising woman who ran an eatery, using electricity for lighting and deciding on the profits earned.

In the study areas in Bihar, the grid was rarely utilised for any major business enterprises. The main type of business activities were petty shops or grocery shops operating from households, often managed by both women and men, in addition to a few photocopy shops and internet cafes managed by men. In the grid village Mogaliya Purandaha, a grain mill owner and his wife had transitioned from using diesel to electricity to operate the mill, which is economically a better option for them. However, the unreliability of electricity impacted their work hours. Some SHS (in Bihar) were not able to support appliances or machinery and only support lighting and mobile charging due to their limited capacities.

In the survey area (Chhattisgarh), mobile coverage was poor or only good in some places⁵² and nobody used mobile banking. However, a surprisingly high number of Indian respondents keep bank accounts.

Figure 23 Answer to the question 'Who keeps a bank account?'



⁵² Distribution of responses: Coverage is only good in some places (53%), good (2%), not good (14%), don't know (6%), n=152).

9. HOW AND WHY DID ELECTRICITY ACCESS AFFECT WOMEN'S AND GIRLS' EMPOWERMENT?

This chapter presents our findings on how, whether and to what extent electricity access affected women's and girls' empowerment in the study cases. Importantly, we explain how and why electricity contributed to increased gender equality and what hindered potential impacts, identifying the factors that played a role. We start by presenting these findings for each of the three countries before we discuss and conclude on the empowerment impacts and their underlying explanations. We adhere to the study's framework of analysis.

9.1. Nepal

Electricity access empowered women and girls in the Nepali case study area by increasing their human resources. At the household level, this was largely seen in time-saving, reduction of drudgery, improved social network (resources) and improved access to information. The time saving and reduced drudgery largely derived from using electricity to cook (using rice cookers) while improved social networks were enabled by mobile phones and access to information by both mobile phones and access to TV. These appliances, which constituted channels for these outcomes have become more affordable, more desirable and more available over the years. In Mahadevsthan, for instance, electricity enabled 33% of the households with a grid connection to reduce drudgery and save time due to the use of electric rice cookers (Annex 5). Among mini-grid households, 15% did the same.⁵³ In the total Nepalese sample (with and without access), rice cookers were kept in 20% of the survey homes.

Using a rice cooker implies less time and effort spent collecting firewood/pinewood cones and also a cleaner kitchen environment due to reduced soot. The women also needed to wash fewer dishes than before and could leave the food unattended and do other chores. This supports findings from Sumba, Indonesia, where the prevalence of rice cookers was 13.5% (World Bank 2015). Our results further resonate with findings from Japan where the rice cooker although not "rated as highly bigger appliances such as televisions and refrigerators, had a revolutionary impact on rural Japanese women in the 1950s (Macnaughtan 2012). In addition to short-term benefits, rice cookers could yield enduring benefits for women through increased convenience, time savings and reduced household work burden. Hence because the uptake of rice cookers did not lead to changes in gender relations, we do not denote this shift as transformational. However, in the long term, this appliance together with the uptake of other appliances and changes (e.g. women taking up higher income positions) the cooker may contribute to changing gender relations.

A mill (run by men) used for grinding spices meant that women no longer needed to manually grind spices. During the qualitative interviews, a couple of electric spice grinders and food processors were observed in people's homes, but no participants in the survey reported that they had them in their homes. Both rice cookers and access to spice

⁵³ Three SHS families reported to keep a rice cooker, but we do not know if this could be run by the SHS.

grinders and food processors increased women's material opportunities and their human resources (reduced drudgery), and agency in daily life (more choice to decide what to do with their time). In Ghiring (the second study site in Nepal), the poor reliability of grid supply from the government provider NEA and poor management⁵⁴ hindered the use of such appliances for extended periods of time, thereby hindering corresponding potential empowerment pathways. Water pumping in (relatively affluent) grid-connected households in Ghiring and Chapacot was beneficial for the women in terms of improved welfare due to a reduced need to travel long distances to collect water.

Also contributing to increasing their material opportunities, some women in Mahadevsthan were observed using grid electricity for poultry farming, tailoring, and, refrigerators, expanding the range of products sold in their shops (as well as improving their working conditions in these shops due to improved lighting). However, in poultry, even though women managed the business, men still made decisions about buying and selling the chicken. Some women said they feel that men are better placed to manage the business because they have more exposure, understand how things work and are better acquainted with most people in the village. We did not find that women's income generation contributed to their economic or psychological empowerment vis-à-vis men nor led to changes in women's agency and gender ideologies (short term). Women's businesses – although enabled by grid electricity – were low-profit or income compared to men's, thereby limiting their ability to close gender gaps in incomes and their relative financial security.

Importantly, the Nepalese women's engagement in poultry farming did not emerge because of the electricity access but was facilitated by a parallel and unrelated programme that trained women in poultry businesses. This programme included a risk reduction system in the form of a "buy-back system".⁵⁵ This suggests that a range of resources are required, in addition to electrification, to enhance women's empowerment, thus an additional type of factor that plays a role for women's empowerment in relation to electricity access.

Charging of mobile phones enhanced human and social resources since phones improved communication and access to information, enabled expansion and maintenance of social networks, and convenience (i.e. rather than having to travel elsewhere to charge a phone). Health worker's ownership and use of mobile phones contributed to increased uptake of health care services among women, which can be said to enhance their human resources and contribute to their empowerment. This supported health services crucial for women and children's health, including maternal health services and child health services such as the storage of vaccines. However, even availability of mobile services for health care provision requires that electricity supply is reliable and that appliances are available. Access to television was also said to increase women's awareness of the benefits of vaccinations and contraceptive options. However, in most cases, we found that contraception was the husband's decision. Health post staff reported that many women came to seek birth control measures secretly because their husbands did not support contraception and questioned their character for making that choice. Since they

⁵⁴ For example, it took the utility a long time to repair faults in the system, making the system unusable.

⁵⁵ After a woman had sourced day-old chicks from a particular breeder, the breeder would buy them back in the case the matured chicken did not sell in their community. The buy-back price would be lower than market value but high enough to prevent the women from having losses.

were completely dependent on their husbands, they did not wish to disobey them openly but were still desperate enough to take the risk.

Interestingly, though women benefited from using mobile phones to get access to social networks, this appeared to provoke men. We were told that women's access to mobile networks triggered men's accusations of infidelity which in turn induced efforts by men to police women's morality and reproductive rights (see also Annex 9.6). In contrast, women's increased engagement in economic activities did not seem to trigger reactions from men (at least women did not complain about this).

Other areas of public life were not affected by electricity. School electricity, even when used as in Ghiring (for fans and computers) was not perceived by teachers to improve students' performance, whether girls or boys. Therefore, it cannot be concluded whether school access to electricity enhances or inhibits girls' empowerment. Boarding school and night classes were not mentioned as an option, but could potentially lead to the more intensive learning environment (cf. Kenya case) as could access to digital platforms (mentioned in Kenya). What was perceived to have made a difference was that the household's electricity access reportedly enhanced girls' opportunities for studying and doing homework in rural Nepal. However, the level of performance between students with and without electricity was reported to be the same, suggesting that there are factors – other than electricity – that affect the performance of girls in school. This is not a particularly surprising finding (Chapter 4).

Explanatory factors

Several factors played a role in whether electricity and related appliances had effects on empowerment.

Enabling factors

A key premise for the close to universal access to electricity in the studied areas in Nepal is that the cost of electricity subscriptions is affordable to a majority of the population. Reliability was good in most cases but not in Ghiring (grid). In micro-hydro villages with mini-grids, scheduled, daily interruptions⁵⁶ affected women and men's flexibility in terms of when they can use electricity. Both women and men planned their activities around the schedule, so the impacts were limited, but the interruptions were one of the reasons why many householders with micro-hydro said they wanted to change to the grid system. Capacity constraints also played a role, and the issue of capacity appeared to have more bearing on the gendered outcomes of electricity access in the Nepali study sites than in the other contexts because people here were using high-consuming household appliances (rice cooker, mill).

Despite the unreliable supply in Ghiring, capacity was a factor in enabling water access in Ghiring and Chapakot as only grid-connected households had pumped water supply. Affordability was another factor since some of the householders living in areas without tapped or pumped water supply bought electric motors to pump water for irrigation purposes using grid electricity. These were few and exclusively men. Therefore, because

⁵⁶ Interruptions were due to overload because the number of households that became connected to the micro-hydro system were many more than initially planned, thus the system was designed to serve fewer number of HHs than it actually did. There were scheduled power cuts in the late morning / afternoon when supply was diverted to mills.

the electrification projects did not cater to water supply, it appeared that both economic class and gender intersected to serve the need.

Inhibiting factors

Certain factors and mechanisms inhibited the empowerment of girls and women in rural Nepal. Women's potential empowerment through involvement in supply was inhibited by the prevailing gender ideologies and social norms which perpetuate the gender ideology that women are less competent than men and have less (important) input to provide in community matters (in this case, negotiating electrification). Also limiting women's empowerment through access, are social norms that assign house ownership to men. These norms persist, although the Nepalese law has recently changed to grant women and men the same rights to land, and even put in place mechanisms to increase women's house ownership. Furthermore, the policy (explicit or not) that grants access (subscription) through house ownership inhibit women's inclusion as subscribers to electricity systems. The distinction between subscription policies and norms is important to make as it means that if policy changes, by broadening what is required to grant access or removing the requirement of house ownership as a test-means for electricity subscription, this can lead to more inclusiveness of women, regardless of the social norms, which are likely to take longer to change.

However, even if women do get the opportunity to subscribe (regardless of or because they have house ownership), other factors exist that inhibit women's capacity to access electricity as subscribers include long and arduous administrative processes combined with women's limited mobility, their reportedly low levels of confidence, and lower negotiating capabilities. Some women became subscribers of electricity when husbands migrated abroad or when they were widowed. This suggests that Nepalese women's empowerment through access to electricity reflects necessity (the man is unavailable) rather than a change in gender norms.

The Nepalese women's limited access to electricity constitutes an important mechanism that inhibits their empowerment through electricity. Women's empowerment pathways at the local level are here affected by far-located macro-level institutional failures. This calls for empowerment assessments to take into consideration micro, meso and macro level contexts and processes to better understand enhancing and inhibiting factors.

9.2. Kenya

In the two Kenyan case study sites in Kitui and Homa Bay Counties, electricity empowered women by strengthening their human and social resources, as in the Nepali cases, but in slightly different ways. We also found positive effects on women's freedom to make short-term decisions and life decisions (empowerment dimension 3). When it comes to human resources, electric light made people feel safer, and several key informants suggested that the risk of outdoor violence for women and children after darkness got reduced by electric light. Similarly, safety increased when they avoid errands after dark, for example, to purchase kerosene. The women's high risk of violence outdoors does not appear to be fully eliminated with electricity, however, since there is a risk even when they collect firewood during the daytime when electric light is irrelevant. However, electric light (and boarding facilities in schools) may reduce the share of school children (12% of girls and 9% of boys among respondents) who have been subject to violence when walking back and forth to school.

Electric light was said to make homework and studies easier, for example by giving girls a better chance to do homework in the evening after completing household chores. In the school in Kalungu (no electricity) a teacher said that girls often come unprepared to school Tuesdays to Fridays, but not after weekends when they have had time to do both homework and housework. Electricity also improves the operation of the school administrations – and in one case (4.1.2) a boarding facility improved girls' performance in particular. However, grid electricity is unreliable and the primary schools' laptops project has not materialised within the survey area.

Electricity has strengthened human resources also by having a positive effect on people's health. Electric lights have led to reduced incidences of respiratory and eye diseases, according to a health clinic leader, through a reduction in the use of highly polluting, traditional paraffin lamps. Moreover, some reported that the use of mobile phones and electricity light reduced conflicts over missing kerosene, and thereby reduced violence. Even the portable lanterns used in Kitui (below tier-one electricity access) were seen as very useful during childbirth in people's homes. However, due to lack of access to electricity and poor reliability to public institutions, the quality of services remains poor.

In terms of decision making (agency), women have some influence over decisions regarding household electricity access, particularly when it comes to appliances, but less compared to men (Chapter 7). Our qualitative interviews showed that the women have started to obtain solar home systems and solar lanterns on their own or influence the household decision on this, though this was only slightly reported as being the case in the survey. The gradually changing strategies by solar companies and projects to create more flexible and affordable services increases women's agency in electricity. Several aspects of the local, socio-cultural context influenced the impacts of electricity. Compared with the two other country contexts, the Kenyan women seemed to enjoy more economic autonomy from the outset, which enabled them to utilise electricity in different ways than the women in Nepali and Indian cases. Electricity was important for running businesses, which are important sources of income to women, who are also frequent users of mobile banking services. This contributed to women's economic empowerment. Another emerging arrangement that may imply opportunities in the future, were solar companies' attempts to use alternative credit scoring models for unbanked rural customers to access and paying for other assets than solar systems, such as water tanks. The "darker" side of this arrangement is that a delinquent customer may potentially be blacklisted without their knowledge – data privacy is an emerging issue within the sector. Otherwise, the impacts from using electric light and mobile phones in Kenya resemble the descriptions provided for Nepal.

Electricity empowered women in terms of strengthening their agency/decision making about their own life. These effects are not large, but worth mentioning. In Kitui County, we found a few women who had carried out part-time studies (e.g. to become teachers) with the help of portable electric lights. This has given them more freedom through the economic empowerment achieved through business or employment. This has made individual women less dependent on men economically and thereby given them opportunities to make their own life choices. This has not been due to electricity alone, but electricity has played a role in such outcomes.

There are two important issues where we found that electricity has had no impact in the Kenyan study areas. First, whilst the grid and decentralised solar systems are only partially

able to provide electricity to public services, the drudgery of collecting water remains persistent and unaddressed. Women and girls literally keep carrying the heavy burden of water collection, spending time and energy on this demanding task, which could have been used for other purposes if rural water supply infrastructure could be improved.

Second, even in villages such as God Bura where there is a range of supply options available, a significant proportion, 43% (74) of the respondents had no access to electricity at all. Even though the diffusion of SHS solutions has been significant, the high poverty levels and geographical spread of settlements appear to hinder a substantial number of households in obtaining any kind of access in this area. This occurs despite the current offering of innovative credit models and end-user payment solutions. They risk being left behind and face the prospects of increased social stratification.

Explanatory factors

Several kinds of factors explain these impacts on empowerment and their limitations.

Inhibiting factors

The largest barrier for empowerment through electricity access in the Kenyan case is that the majority of people in the two study areas simply do not have access to any kind of electricity provision, neither the main electricity grid nor decentralised solutions. As shown, only a few households have grid connections. In part, this can be explained by local physical contexts: a large portion of people simply cannot be reached by the grid because of large distances, dispersed settlements and the prohibitive cost for the government for installing and maintaining the grid for too small a customer base, with low consumption levels. A majority of the population in the electrified study villages either lived too far from the grid (in terms of being too far from a transformer). Thus, there is a misfit between the geographical characteristics of these societies and the characteristics of the centralised energy system.

Another issue was uncertainty about costs and lack of clarity in where, how and who to contact regarding grid connections and maintenance, which also opened up loopholes for exploitative practices by corrupt actors, increasing the costs of connection. We found that unreliability of the grid and poor quality of supply was an almost universal concern in the electrified villages: the experienced problem was not only the blackouts and brownouts but also the lack of maintenance and clear communication channels with Kenya Power.

By far the most dominant factor influencing access to electricity from the grid is electricity's affordability versus the levels of poverty even in the relatively wealthier villages visited, which is a limit to both grid connections and the level of consumption. Widows are by far the group who are least likely to have access (in our material 26.5 % of widows do not have access).⁵⁷ Some of the businesses and most public services such as schools and clinics have access. However, due to the highly unreliable supply, schools and clinics are compelled to have some sort of backup system to cope with the unreliability. This limits the utility of the appliances that they already have, and the kinds of appliances they hope to purchase (affordability, access to capital to invest, and functioning of the appliances under unreliable/brownout conditions); and thereby the services they can offer to customers, pupils and patients.

⁵⁷ Because the sampling was done to include a sufficient number of households with access, the share not having access in reality is higher.

Not only the main grid but also decentralised systems have their own disadvantages (and potentials for improvement), according to the Kenyan cases. The limited power capacities of the most widespread decentralised systems largely limit the use of electricity to basic services such as lighting or mobile phone charging. However, none or only a relatively small percentage of customers are able to afford larger SHS systems that enable the use of appliances such as electric kettles, fridges, irons, and other machines, which are relatively common among grid customers (Annex 5). This affects women more than men, because women spend more time in the house than men do and because time-saving (convenience) appliances tend to be more important to women than men due to women's central role in fetching firewood, cooking and doing other household chores.

Another technical limitation is seen in the availability and prevalence of poor quality systems in the marketplace. Victims of this invest substantial sums of money relative to what they earn into poor quality systems with lumen levels less than that of a kerosene lamp. Another limitation in the decentralised systems is the limited lifetime of battery technology.

Socio-cultural barriers limit women's empowerment in general, in terms of a high level of domestic and outdoor violence, a high risk of food shortage, and high levels of income poverty. Such barriers also make an impact in the realm of electricity. Women had limited freedom to make decisions regarding both access to electricity and appliances. Also here, women are in a subordinate position and are dependent on men financially. Our qualitative material indicates that women have less power to decide in the case of fixed connections (whether grid, mini-grids or SHS) compared with portable systems (lanterns). The reasons are probably that fixed connections are (materially and symbolically) associated with men who tend to own the houses, become the customer, and have a higher income and are perceived as entitled to decide on big issues. In systems with fixed connections and installations, a wife's access to electricity is dictated by her husband. There are exceptions though, like wealthier widows (due to the position of the late husband, their own employment or support from adult children with employment) and other women with economic independence.

Many new opportunities and benefits had opened up by access to the grid, but this came with higher costs than envisaged. The full potential of the benefits is not realised, due to the shortcomings described above. This impacted negatively upon both genders and limited their empowerment, but more so for women and girls.

Enhancing factors

Solar PV-based solutions, encompassing mini/micro-grids, solar home systems and solar lanterns, reach a far higher share of the population than the grid in the selected rural contexts, including in areas where the grid is present. We found that the solar PV-based solutions benefitted a larger number of women than the central grid did. One reason is that the off-grid solar solutions physically reach a larger number of households in each community than the grid does, another reason is lower costs for obtaining a basic level of electricity services (though not a lower cost per unit of electricity, but this is not what matters for people's ability to pay). The small systems are easily portable and easy to purchase and carry home in areas where solar agents are present. They are also easy to install at home ("plug and play systems"). In addition, there is some level of flexibility in use in households compared to grid systems. Lanterns that can be carried to wherever needed and plug and play systems do not have to be firmly fixed in the house/specific

rooms. We found that decision making surrounding decentralised systems (both in terms of obtaining access, choice of appliances and decisions on where, when and how to use the objects) was less male-dominated than in grid-electrified households.

The services and products offered by private suppliers and their agents for solar (pay-as-you-go home systems) were popular and commonly used, particularly in the largest, wealthiest village (God Bura). People also appreciated their presence in the village, and their customer service by phone, often on free-to-call lines, which gave trust. The continued presence and services in villages in the two locally anchored community projects ('Solar Mamas' in God Liech and the Energy Centre in Ikisaya) also enhanced users' trust and access.

9.3. India

The presence of electricity (grid and mini-grid) in the study areas in Chhattisgarh and Bihar is highly valued at the household level as a labour-reducing and life-enhancing tool by both women and men. In line with findings from other studies (Palit et al. 2015, Chandna 2017) which highlight the positive effects of electricity on reducing women's household burdens, the women under study have experienced benefits in terms of increased efficiency and comfort when using light and carrying out household chores (empowering them through strengthening their human resources). Fans and fridges are slightly more common in the grid-connected villages. However, among villages included in the survey, the uptake of convenience appliances for preparing food (cookers, water boilers, blenders) among respondents with access to electricity was lower than in Nepal and Kenya, but irons (16%) and sewing machines (10%, n=182) were most common among the Indian electricity users.

The use of mobile phones has strengthened social networks and has become popular among men, women and children alike (kept by 2/3 of all survey households). Television was kept by 63% of households with grid access and by 48% with mini-grid and is a source of information and entertainment. Phones also play an important role as an entertainment tool in people's everyday lives. In the case of Bihar, it has helped womenfolk to be connected with their family members (mostly men) who have migrated to urban areas in search of gainful employment. The advent of electricity has made it possible, especially to the women folk to charge their mobiles at home. The use of phones has also reportedly increased awareness of women regarding certain concepts such as equal rights of men and women, the right to education, maternal and reproductive health (human resources). The electric light, which creates a sense of extra time – has also allowed increased mobility at night for women as well as helped the households better socialise and hold marriages and festivals for longer hours in the evening (social resources).

Men were said to have decided most often (60%) on the positioning of lights in the surveyed households (Chapter 6). Nonetheless, 81% of the households kept a light in the kitchen, and in addition, some kitchens were part of the living room, of which 62% reported to keep light. This particular finding diverges from other studies which have observed that the kitchen is sometimes downplayed as a social space in need of light (Winther et al. 2018, Winther 2014). It is likely that the installers of electricity had influenced the decisions to put a light in the kitchen (same for Nepal, but for Kenya, this

is more uncertain). Hence suppliers' procedures enhanced women's access to using electric light.

In the grid village of Chhattisgarh, of the most important gains from electricity that was reported was the use of pump sets for irrigation. Agriculture and allied activities are the mainstays of the economy, and medium and large farmers (both men and women were engaged in farming, although the agricultural lands were owned by men) owned electrically operated irrigation pumps.

A mechanism for women's empowerment in our Indian study occurred in the case of the JEEVIKA project (SHS, area not included in our survey), which gave women an opportunity to make decisions regarding the purchase and ownership of the SHS. This decision-making capacity has given women some scope to increase their bargaining power within the household by contesting the functional patriarchy of the households where men are regarded as the breadwinner and decision maker.

Our findings from India do not document that electricity at home or in schools (for fans, lights and projector) resulted in any specific gender differential outcomes for boys and girls. Although it was reported by parents that the probability of students finishing homework/study in the evenings has increased, the teachers noted that there was not much difference in examination results of students (boys and girls) before and after electrification. Moreover, several parents said that they do not aspire for higher education or jobs for their daughters. Rather, their priority was to get the girls married by the age of 20 to the groom of the parents' choice. In the study areas in India, girls were primarily trained to assume household responsibilities and advised to be 'good wives'.

Explanatory factors

There are several kinds of factors in the Indian case (both social and technical) that influence the degree of empowerment of women. Low subscription fees (though relatively high consumption tariffs) have contributed to a high rate of access, whether provided through grids or mini-grids. Another enhancing factor noted (Chapter 7.1) is the advice given by installers to put a light in the kitchen. Men tend to make all major decisions and women are not involved in supply or business activities.

Inhibiting factors

In Bihar, factors such as cost, affordability, capacity and reliability constrained the range of uses of electricity and thereby the effects on empowerment. Most of the grid-connected households had a single-phase supply and it was also unreliable. This restricted the usage and number of appliances a household could use, such as blenders and refrigerators which might have benefited women. In the off-grid villages, the SHS was designed to offer only basic services i.e. lighting and mobile charging facility keeping in view the costs and the affordability conditions of the users. These technical constraints might have contributed to hindering electricity's diversified usage both by men and women, particularly in terms of productive use or appliance penetration. However, in areas with well-functioning grids (Chhattisgarh), electricity was rarely used for productive purposes and the uptake of appliances was low. The lack of uptake in Bihar off-grid villages can therefore not only be ascribed to the limited capacity.

In all the Indian study villages, lack of capital and other market facilities hindered potential entrepreneurial activities in these villages. Similarly, though electrified, the nearest health centre of our study villages in Chhattisgarh neither had proper medical staff, health care providers or medical facilities and equipment. This mostly deterred women from using the facilities of the health centre.⁵⁸

Women's opportunity to become electricity subscribers was inhibited by custom practices where men own houses. Although the Indian law upholds equal share in the property for boys and girls, the family property especially house (and sometimes agricultural lands) were mostly inherited by the son. Daughter inherits it only if there were no male heirs in the family. In this context (as in Nepal) prevailing regulations for subscriptions are based on house ownership, and thereby makes it hard for a married woman to obtain electricity. It was reported both in Bihar and Chhattisgarh that in case of widowed women, the electricity subscription gets transferred to them after the death of their spouses, only if they continued to occupy their husbands' homes. Since decision making is also inherently linked to ownership of resources, the decisions regarding subscription and purchase of electrical appliance were also undertaken by men, and more often so than in the two other case study countries. The patriarchal structure in the Indian cases appear particularly strong compared with the other study countries (Annex 9.6), and in this sense, electricity has not made any significant impact.

9.4. Overall effects on women's empowerment

The country-specific findings provided above have shown a range of impacts of electricity access on women and girls' empowerment – with a particular focus on the underlying factors and mechanisms for electricity's observed gendered effects.

We first take a step back from the effects on gender to an overall development perspective. To the households in our study areas who gained access to electricity, this implied increased well-being, convenience, time savings and access to communication and information, and particularly so to the majority of women who work in their homes and, as in Kenya, run shops, businesses and use mobile money services and banking. The material shows, however, that electricity has not improved the quality of water supply or other public services to any significant extent. Health workers we interviewed pointed to the lack of reliable supply and explained the benefits of using electricity. Similarly, we retrieved accounts of the importance of electricity for providing boarding facilities, but with unreliable and/or costly supply, this kind of efforts to improve children's performances were downscaled or abandoned entirely. Such services do not only depend on electricity but when supporting infrastructures are also in place, reliable electricity access can make health clinics improve the quality and range of services (IEG 2008, Winther 2008, Matinga 2010).

From a gender equality perspective, in which women's position vis-à-vis men in terms of their rights, agency and access to resources are of key interest, electricity access has only had a modest impact, and the effects vary between the studied cases. In all three country cases, there are clear signs of empowerment but in none of the cases did we observe positive changes in all three empowerment dimensions. As documented in this study,

⁵⁸ Even in Bihar, the closest health centre to the study villages was not functioning reportedly due to poor governance.

men have a much higher likelihood than women of becoming recruited in electricity systems at present and thereby obtaining jobs.

Nonetheless, the potential impacts in the long term of having access to light, communication and new media (and in the case of Nepal, rice cookers) should not be underestimated as such changes may impact gender norms in the long term. Moreover, particularly in the Nepalese case, women experienced reduced time on drudgery through the uptake and use of electric rice cookers and electrified water supply. Across the cases, women save time when avoiding walking by foot to procure kerosene or charge their mobiles. In Kenya, the reduced need to walk outside enhances safety, as the risk of violence outdoors was reported to be very high.

The electricity systems under study provided outcomes that are supportive of women's well-being including their social and human resources. In this sense, our study confirms findings in the literature which observes that women benefit from access to reliable modern energy services including electricity (ENERGIA/DfID 2006, Haves 2012, Winther et al. 2017). Access to using light and mobile phones not only enhances women's organisation, convenience and comfort in everyday life, which they benefit from more than men because they tend to work and spend more time at home. Such access also reduces/eliminates their time previously spent on drudgery (walking to procure kerosene, charge mobile phones, communication for social, health/reproductive and productive purposes). The use of mobile phones is important for networking, reduced isolation in the homes, mutual moral support in difficult matters for women (such as becoming a widow and facing discrimination because of this), as well as economic co-operation (through groups etc.). In addition, we highlight the extended use (81%) of mobile banking services among the Kenyan women (Homa Bay), which signals that they are highly active and have more autonomy in economic matters (compared with the Nepalese and Indian study populations). Moreover, the ongoing worldwide digital revolution, conditioned by electricity access among other factors, is also taking place in the Kenyan and Nepalese study contexts, with potentially disruptive impacts that have only been touched upon in the present study (e.g. digital financial inclusion for Kenyan women and the rural poor).

There are large differences between women in how they are able to benefit from and be empowered by electricity and other social changes. This is related to the wealth segment she and her family belongs to, her education, her job situation, and other characteristics of the person and her socio-economic position. Overall, the material context represents a significant constraint. Poverty and lack of jobs is a significant barrier for many women and men's chances to utilise existing options for electricity access, and for using electricity in ways that empower them. Thus, affordability is a large hindrance for progress in this field and is likely to be so in most countries in Sub-Saharan Africa as well as in other parts of the Global South. The area we studied in Homa Bay was wealthier and had more solar products and services as well as grid electricity available than what is common in many parts of rural Kenya, but a large portion was still not able to use it. And among those who used it, the majority used it for only a few purposes. Poverty is a factor related to the local socio-cultural and material context and broader society, policies and international power relations and wealth differences.

Electricity access had a positive effect on stimulating businesses, particularly along Lake Victoria in Homa Bay, Kenya, although mainly enhancing existing businesses rather than stimulating new ones. This positively affected women and men. In all three country

contexts, men were the ones involved in workshops (e.g. carpentry), irrigation systems (India), mills for grinding (Nepal) and using high consuming equipment. With respect to high consuming appliances, the extent to which households and entrepreneurs and public services benefitted from electricity depended on the type of access people ascribed to, as we account for above.

Across the study contexts, women's decision making power has increased in daily life due to their access to electricity's services (e.g. more freedom to schedule their day and contacting other people). However, discriminating structures and gender ideologies largely remain. The relatively high economic independence of some of the women in Kenya is, in the longer term, likely to increase their influence on life decisions, such as staying single or divorcing from a violent husband. In terms of women's involvement in deciding on electricity in their homes in the three contexts, they have the limited agency to decide on access and appliances, but when appliances, light and mobiles arrive in their homes, they administer and use them, deriving a range of benefits. We now discuss which enabling and constraining factors are most important for women's empowerment before we address women's degree of involvement in systems of supply and the effects thereof.

9.5. Discussion of the factors and mechanisms influencing women's empowerment through access to electricity

We here conclude with respect to two of our research questions, those that particularly emphasize the underlying factors and mechanisms for empowerment effects from electricity access:

- RQ2 What are the potentials and limitations of centralised and decentralised systems in terms of enhancing women's empowerment?
- RQ1 With respect to electricity access and use, what factors affect women's and girls' empowerment?

Potentials and limitations of the grid and off-grid systems

According to the country-specific findings presented in the chapter above, details in the socio-technical design mattered to the gendered access to electricity's services. Some of their technical features affected the degree of impact on gender relations. We found that systems with fixed connections, together with socio-cultural norms and customs for distribution of wealth (men being house owners, earning more income than women), resulted in the limited agency for women in terms of deciding on which appliances to obtain and use. In contrast, when the socio-technical design of the electricity provision allows for flexible services, this appears to enhance women's agency in relation to electricity. For example, women who rent portable lanterns for a few shillings a day through the Ikisaya Energy Centre (Kitui, Kenya) have more direct access and autonomy to decide to get a lamp and where to use it, resembling their traditional power to decide on kerosene lamps. Because basic electricity services are needed and flexible systems enhance women's agency, it is, therefore, promising that both private agents and Kenya Power's lantern renting project provide similar, flexible solutions both in terms of technologies and payment models. Similarly, the JEEViKA –TERI (Lighting a Billion Lives' project) in Bihar, has provided opportunities for the women to make choices and decisions as well as to own the energy systems. The women received a clean energy loan

called an 'Energy Security Credit' through JEEViKA to help finance the clean energy system.⁵⁹

At the same time, because they are unable to support high consuming appliances and equipment, small systems limit the potential uses of electricity and hence the opportunities for empowerment. For example, the lanterns in Ikisaya cannot be used for charging mobile phones or powering radios and television (which are services obtained at the Centre). Capacity constraints are not intrinsic to decentralised systems, but the capacity is often constrained due to the economic considerations of various actors that pay for investment and maintenance, including households. The finding from Nepal shows that low-capacity systems have less potential for enhancing women's empowerment. The Nepali finding suggests that at low capacities, such systems risk creating a "watt-ceiling" that limits the capacity of marginalised and poorer women and men to benefit from a wider range of services that high-capacity systems can provide, including welfare benefits from increasingly affordable and desired appliances such as rice cookers and productive uses of electricity. At the same time, the potential for grid and high capacity off-grid systems to enhance women's empowerment should not be over-emphasised, especially given the poor management of central utilities and the observations in relatively remote rural grid areas on low utilisation of the capacity. This is particularly illustrated in the Kenyan case.

In fact, the capacity turned out *not* to be the most immediate hindrance for extended usage and potential prosperity. In grid areas of all the three countries, grid electricity was rarely used for running larger machines (mills, welding and carpentry being exceptions in some areas and primarily used by men). Electricity alone is not a sufficiently strong mechanism for bringing social change and other drivers are more important than electricity for more equality between the genders. Electricity is nevertheless important, but better effects are achieved with supplementary efforts and women-targeted electricity interventions (see below). From this, we conclude that *supportive mechanisms* for stimulating women's (and men's) economic activity are required to tap into the potential for women's economic growth through electrification. Our findings show that objects and appliances have context specific, gendered connotations. Therefore, insight into how existing and new objects become gendered – and how women more easily may lay claim to new technology – is likely to enhance the understanding of what kind of objects, measures and extended activities are desired by women, adopted, and enhance their empowerment.

Other factors that affect women's and girls' empowerment

We have summarised the challenges posed by capacity constraints and lack of supportive mechanisms to stimulate uptake of appliances and machines that could have stimulated economic activities. There are also other aspects of the socio-technical systems that directly affect women's empowerment through electricity. The question of *reliability* is crucial, and indeed, as in the case of the national grid in Kenya and parts of the Nepalese cases, creates a fundamental barrier for people's benefits from electricity. The lack of reliable supply for public and private consumption negatively affects women's empowerment in particular. This is so because women, in their role as care workers and managers of reproductive activities (e.g. water, cooking), are particularly dependent on

⁵⁹ The Ujjwala LPG scheme had been launched in India the previous year (May 2016), but we did not see much evidence of any targeted benefits for women percolating to this area at the time of our field visit (March 2017). Some HHs had LPG gas through regular connections, but these were very few.

enduring electricity services. Moreover, unreliable supply in sectors like health services and schooling strongly and negatively affects women and girls. Lack of examination light during childbirth is the most obvious example, as found in the health clinics visited in the Kenyan study sites. Health workers had to find private solutions like purchasing a portable solar lamp. Although solar lighting could be much better than kerosene lamps or candles, depending on the lumen level (brightness) of the electric light, this would be far poorer than proper examination light powered by a reliable grid or a properly sized and maintained solar system. Cold storage of medicines and vaccines is also seriously affected by unreliable supply. This affects both genders, but since women have more responsibility for children and elderly people, such problems might affect women more than men. For more advanced health care such as surgery, reliable electricity is even more important.

Furthermore, comparison of the Nepalese and Indian contexts on the one hand and the Kenyan on the other demonstrates the significance of *affordability and, in Kenya, the gendered implications when costs of connection/subscription are high*. The relatively low cost of connection makes the quest for universal access within reach (being at 96% and 86% in our Nepal and Indian study sites, respectively). In Kenya, however (with only 6% grid connection rate in our study areas) grid connections and also the decentralised systems offering pay-as-you-go systems with instalments are too costly to most of the population. The many widows in Homa Bay are most likely not to have access in the near future. To balance this tendency that the poorest households do not obtain access, one may look to India where subsidies ensure that the poorest segments (BPL) are provided with free electricity.

Regulations for subscriptions also matter to the gendered outcomes. We found that two regulations had contrasting effects. First, restricting women's agency in electricity; Nepalese and Indian customer regulations require that the subscriber is the person registered as the owner of the premise (normally a man). This hinders married women from being the subscriber. Secondly, also in Nepal and India, installers of electricity in people's houses often followed a predefined procedure of placing light in the kitchen (where women normally work in the evenings).

A repeated theme in the country-specific discussions above is the importance of the *socio-cultural context*, which structures constitute the problem of gender inequality (before electricity's arrival). The findings show how gender ideologies, social norms and the gendered distribution of wealth condition the gendered outcomes of electricity access by influencing the gender roles and power relations that influence the process of electrification, connection, internal wiring and access to appliances, and thereby also the gendered impacts of electricity.

Both men and women initiated the purchases of appliances, but the men still had a stronger involvement in the process of starting up the use of electricity, and thereby the way it could be used. The Kenyan women surveyed, however, had a larger say in deciding about the placement of lights and sockets as well as a choice of appliances than the Indian and Nepali respondents. The gender divisions in the types of appliances associated with women and men's needs, decisions and ownership indicate that beyond appliances which tend to be shared by all householders (television, fans), women tended to have initiated purchases in electric appliances that enhance their central, daily practices (Nepal: rice cookers, Kenya: electric water kettles, India: sewing machines). Men more often initiated acquisitions of television sets, radios, refrigerators and sound systems. For women,

appliances associated with leisure activities and businesses dominate their interests. The effect of the shifts in women's practices (increase in access to material resources) implies reduced drudgery (rice cooker and electric cooker: avoid/reduce time to collect fuel and convenient and quick cooking, electric sewing machine: convenience and speed of producing clothes for home use and sale).

In terms of our hypothesis that overall *policies and international actors* may affect the gendered outcomes of electricity, we first make an observation of the counterfactual. Our review of national policies in the three countries showed that general goals for gender mainstreaming and gender equality are in place national level, and also that electricity policies increasingly are becoming gender aware. However, this report has documented that the engendering on policy on the macro level has not made a significant corresponding impact on the meso-and micro levels. All the studied grid and mini-grid systems were gender blind and became inadvertently male-biased on the local level where only men became recruited as staff. On the other hand, the Indian policies mentioned above-warranting electricity subsidies (including free access for BPL) and the relatively low cost of connection in Nepal have been effective in ensuring universal access. Kenya is currently extending the grid at a fast pace, but our findings show why the vision of reaching the last mile is challenging to achieve even when the centralised grid infrastructure is extended into the villages. Across our Kenyan study areas, even governmental rural schools and clinics have an unreliable supply. There is also an urgent need for government investment in water supply in the rural areas. In forthcoming rural electricity interventions, upgrading public services and *making supply function over time* by investing in maintenance would be a very effective way to empower women and improve the quality of education for girls and boys. Finally, *international actors* played a central and positive role in two decentralised interventions, as we account for in the next chapter.

The following table summarises the impacts of electricity access on women's empowerment according to our framework. It also includes the impacts of women's involvement in electricity supply.

Table 12 Summary of effects of electricity access on women's empowerment

Observed effects of electricity access on women's empowerment			
Dimensions	Sub-dimensions	Observed effects	Comments
1 Overarching issues	Rights Gender ideologies and norms Social positions	Some impact Two interventions challenged gender norms	Electricity plays a role, in combination with other changes, and the most important mediator for this is the mobile phone (and probably the TV, but we don't know the details of this in our cases). Two Kenyan, decentralised interventions included women which had positive effects on norms (and system viability)
2 Access to and control over resources	Material opportunities Material endowments Social resources Human resources (welfare)	Modest impact Largely: no impact Positive impact Positive impact, but drudgery remains	Access in itself is a step towards increased convenience, but there was limited use of el for productive purposes (though businesses in Kenya and sewing machines in India). Male control over long-term assets persists. Men paid in electricity supply. Huge benefit (for all) through mobile phones and new media. Except for electrified water pumps (Nepal), use of rice cookers (Nepal) and blenders (Kenya), electricity has little effect on drudgery.
3 Power to influence decisions (agency)	Life decisions, political power Everyday decisions	Largely: no impact Positive impact	Customary patterns for decision making remain Access brings women more choice in daily life
Negative effects	Negative effects of electricity	Some	Due to women's use of mobile, male control increased (Nepal) Sexual favours asked from women to obtain access (Kenya) Men engaged as staff, increasing gender gap
Agency in the realm of electricity	Household access Household choice of appliances Household use Electricity supply	Men more agency Men more agency Mixed agency Most cases: men staff/receiving payment	Particularly during the subscription and installation process for grid/m-grid Follows custom (with some exceptions: rice cookers etc.) Gender-blind interventions: only men involved. Among 4 women targeted: 2 successful for the empowerment of women, 2 not successful

10. DISCUSSION OF THE IMPACT OF WOMEN'S INVOLVEMENT IN SUPPLY

We here answer the research question:

- RQ3 'To what extent and how does women's involvement in electricity supply empower women as individuals and what is the impact of women's inclusion in supply on the empowerment of women and girls in the wider community?'

Based on our review of previous research (Winther et al. 2017), we assumed that women's involvement in electricity supply would empower them individually in that they would enter a domain associated with remuneration and social privilege (Winther 2008, Winther 2014) which, historically, have largely benefitted men (though there are exceptions, see, e.g. Nye 1992 and Matly 2005 for treatments of the US history). Another pathway to empowerment through women's involvement, which potentially would affect more women than those involved in supply, is the 'role-model effect' that such women can have on other women, and even changing gender ideologies and gender norms among women and men. Beaman, Duflo and colleagues (2012), studying effects of women's political leadership in West Bengal in India, showed that presence of female leaders in communities can change parents' as well as young women's attitudes, while Standal (2008) has shown that women's participation in energy supply systems traditionally dominated by men can change men's views of women and their capabilities – a change in gender ideologies.

In each of the three countries, we wished to include at least one women-targeted intervention. In Chapter 2 we accounted for the extent to which women were included in the interventions, and in Chapter 3 we provided findings on the implications of women's inclusion in the two Kenya study cases as well as people's perceptions of women in supply. We now discuss the impacts of women targeted interventions on women's empowerment in the respective communities, highlighting the conditions for their successes and failures.

10.1. Nepal: Promising micro-hydro initiative failed to deliver

Women were absent in the organisation of grid systems in the two study sites (Ghiring/Chapakot and Mahadevsthan) and also in the off-grid systems in Ghiring derived from the conventional planning and implementation processes that were followed, in which electrification is assumed to be a gender-neutral process and thereby gender blind. The assumption is that positions and engagement in supply are equally open to both women and men. However, this ignores the historical and socio-culturally embedded inequalities between (various groups of) women and men and ends up perpetuating traditional gender roles – in this case, the continued recruitment and dominance of men in electricity supply, enhancing their remuneration and social privilege at the cost of women's. This is why we conclude that gender blind approaches, which currently constitute the dominating strategy in electrification, negatively impacts women's empowerment.

The case of micro-hydro systems in Mahadevsthan is an exception in the Nepalese context, and particularly enlightening because the design of the project specifically aimed to include women in supply. To this end, women were trained in technical aspects of micro-hydro power, but regardless of this, none of these women became involved in the supply. Why then – despite these efforts to train and include women, and despite an initial, successful effort of inviting women along-side men in the construction of the micro-hydro plants – did this “gender approach” not result in sustained involvement of women in electricity supply?

A first argument requires us to look at ‘what was done’ to effect the desired change in a context where conventional gender ideologies and norms are deeply embedded in the social fabric. While training had been provided, it consisted of two short, technical sessions to provide skills to participate in supply, attempting to allow women into a male-defined world. The second argument involves looking at what the strategy to include women ‘stood up against’. The training did not consider the social positions and structures in which the women’s actions were defined, embedded and judged. It was not adequate because it did not work to restructure the existing male-defined world and its patriarchal institutional structures (see below: two interventions in Kenya did contribute such re-structuring of relations). In the case of Mahadevsthan, such structures include the need for women to move to their husband’s homes after marriage, which was cited as one of the reasons why the trained unmarried women did not continue to participate in electricity supply. The manager (a man) of a micro-hydro plant attributed women’s lack of participation to their “unwillingness” and “shyness”, indicating that women are too shy to participate. This suggests that while training can provide the (external) resources in the form of the technical skills for women to participate in electricity supply it does not necessarily change the criteria for assessing women’s social currency which, in this context includes marital status and its associated privileges, family relations and corresponding traditional criteria (shyness/modesty) for achieving social acceptance. In the electricity interventions, beyond short-term technical training, no other resources or support were provided to effect the required changes in attitudes, structures, or practices. The outcome of this effort contrasts our findings from Kenya in which women’s existing engagement in business and activities outside the home are likely to have provided some of them with more internal resources and also increased the social acceptance for women’s involvement in supply (see below). That being said, three out of four women in the survey area in rural Nepal are engaged in groups, which potentially enhance their resource base and give them experiences with outward activities, and 27% of the Nepalese expressed that observing women in supply had changed their view on what women can do.

A downside of the failed attempt in Mahadevsthan to include women in supply is that it risks reinforcing attitudes of what women can and cannot do. Hence a negative case of the ‘role-model effect’ could occur. The manager denoting women’s “unwillingness” and “shyness” as a reason for their lack of participation even though they had been trained, is indicative of this. His simplistic explanation (informed by the dominating patriarchal worldview) in effect allocates the burden of disrupting the inhibiting patriarchal structures to women without a critical assessment neither of the quality and duration of the training nor the gendered structures within which women’s “unwillingness” and “shyness”, as well as actions, occur. In doing so, his and other observers’ essentialising evaluations (unconsciously) perpetuate existing gender ideologies and hierarchies – and leave future attempts to include women with even fewer chances of success.

On a final note, not all men in the studied micro-hydro village in Mahadevsthan have equal opportunity to participate in the energy supply, even among those who were trained. While the system was intended to be a community project, presumably expanding space for inclusion of both women and men, it has in effect become a system that is operated and managed by two young men. In some ways, these men can be considered as an elite or being at the top of the village gender hierarchy in that they are confident and have a relatively higher level of education compared with the 75% of women and 53% of men in the village who have never received an education (Annex 9.1). This suggests that even among men, in the absence of enduring efforts to disrupt existing hierarchies, pre-existing privileges (external and internal resources) facilitate involvement in electricity supply.

10.2. Kenya: Two examples of best practice to empower women and communities

In Kenya, our study of two gender-sensitive approaches to the implementation and set up of electricity supply found clear signs that these interventions had wider and positive effects on women's empowerment. In God Liech (Solar Mama, SHS), the significance of the women-targeted approach was most strikingly reflected when a male participant said he could not believe it when he first heard that women were going to India and then again when he was told that women assembled the equipment that arrived in parts to the village. His view regarding what women can do had changed in the process, reflecting that existing gender norms were challenged (c.f. Standal 2008). Our survey results from Homa Bay further strengthen this perception, where 42% (n=87) of the total sample (including those not responding) confirmed that women's involvement in supply (Solar Mama area and other villages with private solutions and/or grid) had changed their view on women. All the answers were elaborated (by women and men) with positive statements about women's capacities, commitment and dedication; that women can do electricity-related work; and the importance of education in achieving more empowerment for women.

Also at the Ikisaya Energy Centre (Kitui), women gradually came to take a more active role, leading the Board (with 50% representation of women and men) to hire a woman Manager who has led the Centre since then. The hiring of female candidates for vacant positions at the Centre indicates that the local community has come to consider women's involvement in supply as appropriate.

We argue that women's "hands-on" involvement in the provision of these new services in God Liech and Ikisaya had a particularly strong symbolic effect because only very few people in these places had previously related to electricity (c.f. Winther et al. 2017). The services are strongly desirable and associated with social esteem, as expressed in Ikisaya where the local administration referred to the Centre and its "digital" image when explaining why the village stands out compared to neighbouring villages (also in the time after several villages had seen the poorly functional grid coming to their areas). The effects of introducing systems based on women's leadership and participation were profound in that this effort led to new village discourses and modified gender norms, which constitute one of the strongest indicators for women's empowerment. A "double transformation" occurred through two changes that were contingent upon each other; a socio-technological shift and women's increased status. In comparison, in the other sites and systems in which women were occasionally rarely involved in supply, the paths to

women's empowerment were more restricted and only related to implications on the user-side. In the case of grid connections, women's access to using electricity's services tended to go through men (Chapter 5).

External actors played an important role in driving 'the gender component' of the two interventions. This is an important point because it highlights the potential for external actors, whether donors from overseas; policymakers in Nairobi or design engineers from the power utilities, to be the motivation or "change agents" for projects at the local level. The two studied models are small in scale and have fragile viability for their business models due to their weak integration in established energy institutions. Hence the sustainability of the systems is uncertain in the long term. However, the two cases clearly demonstrate that a gender-sensitive approach right from the start can induce fundamental transformations at the local level.⁶⁰

A common trait of the two women-targeted interventions was their continued presence and services in the village, which enhanced users' enduring access. In light of the failing grid (including the lack of maintenance and challenges in communicating with customers), we emphasise that ensuring enduring, predictable services, including maintenance and communication, should also form part of the gendered set up of supply and discussion of people's access to electricity. On this point, the two locally anchored community systems appeared to perform well in that their services were enduring.

In addition to the two community projects, women in rural Kenya are also to some extent involved as local employees and sales agents for private companies selling solar home systems. The substantial share of survey participants in Homa Bay who had witnessed women involved in electricity supply reflect that these new opportunities in supply chains have opened up for women, though these opportunities are more often exploited by men. However, women's involvement in supply may put them at risk (cf. the generally high level of violence outdoors, Appendix 9.7) and personal safety was sometimes cited as challenging by suppliers. One of the officials we spoke to (a man) in an electricity company where a woman is in the senior leadership, said that many women do not want to move to remote areas. He also mentioned that a long-term approach was required to train and mentor local women and that there are workplace attrition issues arising when a woman gets married when she might not want to continue working.

This perceived barrier to women's inclusion resembles descriptions collected in the Nepalese case (and an Indian case, see below), the difference being that in Kenya this assessment of challenges was not made in hindsight regarding why attempts to include women failed. Rather, it was an expression of practical problems faced when electricity starts affecting social practices.

In rural areas, electricity investments, whether grid or off-grid, should primarily be regarded as steps to empower communities. In that way, electricity could serve a key function in many villages supplying solutions that fit the particular context and that benefit all. Such an endeavour could learn from the studied community projects: local staff, women's inclusion, face-to-face customer service, affordable payment structures

⁶⁰ According to a SIDA representative in one of our workshops, there is a dearth of documented case studies to learn from. In SIDA's involvement in the Power Africa programme, they have begun to incorporate the need to implement women's empowerment approaches, especially in projects which aim to bring electricity in organised ways to communities in Somalia that did not have access before.

(including pay per service), products and services reachable also by people living at a distance from cities and village centres. Also, the studied private sector initiatives provide examples of best practice: functioning solar home systems and other village scale systems, mobile money transfer and payment in instalments. The material presented suggests that the likelihood of success of programmes aiming for electricity access for all would increase if they from their initiation were centred on women's needs, leadership and participation. Electricity access is gendered, and thinking in terms of community projects organised at the village scale with supply managed and operated by women (and men); context-sensitive training and incentive measures; and the provision of support functions for enduring supply and well-functioning socio-technical system, would be well suited to creating viable systems and meeting women's needs as well.

10.3. India: Electricity introduced as a realm for men

In the grid systems in Bihar and Chhattisgarh, gender-blind interventions implied that there were no requirements for gender balancing during recruitment. In the study cases, it was reported that the technical and engineering positions were occupied by men. Women held administrative jobs in the electricity sector, and also when technically qualified, they were said to prefer to take up postings in urban/semi-urban areas which required fewer field visits. The mentioned factors for this were women's difficulties in managing household responsibilities and balancing family life and commuting to sites. It was also reported that a woman's family members would not appreciate her taking up 'masculine' jobs such as line staff, which would require climbing poles and extensive travelling to different places. Moreover, married women are expected to wear saris, which was said to be incompatible with work clothes. Concerns for safety, security and the 'social aesthetics' (Carrithers 1992) constrained women from taking up such responsibilities.

It should be mentioned that the centralised grid systems follow a top-down approach that offers limited opportunities for recruitments on the local level. Hence, neither local women nor local men were involved in the electricity supply process and system. All the processes and installation were carried out by the electricity board workers.

Though numerous studies have indicated greater participation of women in decentralised off-grid systems (Botswana Power Corporation 2011, Empower Generation n.d., Palit et al. 2015, Chandna 2016), our study did not observe any active involvement of women in the off-grid villages in the Indian case study. As in the case of grid systems, women were said to prefer to perform administrative work in central places. Numerous studies have documented that women are underrepresented in STEM (Science Technology Engineering and Mathematics) fields the world over (Ryan 2014, Etkowitz et al. 2000, Xie and Shauman 2003). Whether centralised or decentralised systems, the government-driven provision of electricity studied in Chhattisgarh did not include a strategy for involving women in the electricity supply.

When we probed women in the villages, they stated that, in principle, they would have liked to be trained for minor repairs and maintenance responsibilities as it would open up employment opportunities for them. However, in practice, they said they did not want to take up such jobs and instead conform to their traditional roles. Men expressed that it is risky and disgraceful for women to take up jobs of repair and maintenance especially if they have to visit various households and travel to other villages to undertake repair

works. This shows that women's (potential) involvement in electricity supply was governed by gendered patterns of what constitutes a 'man's and a woman's job', hence rooted in the prevailing gender ideology of what is acceptable behaviour. In other words, women's freedom to pursue their strategic interests and hence empowerment is conditioned by men's changes in attitudes and support.

In contrast to these gender blind approaches, the provision of SHS in Bihar was attuned towards engaging with women. The approach required that only women members of Self Help Groups (SHG) could be registered as the owners of the SHS system, and from a gender perspective, this was their main accomplishment. A man designed and installed each system. Reportedly, some women had been offered the opportunity to be trained as technicians and to be engaged in installations of the systems. However, we were told that the prevalent practices prevented women from taking up such tasks due to the 'masculine label' attached to electricity/technical related jobs.

Hence, even in the case when women were offered the possibility to be trained as technicians, socio-cultural barriers hindered realisation. This soft approach of attempting to include women was soon abandoned for reasons both women and men could not explain. Comparison across cases, however, indicates that it is the manner in which the intervention addresses women's participation that matters. For example, the Barefoot Engineer project specifically target poor women and offer them six months of training in India. This initiative provides, both in our Kenyan case and in Afghanistan (Standal 2008), a radically different picture of how gender sensitive electricity interventions may not only increase acceptance for women's active involvement but also affect prevailing gender norms in the society. Any progress in this domain would require consistent efforts to dispel these engrained gendered notions and open up new paths for women to get involved in the supply.

10.4. Summary and discussion

A substantial part of our research has explored the gendered set-up and organisation of various types of electricity access in rural areas and the implications for women's empowerment. As part of our framework, we looked at potential signs of changes in gender norms and women's social position (empowerment dimension 1) deriving from women's involvement in electricity interventions.

In the Nepalese and Indian cases that attempted to include women, the initiatives failed because the attempts were too weakly designed, implemented and followed up to make a lasting effect, especially in view of the deeply embedded in existing practices that ascribe 'appropriate' roles to women and men. When we probed into the reasons for women's non-participation, barriers that appeared were women's need to move to her husband's place when getting married (Nepal) and that women's mobility is (socially) hindered as are their (social) possibilities to do technical tasks (India). In relation to the success cases in Kenya, there are two key points of difference. First, in Kenya, the gender approach was 'strong' as it was instructed from the external implementer who also did steps to ensure in-depth training, a gender-balanced recruitment strategy and follow-up over time in the years after implementation. Secondly, though some staff involved noted challenges with women's participation, the existing business practices in rural Kenya where women have participated for a long time, implied that the barrier for women to enter the realm of electricity was much lower than in Nepal and India. Nonetheless,

Standal's (2008) thesis from Afghanistan (Solar Mama project), where gender norms are no less discriminating than in the Nepalese and Indian cases, proves that also women in such constraining contexts can be trained, recruited and take part in supply in successful ways. When implementing this kind of strategy, it appears important to also engage with men to obtain success.

Globally, modern energy and electricity supply is a realm dominated by men (Dutta et al. 2017). In 2011, female employment in the electricity, gas and steam, and water sectors was half the level of male employment (World Bank 2011). Our results help account for how and why it is men rather than women who become recruited in supply on the local level. Gender-sensitive policies and strategies are an important but not sufficient requirement to achieve gender balance and gender equitable outcomes. Insight into the socio-cultural context and existing practices is also necessary in order to balance unequal preconditions and involve women in manageable ways. Enduring involvement from the implementer side is also a condition for success (both to obtain gender equality and system viability).

Our findings on gender-sensitive interventions in Kenya document that women who become involved in supply may gain increased self-esteem. As shown in previous studies, when women get involved in a technical/managerial position in the electricity projects or in the electricity supply system they are more often likely to be listened to in their community, which may help overcome traditional social barriers (Khan 2003). When women take up leadership positions, this may positively affect women's position, status and role in the society (Bryce and Soo 2004, Khuller 2002, Beaman et al. 2012). Our findings confirm that such engagement may transform the view of women in the local community when the process of including them is based on insights into socio-cultural factors and include measures to overcome their barriers. Policy makers and implementers in the public, voluntary and commercial sectors can directly address the gendered planning, management and organisation of supply.

11. REFLECTIONS ON THE ANALYTICAL FRAMEWORK DEVELOPED AND SUGGESTIONS FOR FURTHER RESEARCH

11.1. A framework for capturing the complexity and explaining the mechanisms for electricity's gendered impacts

We consider the analytical framework developed (section 1.2.2, see also Winther et al. 2017) to be comprehensive and able to capture both minor adjustments in women's daily work and life as well as structural aspects related to electricity access. The framework also enhances analysis of how and why electricity access in a given context results in a set of gendered outcomes. This framework constitutes our contribution to answering the final research question:

- RQ4 How may empowerment in the realm of electricity be conceptualised and measured?

The framework builds on Naila Kabeer's (1999, 2001) work on measuring the gendered impacts of interventions. Due to the fragmented existing body of literature, a framework is a tool for systematising research questions, methods and findings, and for enhancing dialogue across various disciplines, and also researchers and practitioners. When planning the empirical study, we employed the framework to guide our qualitative and quantitative work, and we developed interview guides and other research tools with the purpose of covering the various empowerment dimensions (TERI et al. forthcoming). The framework also helped us to analyse the material and structure the way in which we present the results.

We consider this empirical study as an innovative attempt to establish the multifaceted, gendered outcomes of electricity access. In addition, the material provides robust insights into the contextual factors that conditioned electricity's impacts. The study is the first of its kind to our knowledge, to provide a cross-country, gender-sensitive analysis of electricity access, use and decision making. These micro-politics of electricity access are important for understanding the gendered outcomes of electricity access, and an area in need of more research.

We provide here some reflections on the framework's applicability in the presented empirical study and discuss the limitations we encountered.

11.2. Difficulty in establishing causality

An initial ambition for the survey was to establish causality. We wanted to measure a set of empowerment indicators and establish causality by comparing the situation of respondents with various types of electricity access (including households without access). This is a procedure typically carried out in statistical impact evaluation studies, and by expanding the range of indicators, we hoped to gain new, statistically significant

data. An alternative to establishing causality, which we did not have, would have been to have baseline studies from the areas in question before electricity's arrival.

The actual situations encountered in the field meant that we were not able to prove causality statistically, both within countries and across the three countries. In Nepal, it was hard to find households without access, which made it difficult to compare those with and without access. In both Nepal and India, village electrification is organised in a top-down manner, with only one main system of electricity access available in a given area. In Nepal, there were instances where local men took initiative to become connected, but after implementation, they became part of the given system that was available in their area. So whilst observed differences in our findings could be explained by different types of electricity supply, the differences could also equally be explained by contextual differences (which may also differ within countries, away from the selected study sites). Third, in Kenya, it was difficult to find ordinary householders with a grid connection. The few households who did have a connection are not representative of the rural population at large in the study sites (connections are expensive compared to Nepal and India). Therefore controlling for socioeconomic factors did not seem purposeful, given the low number of survey respondents with grid connections (32 of 207). In addition, many households in Kenya were found to keep or have choices of several types of access, which limited the possibility to compare households with and without access in a stringent way. These dynamics meant that we had to spend considerable time cleaning the survey data and sorting out how we should define the various types of access that we actually encountered. These reasons contribute to why our survey data, though representative of the current situation in the case study contexts, do not statistically prove causality regarding electricity's impact.

11.3. The danger of too many data points: flexible use

In conceiving the framework, our experience and the literature review made it obvious that it has to be comprehensive to adequately cover the various aspects of empowerment. However, this inclusive strategy, and the many configurations of "access" that are currently recognised (as opposed to the binary, "with" or "without" electricity) resulted in a framework that generated a large number of possible data points. This may appear daunting to potential users of the framework. We nonetheless regard the framework as fruitful, because it reminded us about the need to keep an open mind about the possible outcomes of electricity access. We also used the framework for weighing various types of effects against each other. We would urge others to experiment in using it flexibly. For example, one may study one dimension of empowerment rather than all aspects. Similarly, users might want to use it only to assess off-grid electrification vs no-electricity, as long as such adjustments and their implications on the results are clarified. What we find particularly critical is the role of overarching factors: women's and men's rights, gender ideologies and norms, and social positions. These are particularly useful in defining how electricity "settles" in and impacts the lives of women and men. We find that these can be applied for interpreting the gendered impact of any intervention.

Electrification and its impacts are complicated, dynamic processes and occur along with other social, economic and political processes – positive and negative. The same is true for gender relations, which are always dynamic and changing. This makes isolation of electricity's impacts on gender relations and women's empowerment particularly complex. Of great importance in this process is time. A crucial question is, given the

existing lack of electricity, poverty, gender imbalances in many places: after how long a period is it reasonable to expect specific changes? This is a question – often neglected in the literature – that emerges from our experiences that our framework does not address.

11.4. Recommendations for further research

- i. Longitudinal studies of how electricity access affects gender relations over time, for example by using the EFEWEE framework (Winther et. al. 2017) would be useful to policy and programme development by giving insights into the type, scope and timing of impacts of different types of access. This kind of study would also enhance the knowledge of what kind of policies and strategies that have gender equitable outcomes.
- ii. There is a need for more research on the gendered macro- and micro-politics of electricity, including the gendered involvement and decision-making processes surrounding the provision of and access to electricity.
- iii. Assessing whether women who become empowered in the public realm due to inclusion in supply chains also have improved power in the private domain and vice-versa (i.e. does being respected in society because you supply electricity lead to respect from your husband or improved opportunities for decision making at home).
- iv. This research had not studied subsidies in detail, but given the low cost of connection/subscription in Nepal and India, and the negative impact on women in Kenya of the high cost of connection, there is need for independent research on how subsidies could be targeted in Kenya to maximise empowerment benefits for women in particular and poor groups in general.
- v. Our research showed clear successes in involving women in supply in Kenya due to the pre-existing norm, capacity building and long-term support. What is unclear is what kind of support is required to effect changes in specific contexts, and how long support must be offered, at a minimum to effect changes. Furthermore, these were small-scale projects. Research into a capacity building framework that is most likely to catalyse the “tipping point” for change at a bigger scale is needed.
- vi. One important but potentially grey area in our framework is how women’s subscription to electricity and payment of bills should be interpreted. Within the framework, we interpret these as an indicator of some level of power to access electricity and that subscribing and paying for electricity would grant the woman some level of power over its use (agency). However, this might not be the case. A woman paying for electricity might be disempowering if – like most women in settings similar to our study settings – she earns little income (especially with respect to her husband) and has to spend a proportion of this income on paying bills.
- vii. The way we employed the EFEWEE framework was ambitious in that we attempted to look at all the three empowerment dimensions and study them qualitatively and quantitatively in three different countries and six different

study contexts (two in each country). This approach has limitations because the qualitative work was broad rather than deep, hence not allowing for in-depth knowledge of individual experiences in each context. We, therefore, encourage more ethnographic studies in this realm. As to statistical studies, we consider our framework as an inspiration for documenting the impact of electricity access in a more comprehensive way than what has been common.

- viii. The EFWEE framework is useful in comprehensive assessments of women's empowerment in electrification. It's an application in analysing many different configurations of electricity supply the framework has proved useful for assessing the multi-tiered energy services for women's empowerment. We encourage other researchers to test our framework, adjusting it to their needs and improving on it.

12. CONCLUSIONS AND RECOMMENDATIONS

12.1. Conclusions

Our empirical research confirms that there may be several paths to women's empowerment through electricity, but, as also shown in our literature review (Winther et al. 2017), a considerable share of the potential is often left untapped. Based on the studied cases, women's involvement in supply is the most directly observable pathway for transforming gender ideology and discriminating norms. Both the manner in which women's inclusion was planned and practised and the socio-cultural context played a large role in the extent to which such outcomes were realised.

The report has shown that the provision of affordable and reliable electricity access to householders and businesses contributed to women's empowerment through modified social practices that enhanced daily life for women in rural areas in crucial ways. Nonetheless, universal access has not yet been realised, hence access is not for all, and in Kenya, widows and single/divorced women householders were the least likely to have access. Also, across the country cases, because married women's access to using appliances tended to be controlled by her husband and sometimes her extended family (Nepal, India), this path appeared to be a slower and more unpredictable road (barrier) compared to the one mentioned above.

The Nepalese women's uses of rice cookers and the arrival of mills for grinding spices have implied important reductions in women's drudgery, which has contributed to increasing their human resources and their *potential* to pursue income-generating activities and have more leisure time (i.e. empowerment dimension 2). In Kenya, women operating businesses benefit from light, mobiles and mobile banking facilities, potentially increasing their economic empowerment. Nevertheless, in all three study contexts, and in India in particular, the immediate effect of using electricity primarily enhanced women's *performance of their traditional roles as caregivers*. Discriminating structures remained, as observed elsewhere (Standal and Winther 2016). Had electricity access significantly reduced women's immense burden of drudgery, the picture might have looked different. Rather, based on the research on electricity's *uses* in our study areas, we are not able to observe structural changes such as gender ideologies and norms (empowerment dimension 1) or increased ability to influence life decisions (empowerment dimension 3), which constitutes empowerment's strongest indicators according to our framework. In contrast, the two interventions that put women in leadership roles in supply directly affected gender norms, as noted above. With respect to women's drudgery tasks, the findings from this study suggest that the provision of functioning electricity supply in public services (and supply of equipment) would have been a more effective means, as are the more incremental but important reductions in drudgery deriving from women's access to using electricity, appliances and mobile phones.

Our study has contributed to understanding how the organisation of electricity supply may come into play in shaping the gendered outcomes of electricity access. The material from selected parts of rural Nepal, Kenya and India demonstrate that gender blind

interventions, together with local norms and practices, hinder women's empowerment in that the provision of access is tacitly designed to become a realm largely dominated and controlled by men. This finding strengthens our previous recommendation (Winther et al. 2017) that women should be ensured of – and organise themselves to demand (c.f. RA3) – full participation in the planning, managing and operating of energy programmes and projects. This kind of strategy would comply with a central target in the SDG 5 on gender equality which highlights women's equal opportunity to be included in leadership on all levels. SDG 7 does not include this target.

The study sheds light on what impact effective electricity policy could have on the ground if it grants women opportunities to participate in supply. When women are given privileges, it often triggers initial reactions from men, but because the need for electricity, connectivity and charging capacity is high, and given time, it is likely, as in the studied cases where we observed 'double transformations' (i.e. a shift in technology and a shift in gender norms), that such barriers would be overcome.

In conclusion, this study shows that the issue of access and the realised benefits of access are not only, or even mainly, a question of technology, but policies, processes of implementation and organisation of supply, and end-users needs, social positions and aspirations.

12.2. Recommendations

This study adds to the literature on how electricity access may empower women and contribute to gender equality by presenting findings on underlying factors and mechanisms that influence the gendered outcomes. Thus, when providing recommendations, we not only highlight the reasons for the effects of electricity access on women's empowerment but also the reasons for "lack of" effects.

Our work has demonstrated that obtaining electricity access matters to women and men, but that the choices and opportunities for deciding and using electricity are gendered and contextually dependent. Gender-blind programmes and projects are likely to reinforce a particular set of ideas about end users: men doing productive work and women occupying households, apparently benefitting from electricity through a trickle-down process. Part of what is missed in this perception of the user side is insights into the needs, social positions and negotiating power of various groups of women and men. In particular, our study shows a need for supporting investments both for improving the quality of public services and enhancing women's economic enterprises.

In the study areas in Nepal and India, subsidies have resulted in almost universal access. This is far from the situation in rural Kenya, where the grid is not only costly but often dysfunctional. In response, many Kenyans living in rural areas purchase solar systems through private actors. However, private actors do not address the situation of the poorest, those living at a distance from central places and the need to provide electricity access to enhance the quality of public and communal services. This is where the governments, together with private and public partners, should strengthen their current efforts to provide gender equitable grid extensions and decentralised systems of supply.

In our study, we compared various systems of supply spanning from grids to portable lanterns, and a key question was how various systems empower women. Rather than

finding that one type of system provides more empowerment than the other, our material demonstrated that reliability and affordability (access and consumption) are much more important than the choice of system. Governments have committed themselves to ‘reaching the last mile’ and providing access to all by 2030, hence in only 12 years’ time from now (2018). As a result, there appears to be a strong emphasis on fast growth in the number of households with access, typically measured through (somewhat unclear) measures such as “connections”. However, there is a lack of focus on how the supply of electricity functions in practice after installation and upon ensuring enduring, predictable services over time. Our research shows that both of these are significant constraints that diminish the potential of electricity to bring empowerment, social and economic effects.

In addition, we highlight that an effective mechanism for enhancing women’s human resources and thereby empowerment (dimension 2) is potentially through ensuring the enduring provision of reliable and electricity to public services (water supply, health clinics, boarding schools), which reduces women’s drudgery, increases safety and advance children’s learning – given that other supportive infrastructures and equipment are in place. In the studied cases, this potential remains largely untapped. Illustrative of the significance of well-functioning public services to women’s empowerment, this aspect constitutes a separate target in the SDG 5 on gender equality. In comparison, the SDG 7 is focused on providing universal access to clean energy (measured through ‘share of the population’ with access, i.e. households) and does not (yet) address electrification of public services as a target.

Capacity building is often interpreted in an instrumental way as technical training of women to participate in electricity supply (e.g. engineering and business activities), thereby opening up spaces for women to participate in the realm of electricity and beyond. The presented research, especially from Nepal, has shown that this instrumental path may not be adequate in itself. Electricity providers including policy-makers and rural electrification agencies should engage women and men in a consistent manner for an appreciable length of time (throughout project cycles and value chains), focusing on dialogue on gender norms and ideologies in order to co-identify how to address and overcome socio-cultural barriers (e.g. marriages, work uniforms that are inconsistent with traditional values etc.). There is a need for continuous development and updating of tools and practical guidance on how to recruit and retain women in energy supply. While guidelines about understanding gender inequities in the energy sector exist, there is a need to update them by paying particular attention to addressing women’s social conditions beyond education and financing. These social conditions lead to women’s exclusion in energy supply and use, hence emphasis should be put on how the heavily patriarchal electricity supply space could be modified to accommodate women’s needs, rather than just focusing on trying to make women fit in a patriarchal energy and social space. Because men dominated energy spaces constitute the main problem, this is what should be addressed.

Policy and practice need to provide for reliable access as well as equipment for public services to effectively use electricity to provide services. Similar types of public services may have different priorities/ needs depending on the local context. For example, in the studied Indian schools, fans were desired to making learning comfortable, while in Kenya, teachers put emphasis on lighting for studying and security, as well as power for laptops. Thus, related to electrification of public services, there is need to develop

frameworks/tools that help policymakers and planners define what kind of access, electricity services, associated equipment, and maintenance packages are required in different settings. Such tools should not just allow for technical and generalised definitions of needs and priorities but should also value and allow for local viewpoints.

There is now increased funding for electrification, but inter-ministerial and interdepartmental planning of infrastructure and services need to be strengthened to ensure that electricity services are planned into infrastructure development in a gender responsive manner. Such integrated planning should be linked to gender equality performance. In Kenya, there is a discrepancy between the need for Kenya Power (distribution utility) to answer to its shareholders (i.e. profit motive) versus non-profitable operations such as maintenance in rural areas. This discrepancy needs to be recognised by the government. Also, as private sector actors become more involved in electrification, such planning appears particularly important because such actors will only target women when it serves their commercial interests (Matly 2005) and they do not typically bear responsibility for gender equality issues, unless through their own voluntary corporate policies. The private sector, often in partnership with governments, is increasingly taking on the role of electricity providers (from national, government-owned utilities), especially in African settings. They, therefore, play a role in structuring gender benefits and their influence will likely increase over the next few years. Public financing, as well as regulations, could, therefore, be used to leverage and motivate a gender transformative approach to service provision.

The current slogan of “leaving no one behind” (2030 Agenda) will not be fully achieved without such measures to increase social justice in general. These measures would also make it possible for ordinary women and men (the majority of the rural population) to move beyond the basic levels of electricity use (tier 1-2). Financial support to households, either through cash transfers, general redistribution of wealth in society or subsidised prices for electricity provision (grid and off-grid) is necessary to achieve electricity access for all, including single women households.

As to the SDGs and SE4ALL, we recommend gender-specific strategies and targets for electrification of public services specifically health care, education and water facilities. The SDG 7 should look to several of the targets identified in the gender goal (SDG5), such as measuring the share of women involvement in energy leadership and management. The SDG5 also identifies improved infrastructures and enabling digital technologies as key strategies to end discrimination, and to these ends, electricity is a key enabling factor.

12.3. Suggestions for Policy and Practice

Based on comprehensive research conducted in six case study areas in rural Nepal, Kenya and India, this report proposes to:

1. Consult and consider measures to make electricity subscriptions gender inclusive

Addressing: energy ministries and regulators at the national levels and private/voluntary actors who plan and implement electricity systems (grid/off-grid)

Possible options:

a. Allow other individuals than house owners to obtain subscription (grid and off-grid)

- Problem: In many contexts, only the formally registered owner of a house can subscribe, and this person tends to be a man.
- Effect: women depend on husbands or other men for obtaining access to electricity. This hinders women's agency and access to electricity
- What can be done? Modify regulations for a subscription so that a person registered at a certain address (citizenship card/ID) can obtain subscription
- What will be the result: Women living in houses they do not formally own, will get the possibility to access electricity and get access to using electricity's services.

b. Ensure that instalment guidelines for house wiring give priority to the kitchen area

- Problem: In Homa Bay, Kenya, 39% of the households with a subscription to electricity do not have to keep electric light in the kitchen. On an average, they keep 5 light points. In areas with systems offering portable systems in Kenya, women regularly use lanterns in the kitchen, indicating the need for light in kitchens.
- Effect: Every evening after darkness a female member of the household (female head, daughter, other women or a servant) cooks a meal. Performing this activity with only kerosene, the light of mobile or the light from the fire is inconvenient and more time consuming than when cooking with electric lights.
- Promising models: In Chhattisgarh, India (where more people than in Kenya say that men decide on lights and appliances), the homes are 20 percentage points more likely than in Kenya to have lights in the kitchen, even when there is only one light point in the house. In Chhattisgarh (and Nepal), installers advice people to put up light in the kitchen, which has resulted in electrified kitchens.
- What can be done? Modify prescriptions/regulations in Kenya so that installers of electric equipment/light as default advice householders to put lights in the kitchen.
- What will be the result: Kenyan women will get an improved working environment and increased efficiency. Symbolic implication: It is possible that the electric light in the cooking place would contribute to increasing the value of women's work.

c. Make electricity subscriptions affordable

- Problem: Homa Bay, Kenya: 74% of widows do not have access to either grid or off-grid electricity. For other types of households where also men reside, a lower share (ca 40 %) do not have access. The high connection/subscription fee to the grid and SHS makes electricity access out of reach to the widows due to a high level of poverty, partly resulting from HIV epidemic in the area. In comparison, the cost of grid connection is more than 3.7 times higher in Kenya than Nepal and 37 times higher than in India, where universal access to either grid or off-grid electricity is almost achieved in the study areas.
- Effect: The high cost of connection/subscription to grid/off-grid supply particularly hinders women's agency and their access to electricity and adhering services
- What can be done? Investigate what mix of solutions (grid/off-grid) would work under what conditions in rural Kenya and make electricity connections/subscriptions (grid and off-grid) affordable to all. Consider lowering connections fees for marginalised groups and further improvement of the social tariffs ('the lifeline tariff') (e.g. make it into a Free Basic Energy Tariff with free access up to 50 units/month).
- What will be the result: The poorest segment of the population would get access to electricity and to using electricity's services. This would enhance their convenience, reduce drudgery and time use (making mobile charging possible at home and eliminating need to buy kerosene), improve the indoor environment, which would ease their lives and enhance communication. This would also imply less social exclusion and dependency on others.

d. *Improve women's access to adopting appliances and machines powered by electricity*

- Problem: Across the three countries, most of the appliances observed in people's homes were either controlled and used jointly by household members or decided on/controlled/owned by a man. This results from women's income being ca 40% lower than men's and because men tend to own the house and are the electricity subscriber.
- Effect: Women have limited decision making power to obtain appliances and equipment that fulfil their needs, including time-saving appliances and machinery for productive activities (e.g. mills).
- What can be done? Adopt a systemic approach (e.g. appliance supply chains, financing, credit schemes) and work with local groups and communities to identify suited schemes (rental, instalments etc.) for making appliances and machines that women want available and affordable.
- What will be the result: Women would get a higher likelihood of adopting appliances that could help reduce the time spent on drudgery

tasks and/or make productive activities become more convenient and effective.

2. Consult and consider measures to make electricity systems gender responsive

Addressing: energy ministries, regulators, rural electrification authorities, electricity suppliers and private/voluntary actors who plan, implement and operate electricity systems

Possible options:

e. Ensure a minimum degree of reliability

- Problem: The grid in many rural areas counties is highly unreliable.
- Effect: This negatively affects private households, forcing people who wish to have access to electricity to also keep solar systems, not only as a back-up but in effect as their main type of supply (Nepal, Bihar, Kenya). Unreliability also negatively affects businesses and the quality of public services (see also below).
- What can be done? In the process of creating access for all, governments need to invest sufficiently in ensuring at least a minimum degree of reliability by emphasizing maintenance, monitoring and sustainability of existing grid systems and networks (lines etc.) as well as off-grid systems of supply.
- What will be the result? People and institutions who have already paid a high cost for obtaining access would get the service they have paid for. It would make the share of the population with access appear real and not only intended/potential, which is in line with the Global Tracking Framework that accounts for reliability and affordability.

f. Provide enabling conditions for the involvement of women and men in supply to ensure gender equitable outcomes

- Problem: Conventional, gender-blind electricity interventions (whether grid or off grid), are male-biased in that mainly men are recruited and get paid jobs in the systems of supply on the local level. In centralized systems, some women are recruited for administrative jobs in central areas. In contrast, two cases of localized electricity systems (Kenya), both supported by external donors, represent best practice in that the adopted gender approach resulted in women becoming key players in the supply system. This had the additional effects that gender norms were modified and that customers were handled in a way that sustained their enduring access to services (e.g. in case of non-payment, the female staff suggested a schedule for repaying debts while maintaining access).

- Effect: The male-biased systems increase the gender income gap, serve to reinforce stereotyped gender roles, and lead to missed opportunities in terms of influencing gender norms that discriminate women.
- What can be done? Spot possibilities for ‘double transformation’ (electricity access and transformed gender relations) when setting up localised systems of electricity supply:
 - i. stating in the project strategy that women’s inclusion in supply is a goal (33%, or 50% of staff, and, in a series of interventions, ensure an equal number of women and men leaders); that they should have equal pay as men; and that the degree to which these goals are realised will be monitored and reported
 - ii. working in collaboration with women’s groups in the local community to find champions and leaders who can take part in the planning of the intervention and in the recruitment and training process (e.g. ensure that the training is substantial so as to reduce the need for technical pre-qualifications) and ensure that the project accommodates women staff’s particular needs and creates conducive working conditions including in the field (e.g. kindergarten, separate toilets, work hours, buildings and infrastructure, security)
 - iii. include a budget that accommodates for women’s inclusion
 - iv. expect resistance (silent or open) from men, and include men actively in the gender-sensitive planning to get them on board regarding the wider benefits of including women
- What will be the result: Women’s inclusion in supply would:
 - vi. empower the individual women involved who will get increased psychological power and economic autonomy and become role models for young girls
 - vii. contribute to changing stereotyped gender roles and expanding the expectations for what women can do
 - viii. enhance the local system’s financial viability (based on two case studies and involved people’s assessment)
 - ix. reduce the barriers to field work and operations for women technical staff
 - x. contribute to making poor segments maintain access to electricity (such groups are at times are unable to pay the fees, for example, due to seasonal variation in income, and in the case of Ikisaya, customers highlighted the female staff’s flexibility, politeness and willingness to negotiate ways to pay back in the near future.

3. Consider measures to strengthen public services

Addressing: energy-, health-, education and water ministries and planning agencies

Possible options:

g. Ensure that public services are provided with reliable electricity access and necessary equipment

- Problem: The study observed that water provision systems had rarely been targeted for electricity, and this negatively affects women in particular (time use). Clinics were often targeted and connected, but supply tended to be non-functional which implies that electricity could not be used and the qualities of services remain poor. Because electricity in the study areas does not improve the quality of such services, the high amount of women's drudgery work continues. There are also serious impacts on health (e.g. no capacity to store medicines needed quickly after a snake bite, lack of examination light when giving birth, poor quality of drinking water taken from lakes etc.). Another problem is the lack of equipment to facilitate the use of electricity (e.g. pumps, pipes, fridges, lamps). Schools more often have a subscription, but the reliability of electricity supply is relatively low, and equipment for labs, computers etc. are lacking. Boarding school facilities have a documented positive effect on girls' performance in particular, and such services depend on electricity for being able to operate. However, the situation with unreliable supply hinders the operation of boarding facilities. A milling facility (Nepalese site, owned by men) reduced women's drudgery but was only observed in one single site/village.
- Effects: Drudgery tasks remain, health problems remain, girls' education opportunities remain limited
- What can be done? Electricity, water and health sectors should work together (e.g. in inter-ministerial action groups addressing specific problems) to ensure that village infrastructure is improved in key public services that women in particular depend on. In particular, water supply should be targeted for electrification / included in electrification plans for an area. In health clinics and schools, the reliability of supply should be ensured and monitored (e.g. yearly, which tier), as should the provision of equipment/appliances that are needed to provide needed services (e.g. milling).
- What will be the result: Women's drudgery tasks would be reduced, allowing them to spend more of their time on productive activities (if other conditions are in place) and for leisure (having today a working day from 12-16 hours). Improved health and improved quality of education.

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ANNEX 1 : CASE STUDY INFORMATION

National level Indicators

Indicator	Metric	Year	Comment	Data source	Kenya	India	Nepal
National Income	Gross Domestic Product (in million)	2017	constant prices 2010 USD	World Development indicator, World Bank	58,116.22	2,629,542.21	21,345.76
Human Development	HDI score	2015	-	Human Development Report, 2016, UNDP	0.555	0.624	0.558
Human Development - Male	HDI male	2015	-	Human Development Report, 2016, UNDP	0.577	0.671	0.582
Human Development- Female	HDI female	2015	-	Human Development Report, 2016, UNDP	0.531	0.549	0.538
Gender Inequality	Gender Inequality Index	2015	-	UNDP	0.565	0.53	0.497
Gender Inequality	Gender Gap Index	2017	-	World Economic Forum	0.702	0.683	0.661
Inequality	GINI	2016 Kenya 2011 India 2010 Nepal	--	The World Factbook, Central Intelligence Agency	48.5	35.2	32.8
Life expectancy male/female	female and male life expectancy	2016	-	The World Bank Open Data	65/69	67/70	69/72
Literacy male/female	Gross enrolment ratio, primary (% of primary	2016	girl and boy school enrollment	UIS UNESCO	77.43/ 75.65	106.15/ 123.87	85.21 / 82.86

Indicator	Metric	Year	Comment	Data source	Kenya	India	Nepal
	school-age population)						
Ownership of telephones male/female	Mobile ownership by Gender (% of population)	2017 India and Kenya, 2016 Nepal	-	The Mobile Gender Gap Report 2018, GSMA (UK Aid) - Kenya and India; DHS Nepal 2016	92%/85%	80%/65%	89%/72.6%
Ease of access to credit/bank services	Ease Of Access To Loans Index	2016	Scores from 1 to 7	The World Bank Open Data	4.01	4.42	3.86
Access to electricity	% of population	2016	-	World Development indicator, World Bank	56	84.5	90.7
Access to clean cooking	% of the population	2016	-	World Development indicator, The World Bank	13.4	41	27.6
Ownership of telephones/mobile phone coverage	fixed telephone subscriptions per 100 people	2016	-	World Development indicator, World Bank	0.2	1.8	3
Traditional sold biomass /total energy consumption		2013	-	International Energy Agency		24%	
Land ownership male/female		2011-12 India	-	India: India Human Development Survey, University of Maryland and NCAER		83%/ > 2%	

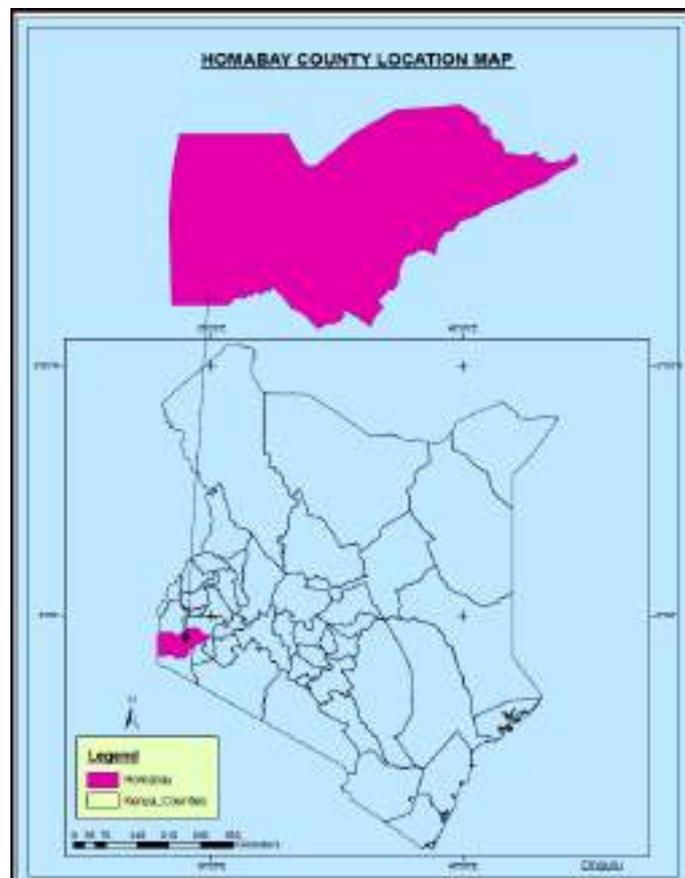
Local level indicators

Indicator	Metric	Year	Data source	Kenya	India	Nepal
Population	Population (in Thousand)	2016	The World Bank open data	49,699.86	1,339,180.13	29,305.00
Per cent of households access to non-solid fuels	Households using clean cooking fuel (Electricity, LPG/natural gas, biogas)	2015-2016	National Family Health Survey, India		43.8	
Gender Development Index	Gender Development Index	2015	UNDP	0.919	0.819	0.925
State				Nyanza Province	Chhattisgarh	Province 3
District				Homa Bay County	Balodabazar and Mahasamund	Dhading
Population density (persons per km2)	Density/km2	2011 Nepal India; 2009 Kenya	Kenya National Bureau of Statistics, Census of India, Census of Nepal	302.8	349.60 and 216	174
Per cent females		2011 India	Census of India, Census of Nepal		50.09% and 50.45%	50.40%
Per cent electrified households	Households with electricity (%)	2015-2016 India	National Family Health Survey, India		88.2%	
Per cent of households access to LPG	Households using clean cooking fuel (Electricity, LPG/natural gas, biogas)	2011 and 2015-16 India	Census of India, National Family Health Survey		4.81% and 12.9%	

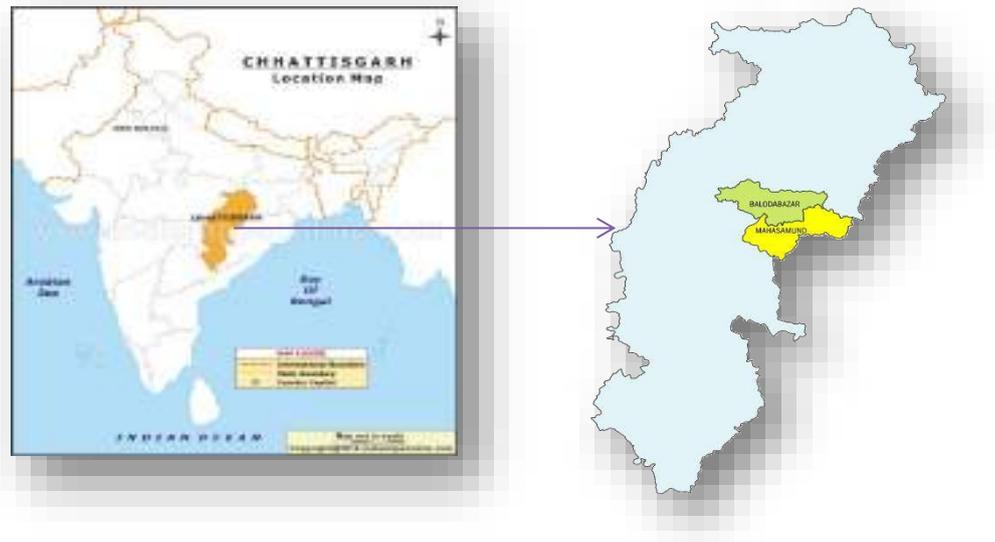
ANNEX 2 : MAPS OF STUDY SITES



Map of Nepal with projections of the study sites: Tanahun (left) and Dhading (right). Map retrieved from <http://xplornepal.blogspot.com/2010/12/map-of-nepal.html>



Map of Kenyan survey site: Homa Bay (Western Kenya)



Map of the first study site, India: Chhattisgarh. Retrieved from INDmaps. <http://www.indmaps.com/state-map/chattisgarh/chattisgarh-location-map.html>



Map of the second study site, India: Bihar. Retrieved from <http://www.indmaps.com/state-map/bihar/bihar-location-map.html>

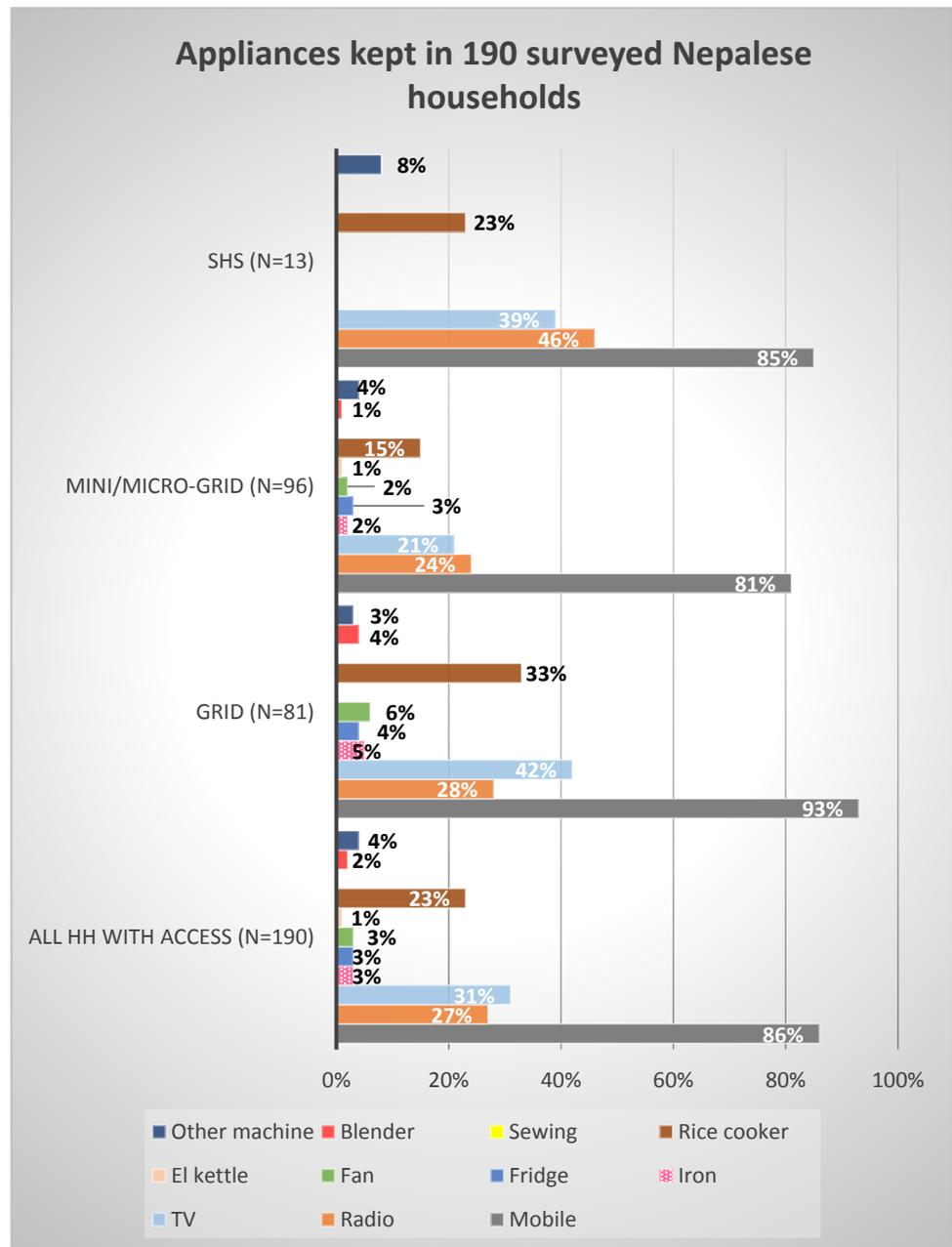
ANNEX 3 : LIST OF INTERVIEWS IN VILLAGES

Type of interview/ method	Nepal total	Nepal Women	Nepal Men	Kenya total ⁶¹	Kenya Women	Kenya Men	India total	India Women	India Men
Key people	6	3	3	19	7	12	17	10	7
Staff, electricity supply	8	0	8	9	3	6	9	-	9
Public services	10	8	2	12	2	10	15	9	6
Shops and businesses	6	6	0	8	6	2	10	8	2
Householder with electricity access	19	12	7	13	8	5	24	15	9
Householder without electricity access	4	3	1	9	7	2	13	8	5
Life story	8	4	4	11	6	5	12	6	6
Total number of interviews	61	36	25	81	39	42	100	56	44
Focus group discussions ⁶²	8	4	4	7	4	3	12	6	6
Total number of interviews and focus group discussions	69	40	29	88	43	45	112	62	50
Survey	220	161	59	207	151	56	215	151	64

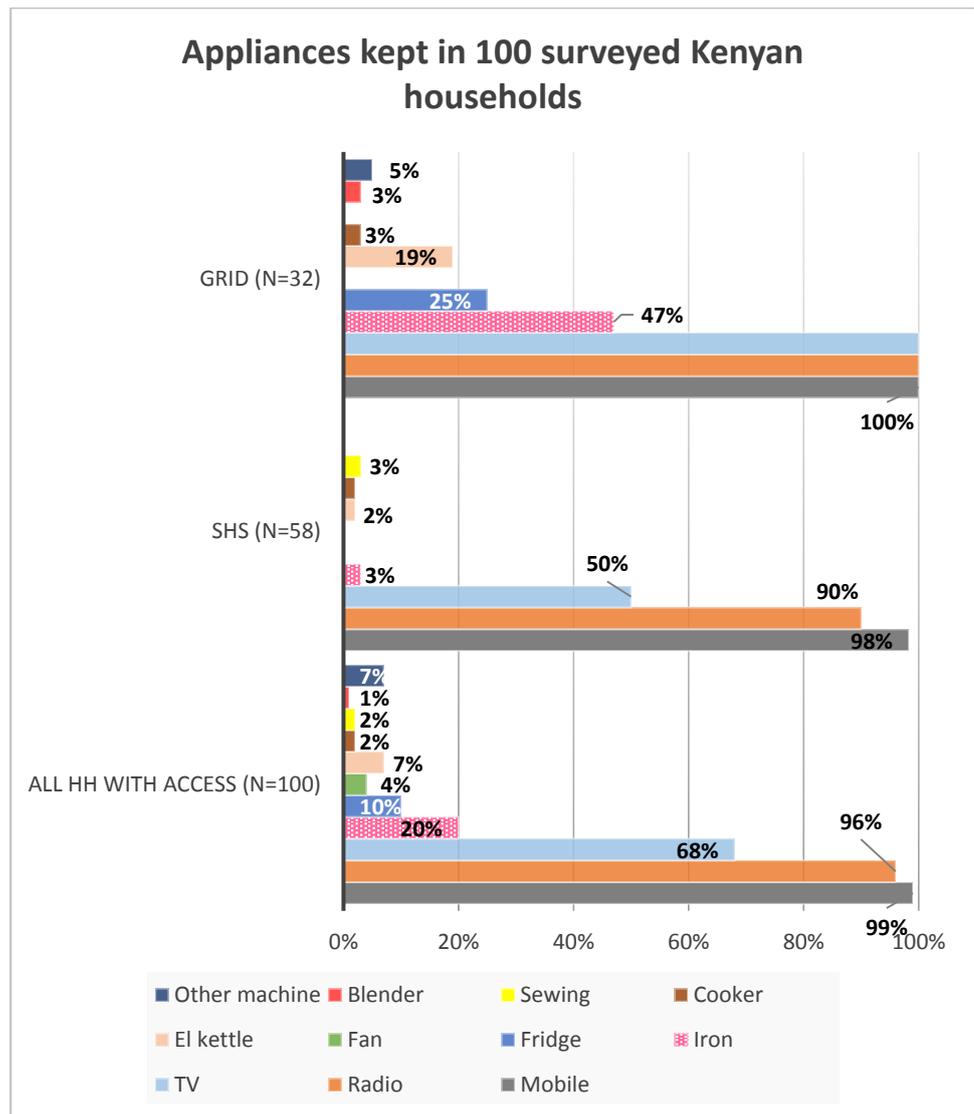
⁶¹ Interviews in Kenya were carried out in Homa Bay and Kitui counties.

⁶² When denoting some focus groups as “women” and others as “men”, it reflects the gender of the majority of participants.

ANNEX 4 : APPLIANCES PER ACCESS TYPES

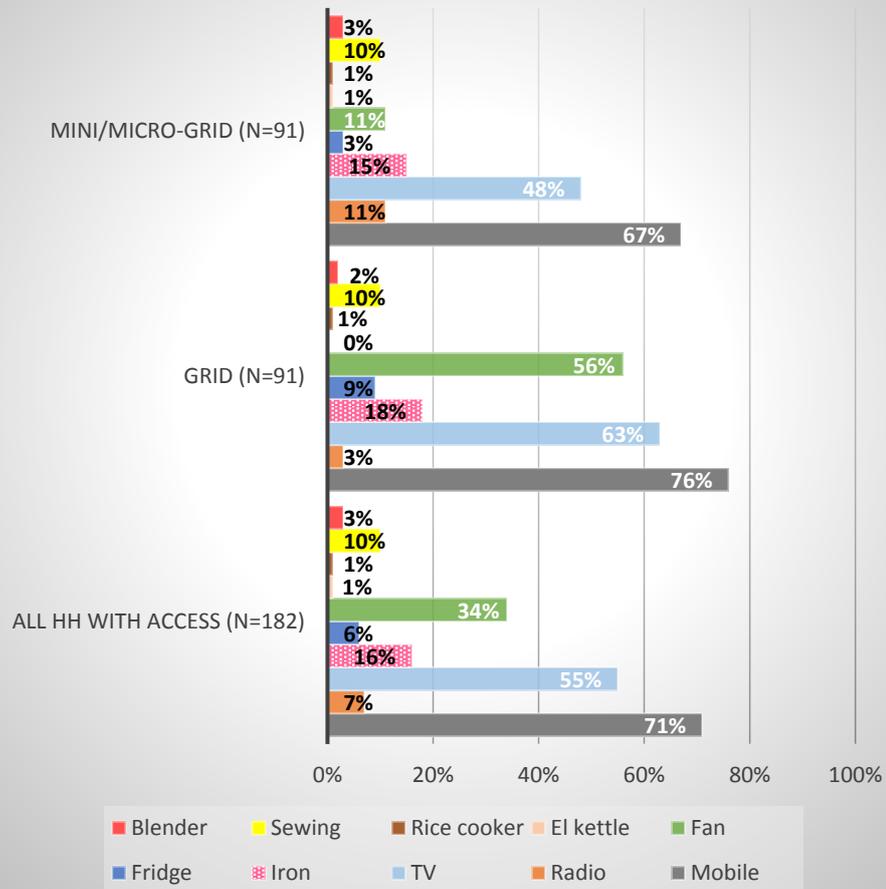


Only three of 13 households with SHS kept rice cookers, so percentages to be interpreted accordingly. We do not know if these appliances are used together with the SHS or in other households with other kinds of access, or used at all.



In the Kenyan sample, six households had a mini-grid connection (Kiwa Island) and four who kept a generator. The appliances kept by these 10 households are included in the total number with access (n=100) but not shown separately.

Appliances kept in 182 surveyed Indian households



Not shown in this figure: 10% (9 households with grid and 9 with mini-grid) keep an electric sewing machine. See Annex 6 for more details.

ANNEX 5 : APPLIANCES: GENDERED CONNOTATIONS AND USES WITH VARIOUS SYSTEMS OF SUPPLY⁶³

The most common type of appliances observed in the EFEWEE Survey, the type of electricity system with which they occur/are used, and their gendered connotations

Object	Country	Decided, purchased, kept and used by women/men household members	Type of subscription	Gender connotation
Mobile phones	Nepal	Decided and purchased by man, other people, both. Kept by both and used by all QA22: among 220 hh: kept by 88 women, 89 men, 6 jointly, 68 by 'other people'	75 grid, 78 m-g, 11 SHS, 10 b/l ¹ , 1 no access	Neutral
Mobile phones	Kenya	Decided, purchased and used by both. QA22: among 134 married respondents: kept by 110 women and 122 men, 8 jointly, 4 'other people'	32 grid, 6 m-g, 57 SHS, 5 b/l, 4 gen., 85 no access	Neutral
Mobile phones	India	Kept by men, used jointly. QA22: among 146 hh: kept by 4 women, 139 men, 7 'other people'.	69 grid, 61 m-g, 5 batteries, 11 no access	Male/shared
Radios	Nepal	Decided and purchased by man, other people. Custody: both, man. Used by all	23 grid, 23 m-g, 6 SHS	Male/shared
Radios	Kenya	Decided and purchased by man (70%), both, woman. Custody: man, both, woman. Use: man, both, woman	31 grid, 6 m-g, 51 SHS, 2 b/l, 4 gen.	Male/shared
Radios	India	Decided, purchased and owned by man. Use: all	4 grid, 11 m-g	Male/shared
Colour TV	Nepal	Decided and purchased by man, other people. Custody: Both, all	34 grid, 20 m-g, 5 SHS	Neutral
Colour TV	Kenya	Decided and purchased primarily by man. Custody: both. Use: both, woman	29 grid, 6 m-g, 29 SHS, 3 gen	Neutral
B&W TV	India	Decided, purchased and owned by man. Use: all. Kept by 101.	70 grid, 31 m-g	Male/shared
Colour TV	India	Decided, purchased, owned and used by both/all. Kept by 65.	38 grid, 27 m-g	Neutral
Rice cooker	Nepal	Decided and purchased by man, other people, woman. Custody: Both, all, woman. Used by woman, both, all. Kept by 44 hh.	27 grid, 14 m-g, 3 SHS	Female

mg refers to mini- or microgrid.

⁶³ Items interpreted as being female are marked in pink, male objects in blue, and gender neutral objects are not marked.

Other types of appliances observed in the EFEWEE Survey, the type of electricity system with which they occur/are used, and their gendered connotations. The numbers in brackets show the frequency of occurrence in the sample.

Object	Country	Decided, purchased, kept and used by women/men household members	Type of subscription	Gender connotation
Blender/mixer	Nepal (4)	Decided and purchased by woman, other people. Custody: woman, other people. Use: women, all	3 grid, 1 m-g	Female
Blender/mixer	Kenya (1)	Decided, purchased, owned and used by woman	1 grid	Female
Blender/mixer	India (5)	Decided, purchased and owned by man, woman (1). Use: all	2 grid, 3 m-g	Male/shared
Cooker	Kenya (2)	One decided by man (no info on custody/uses)	1 grid, 1 SHS	Unknown
DVD player	Nepal (1)	Decided and purchased by man, other people. Custody & use: man, both, other people	1 m-g	Male
Electric kettle	Nepal (1)	Decided, purchased and owned by other people. Use: all	1 m-g	Neutral
Electric kettle	Kenya (7)	Decided, kept and used by woman	6 grid, 1 m-g	Female
Electric kettle	India (1)	Decided, purchased, owned and used most by woman	1 m-g	Female
Electric saw	Nepal (1)	Decided and purchased by man, other people. Custody & use: man, both, other people	1 SHS	Male
Fan (table /ceiling)	Nepal (6)	Decided and purchased by man, woman, other people. Custody/use: All, both	4 grid, 2 m-g	Neutral
Fan (table /ceiling)	Kenya (4)	Decided and purchased by man (3), woman (1). Custody: man, jointly	4 m-g	Neutral
Fan (ceiling)	India (33)	Decided, purchased, owned and used by all	30 grid, 3 m-g	Neutral
Fan (table)	India (33)	Decided, purchased and owned by man. Use: all	25 grid, 8 m-g	Male/shared
Iron	India (30)	Decided, purchased and owned by man. Used by all.	16 grid, 14 m-g	Male/shared
Fridge	Nepal (6)	Decided and purchased by man, other people, woman. Custody: both. Use: all/both	3 grid, 3 m-g	Male
Fridge	Kenya (10)	Decided by both, man. Custody: man, woman. Use: women.	8 grid, 2 m-g	Neutral
Fridge	India (11)	Purchased by man, used by all.	8 grid, 3 m-g	Male/shared
Iron	Nepal (6)	Decided and purchased by man, other people, woman. Custody: both, all. Use: both, all, woman	4 grid, 2 m-g	Neutral (negotiated?)
Iron	Kenya (20)	Decided, purchased, owned and used most by woman	15 grid, 3 m-g, 2 SHS	Female
Rice cooker	India (6)	One respondent: Decided, purchased and owned by man, used by woman. Other respondent: All members decided etc.	3 grid, 3 m-g	Female (negotiated?)
Sewing machine	Kenya (2)	Decided, purchased owned and used by woman	2 SHS	Female
Sewing machine	India (18)	Decided by woman, purchased by man, owned by man, both, woman. Used by all	9 grid, 9 m-g	Female/male (negotiated)
VDC player	Nepal (1)	Decided and purchased by man, other people. Custody & use: man, both, other people	1 m-g	Male
Water pump	Nepal (1)	Decided and purchased by man, other people. Custody & use: man, both, other people	1 grid	Male

ANNEX 6 : LIST OF 25 INTERVIEWED STAKEHOLDERS IN ENERGY SECTOR

Country	Institution	Designation	Place	Date	Gender
Nepal	Alternative Energy Promotion Centre	Executive Director	AEPC Office, Kathmandu	22 April, 17	Male
Nepal	Alternative Energy Promotion Centre	Senior Officer - Solar Energy	AEPC Office, Kathmandu	22 April, 17	Male
Nepal	Alternative Energy Promotion Centre	Assistant Program Officer - GESI	AEPC Office, Kathmandu	22 April, 17	Male

Country	Institution	Designation	Place	Date	Gender
Kenya	Kenya Power	Chief Engineer, Off-Grid Power Stations	Nairobi	29 Nov. 17 15 Oct. 18*	Male
Kenya	Ministry of Energy	Deputy Director of Renewable Energy	Nairobi	27 Nov.17 15 Oct. 18	Female
Kenya	Energy Regulatory Commission	Director of Renewable Energy	Nairobi	27 Nov.17 5 Oct. 18	Female
Kenya	Powergen	Special Project Fellow	Nairobi	29 Nov. 17	Male
Kenya	Kengen	Middle Manager	Nairobi	20 June 17	Requested anonymity
Kenya	wPower	Director of Partnerships	Nairobi	23 June 17	Female
Kenya	BBOX	Country Director	Nairobi	12 Feb.18	Female
Kenya	Former Kenya Power	Former lead of different departments	Nairobi	30 Nov 17 3 Oct 18	Female
Kenya	University of Nairobi Department of Sociology and Social Work	Lecturer, Consultant, Researcher	Nairobi	04 June.15	Female
Kenya	Nature Kenya	Executive Committee Member	Nairobi	12 Oct.15	Female
Kenya	World Bank	Energy Specialist	Nairobi	11 Oct. 18	Female
Kenya	Renewvia	Chief Executive Officer	Nairobi	12 Oct. 18	Female
Kenya	Rural Electrification Authority	General Manager, Projects	Nairobi	12 Oct. 18	Female

Country	Institution	Designation	Place	Date	Gender
India	CREDA	Assistant Engineer	Raipur	2 Sept. 16	Male
India	CSEB (state utility)	Junior Engineer	Jhalap	6 Sept. 16	Male
India	State Utility	Line Man Assistant	Raitun	6 Sept. 16	Male
India	JEEVIKA	SDM	Purnea	20 March 17	Male
India	JEEVIKA	DPM	Purnea	20 March 17	Male
India	NBPDCL	Executive Engr (supply)	Purnea	19 March 17	Male
India	NBPDCL	Executive Engr (rural)	Purnea	19 March 17	Male
India	Jai Vaishnavi	Service In-charge	Purani Garail	21 March 17	Male
India	TERI	Fellow	New Delhi		Male

* Dates marked in bold indicate the second time of interview/meeting.

ANNEX 7 : REPORTED DURATION OF HOMEWORK (EFEWEE SURVEY)

Percentage of GIRLS doing homework (hours/day) across access types (three countries)

Percentage Girls (13-17) by Homework hours (<i>per day</i>)				
Nepal				
Access Category	1 hr	1-2 hrs	More than 2 hrs	Total
Grid	36.8	36.4	83.3	42.6
Mini Grid	31.6	50.0	0.0	36.2
SHS only	21.1	9.1	0.0	12.8
Batteries/ Solar Lanterns only	0.0	4.5	16.7	4.3
Stand alone generators only	0.0	0.0	0.0	0.0
No Access	10.5	0.0	0.0	4.3
All Girls (13-17)	19	22	6	47
Kenya				
Access Category	1 hr	1-2 hrs	More than 2 hrs	Total
Grid	17.6	34.5	36.0	31.0
Mini Grid	0.0	0.0	0.0	0.0
SHS only	35.3	24.1	28.0	28.2
Batteries/ Solar Lanterns only	0.0	3.4	0.0	1.4
Stand alone generators only	0.0	6.9	0.0	2.8
No Access	47.1	31.0	36.0	36.6
All Girls (13-17)	17	29	25	71
India				
Access Category	1 hr	1-2 hrs	More than 2 hrs	Total
Grid	53.3	45.5	0.0	48.6
Mini Grid	20.0	45.5	0.0	35.1
SHS only	0.0	0.0	0.0	0.0
Batteries/ Solar Lanterns only	0.0	0.0	0.0	0.0
Stand alone generators only	0.0	0.0	0.0	0.0
No Access	26.7	9.1	0.0	16.2
All Girls (13-17)	15	22	0	37

Percentage of BOYS doing homework (hours/day) across access types (three countries)

Percentage Boys (13-17) by Homework hours (<i>per day</i>)				
Nepal				
Access Category	1 hr	1-2 hrs	More than 2 hrs	Total
Grid	23.5	38.9	100.0	35.1
Mini Grid	70.6	33.3	0.0	48.6
SHS only	5.9	11.1	0.0	8.1
Batteries/ Solar Lanterns only	0.0	16.7	0.0	8.1
Stand alone generators only	0.0	0.0	0.0	0.0
No Access	0.0	0.0	0.0	0.0
All Boys (13-17)	17	18	2	37
Kenya				
Access Category	1 hr	1-2 hrs	More than 2 hrs	Total
Grid	12.5	19.2	28.0	21.2
Mini Grid	0.0	3.8	0.0	2.4
SHS only	37.5	36.5	36.0	36.5
Batteries/ Solar Lanterns only	0.0	0.0	4.0	1.2
Stand alone generators only	0.0	1.9	0.0	1.2
No Access	50.0	38.5	32.0	37.6
All Boys (13-17)	8	52	25	85
India				
Access Category	1 hr	1-2 hrs	More than 2 hrs	Total
Grid	0.0	58.6	0.0	56.7
Mini Grid	0.0	37.9	0.0	36.7
SHS only	0.0	0.0	0.0	0.0
Batteries/ Solar Lanterns only	0.0	0.0	0.0	0.0
Stand alone generators only	0.0	0.0	0.0	0.0
No Access	100.0	3.4	0.0	6.7
All Boys (13-17)	1	29	0	30

ANNEX 8 : SOCIO-CULTURAL AND MATERIAL CONTEXTS, THREE STUDY AREAS

8.1 Socio-economic profile and livelihoods

Nepali study sites

In Nepal, both study areas are remotely located in hilly areas and have extremely poor road infrastructure and connectivity to the nearest major town and highway. Local transportation is available in the form of buses and jeeps, which make multiple trips in a day, but vehicle overloading is common, causing the journey to be quite unsafe on the bumpy, unpaved and sometimes steep roads. This situation is further aggravated during monsoons, which makes the road muddy and vehicles often get stuck, a major problem during medical emergencies. The Nepal study area included in the survey, Mahadevsthan,⁶⁴ (in Dhading district) which is prone to natural disasters such as floods. The area also suffered severely from an earthquake in 2015, which negatively affected livelihoods. The other Nepali site, Ghiring, is less prone to natural disasters.

The participants in our survey (Mahadevsthan) had limited education, as shown in Figure 24. This rate of illiteracy is above the national average which stands at 57.4% for women and 75.1% for men (Govt. of Nepal 2016).

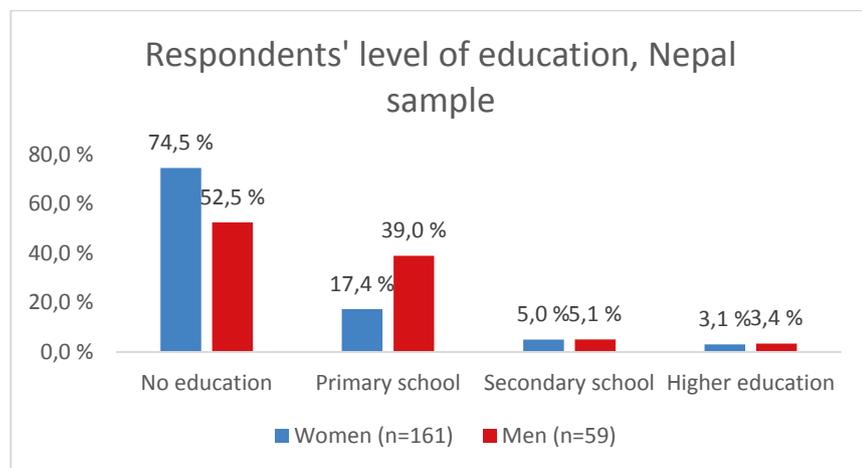


Figure 24 Respondents' level of education (Nepal)

In both areas in Nepal, most women and men are engaged in agriculture and subsistence farming. Almost all households own agricultural land, though the economically stronger households tend to have larger and better irrigable land holdings, which is key for high productivity in hilly regions. A large segment of the economically weaker part of the population works as casual labourers in agriculture and construction (locally or in nearby towns and cities). In addition, several people (women and men) are engaged in small-

⁶⁴ Mahadevsthan (also referred to as Benighat Rorang) is located more than two hours' drive from the closest highway. The community has suffered several displacements and has also been a host community for other disaster-displaced communities.

scale / home based productive activities which include small grocery shops, eateries, tailoring units, poultry, goat rearing, grain mill, a furniture workshop, photocopy and photo studio. As many as 83% of the Nepalese survey households had a women member forming part of a group involved in welfare improvement e.g. microfinance, which was also common in the Kenyan but not in the Indian sample.

An important aspect of the household economy in the Nepali sites is that many men, particularly in Ghiring, out-migrate and work abroad.⁶⁵ For example, in our survey (Mahadevsthan), 14 out of 139 married women in the sample reported that there are no adult men living in the household.⁶⁶ Though we did not ask specifically about remittances sent by a husband to a wife in the survey, our qualitative material indicates that such transactions do occur, potentially leaving women with a higher degree of agency in economic matters than what she might have enjoyed if the husband were living at home.

Women’s types of income generation (Figure 25) was reported by 159 of the 220 Nepali survey participants, which probably reflects that women in non-responding households did not have a regular income. Therefore, the reported shares are probably higher than in reality. Nonetheless, our survey results from Mahadevsthan (Nepal, N=220) show that more women than men derive income from agriculture. Approximately half of the men in the sample have casual labour. We also note that 70% of the women produce and sell small things. In the Kenyan and Indian sites, such small-scale production/sales are less common (below).

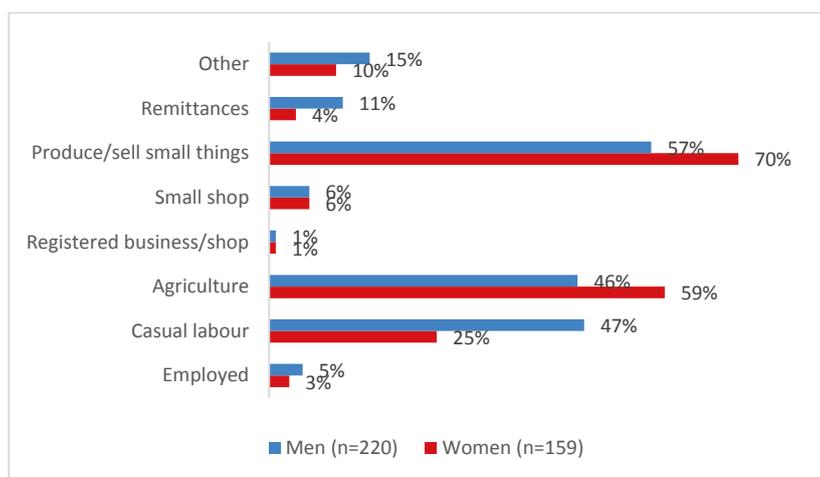


Figure 25 Women and men’s types of income, Nepal sample, N=220 (EFEWEE Survey)

Kenya study sites

In Homa Bay County in Western Kenya, the studied villages located close to Lake Victoria (God-Bura and Kiwa Island) host a vibrant fishing industry that brings possibilities for income beyond farming, and there are many shops and businesses. Private promoters of small solar systems are very active in the area. This is in contrast to other parts of Kenya such as Kitui County in Eastern Kenya where we did qualitative research, where income

⁶⁵ In Ghiring we were told that almost 75% of men are working abroad. Our interviewees pointed out that due to their low levels of technical skills and basic educational qualifications, the out-migrated men are usually hired as low-skilled workers.

⁶⁶ We do not know if these husbands have migrated or are living with second wives.

opportunities are few and fewer private solar agents promote their products. The study villages in Kitui are also remote, water stressed and prone to droughts.

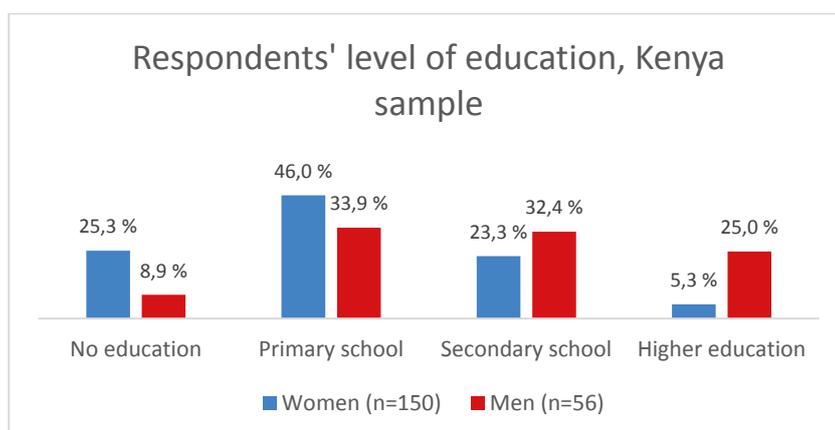


Figure 26 Respondents' level of education (Kenya)

As shown in Figure 27, relatively few survey respondents in Homa Bay reported that they make an income from agriculture in (N=207), though we learned from qualitative research that subsistence farming is widespread. As many as 41% of the women are involved in running shops or businesses. 30% of the men make a living from fishing, and 12% of the women are involved in fish trading. A relatively high share of the men in the sample have permanent employment (22%) and similar to Nepal, it is very common (66%) for the Kenyan women to be part of self-help groups.

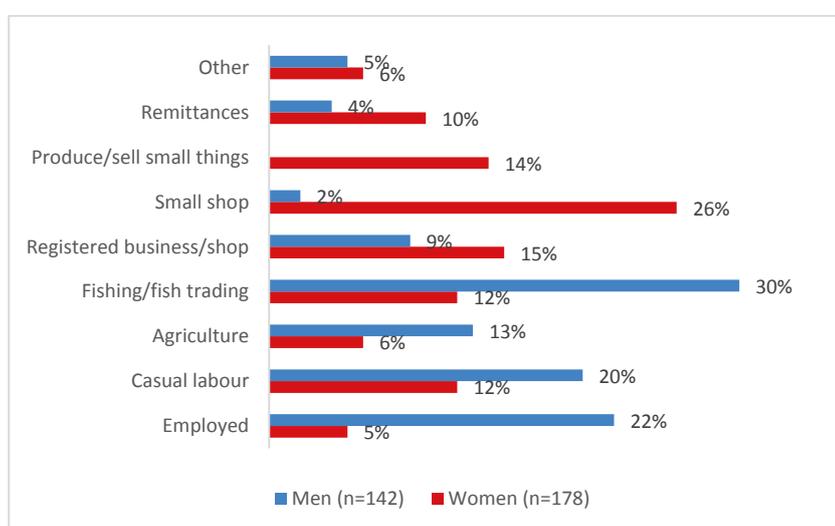


Figure 27 Women and men's types of income, Kenya sample, N=207 (EFEWEE Survey)

Indian study sites

The study areas in India are land-locked. The selected study area in Chhattisgarh consists of forested areas within a wildlife sanctuary which is also relatively frequented tourist area. The central grid reaches the outskirts of the forest, while off-grid and un-electrified villages are located within the forest. The forested villages are accessed by poor roads without basic transport services, whereas the studied grid-village is connected to permanent roads and had frequent mini-bus services. In the interior parts of the forest, people depend on agriculture and forest produce for income. The electrified village in the

outskirts has more diversified enterprises. The state of Bihar is traversed by the river Ganga, which makes plains of the state fertile and arable.

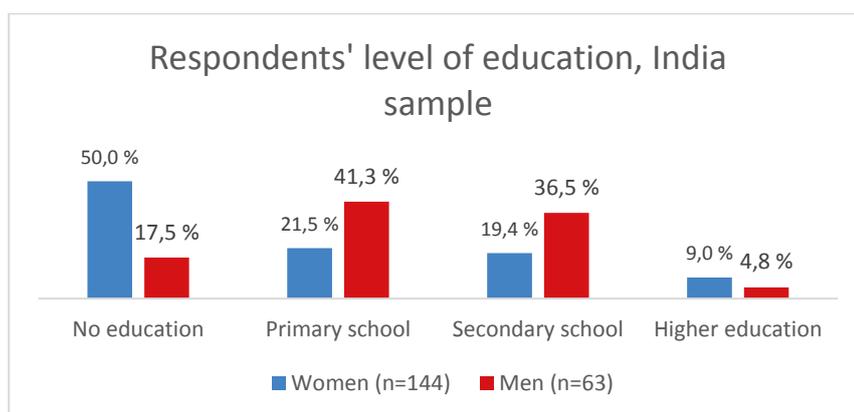


Figure 28 Respondents' level of education (India)

In the survey area in Chhattisgarh, casual labour and agriculture are the dominant sources of income both for women and men (Figure 29). In contrast to Nepal, none of the Indian households said that the woman produces things for sale, and they rarely run shops /businesses compared to what was reported by the Kenyan households. Furthermore, in contrast to the surveyed Nepal and Kenya women and also our study area in Bihar (India), where there are many women self-help groups, very few women (6%) in the survey sample in Chhattisgarh form part of groups engaged in development activities (e.g. self-help groups). In short, women and men in the study area in Chhattisgarh appear to have few other means for making a living than agriculture and casual work.

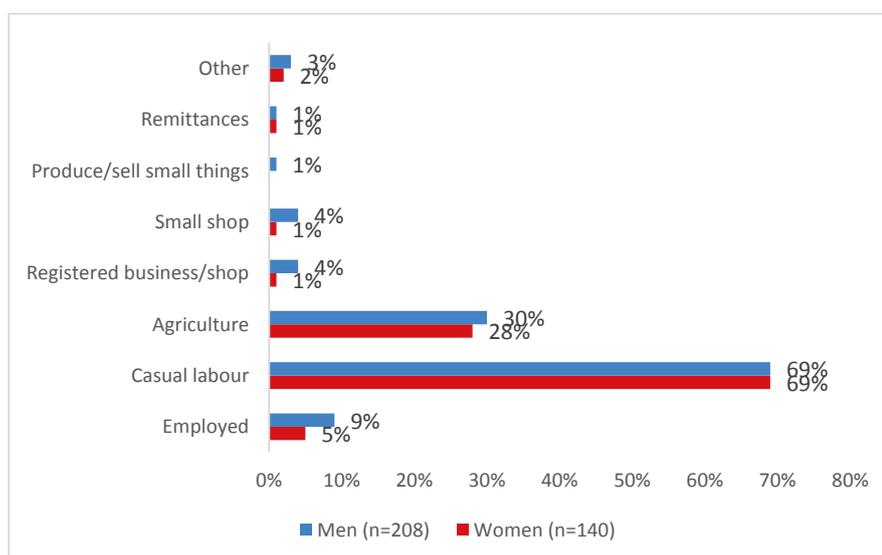


Figure 29 Women and men's types of income, India sample, N=215 (EFWEE Survey)

8.2 The women's level of income compared to the men

In the Kenyan and Indian samples, the reported levels of income show that women's make approximately 40% of men's average income, while we did not obtain similar data

from Nepal.⁶⁷ In the Kenyan sample, women generate 1.3 USD per day on an average, while the Indian women only make 67 US Cents per day. Very few women and men reported making use of electricity for productive activities.

8.3 Household composition⁶⁸

Across the three country studies, a woman usually moves into her husband's home when getting married. Particularly in the Indian sample, but also among the Nepalese households, it is relatively common that a couple resides with the parents of the husband, thus several adults often share a residence.⁶⁹ Having an inter-generational household composition may positively affect a household's joint affordability to obtain electricity access. Also, as noted, 14 of the married Nepalese women said there was no man living in their households, which indicates that the husband has out-migrated, leaving everyday responsibilities to the woman or parents-in-law. At the same time, inter-generational living patterns may restrict a young woman's ability to make decisions (e.g. Standal and Winther 2016) and also use electricity because young women enjoy fewer privileges than men and older generations. For example, a young woman we met in Nepal who was living in the first floor of a house, did not have access to using electricity, while her parents-in-law, occupying the ground floor, had access.

In the Kenyan sample, it is not very common that several women and men live in the same house.⁷⁰ Polygamy is present in Homa Bay, so in a compound of several houses (counted as individual households in the survey), a husband with more than one wife may belong to and support more than one house. The high share (38%, n=57) of women without a husband in the Kenyan sample, of whom most (53) were widows, contributes to lowering the average number of adults per household. The high number of widowed women (35%) is probably linked with the high prevalence of HIV in Homa Bay, which was at 26% in 2017, nearly 4.5 times higher than the national prevalence (National AIDS Control Council 2018), rising from 24% in Homa Bay in 2002 (Omwege et al. 2006).

8.4 Gendered assets and decision making patterns

Almost all the survey households were self-tenants, i.e. they own the houses they live in. The land is mainly controlled by men. In 89% of the Nepalese cases, the land on which the house is built either belongs to the man or the man's father/parents and 6% of the cases the land belongs to a woman.⁷¹ In Kenya, the land was owned by either the man (50%), both spouses (19%) or widowed women (30%). In the Indian sample, 75% reported that the land was owned individually by the man, 11% by the woman and 10% by other people. Figure 30 shows the similar distribution of house ownership⁷² irrespective of the marital status of respondents.

⁶⁷ In Kenya, women were said to make 39 USD/month in average (n=37) and men 102 USD/month (n=44). In India, women's monthly income was 20 USD (n=133) and men's income was 46 USD per month (n=193). For Nepal we only have figures for people in permanent positions: women 135 USD/month (n=4), men 120 USD/month (n=10).

⁶⁸ When presenting results, we refer to results from the EFEWEE survey if not otherwise indicated.

⁶⁹ In the Indian sample, there were 1.79 adult women and 1.79 adult men per household and in Nepal co-residence was slightly less common; 1.47 women and 1.35 men per household.

⁷⁰ In the Kenyan sample there were 1.10 women and 1.06 men per household in average.

⁷¹ The number of responses to land ownership: Nepal (218 of 220), Kenya (192 of 207) and India (167 of 215).

⁷² The number of responses to house ownership: Nepal (212), Kenya (200), India (210).

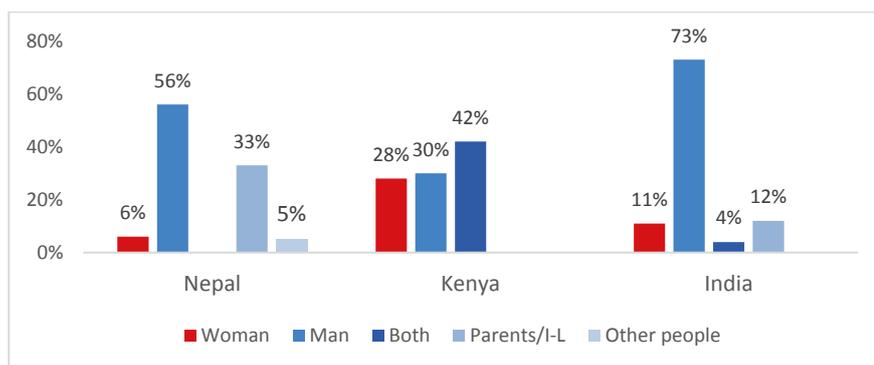


Figure 30 House ownership in the study sites in Nepal, Kenya and India (EFWEE Survey)

In Nepal, five of the 13 women house owners (6% of all house owners) are widows and eight are married. In Kenya, all the 53 house-owning women (28%) are widows, hence no married woman in the Kenyan sample owns a house in her own right. In India, among the 23 (11%) woman-owned houses, 15 (65%) are widows, one (4%) is divorced and only seven (30%) are married. *This leaves the shares of women-owned houses among married women at 4% in Nepal, zero in Kenya and 3% in India.*

To examine whether women are perceived to have long-term right and control over other kinds of assets, we asked survey participants: “If a woman owned a traditional item, would she keep it in the case of divorce or widowhood?” In Nepal and India, we gave an example of jewellery and in Kenya, we suggested a bed. Women in Nepal are often given jewellery as a personal kind of bride gift (*pewa*) at the time of marriage, and probably for this reason, none of the Nepali respondents objected to the idea of women keeping this personal gift in the case of divorce or widowhood.

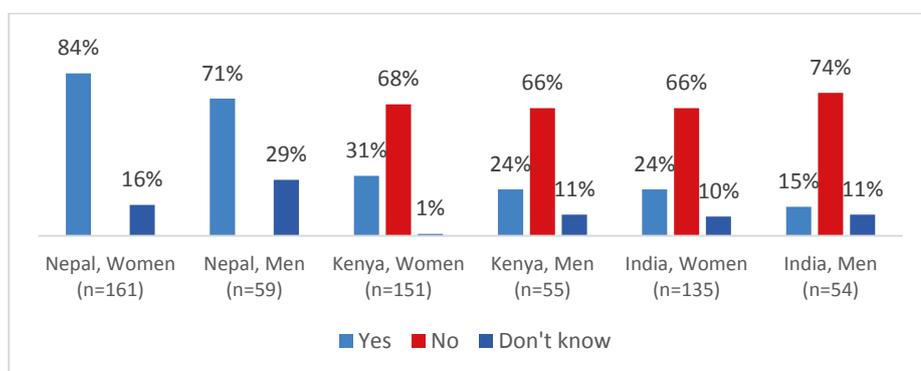


Figure 31 Women and men's views on a woman's likelihood/right to keep a traditional item in the case of divorce or widowhood (EFWEE Survey)

In Kenya, 68% of the women and 66% of the men did not think a woman may/would keep a traditional item (bed), even if the question specified that the item would be “owned by her”. Among the Indian men, 74% said that a woman would not keep the traditional item (jewellery) in the case of widowhood or divorce.⁷³ Across the three countries, there is a tendency that women more often than men think that a woman would keep the item. This suggests that when people responded, both their previous experiences/observations

⁷³ During the qualitative research we learned that in this part of Chhattisgarh, a local tribal court decides who would keep a traditional item based the reason for divorce. If the man is found guilty then the women usually retains the items while if the women is found guilty then the man retains the traditional items.

and personal norms came at play. It also shows that while women think they have some property rights, men are less likely to think so.

We asked the same question on a woman’s likelihood/right to keep an item with reference to modern appliances (Figure 32), giving the examples of a radio/freezer/TV/Solar Home System/cook stove.

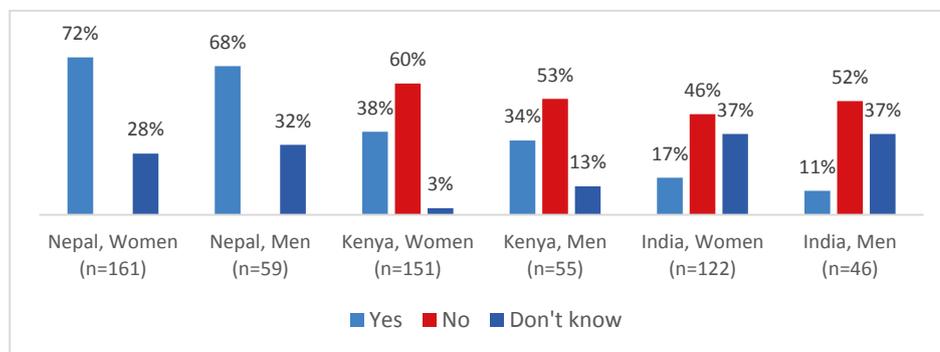


Figure 32 Women and men’s views on a woman’s likelihood/right to keep a modern item/appliance in the case of divorce or widowhood (EFEWEE Survey)

Here, the share of respondents saying they ‘don’t know’ increases in all three countries (as if they have never witnessed such an event). In this case, the difference between Nepal and the two other countries do not relate to the bridewealth, and is therefore particularly interesting: Nobody in the Nepal sample said a woman cannot take with her a modern object that she owns in the case of divorce or widowhood. This implies that the general perception in the Nepal site is that women own and control modern assets individually.

In Kenya and India, as in the case of a traditional item, there is still a majority saying that a woman would not keep the item, but the share saying ‘no’ is slightly lower than for traditional items. For Kenya, the shares saying yes increase as we move from traditional to modern, while in India the shares decline. Hence, in Kenya, the modern items are adopted in a way that slightly points away from the traditional pattern of men controlling items. In India (i.e. our study site in Chhattisgarh), modern appliances are associated even more strongly with the male/extended family as compared with traditional items.

These results from an important backdrop when we consider the gendered access to deciding on electricity, acquiring appliances and using electricity. Within our study sites, women in Nepal appear highly autonomous in the possibility of keeping assets and hence deciding over them in the long term (recall quite a few with migrant husbands). In Kenya and India, where about half of the population believes a woman cannot keep an appliance obtained by her in the event of divorce or widowhood, this might influence women’s willingness to invest in the same, though other factors such as affordability, access (geographical location) and sufficient/reliable power probably also matter. Also relevant in this picture is the perceived probability for divorce, which rate is relatively low in our three samples.

As an attempt to understand intra-household decision making,⁷⁴ we asked respondents: “Who in the household tends to decide how the money you have earned should be spent?” The most common answer was that the married couple jointly decides on the spending, as shown in Figure 33. Because there are many widows in the Kenyan sample, we disaggregate the findings from Kenya on married women and men as well as women and men in general.

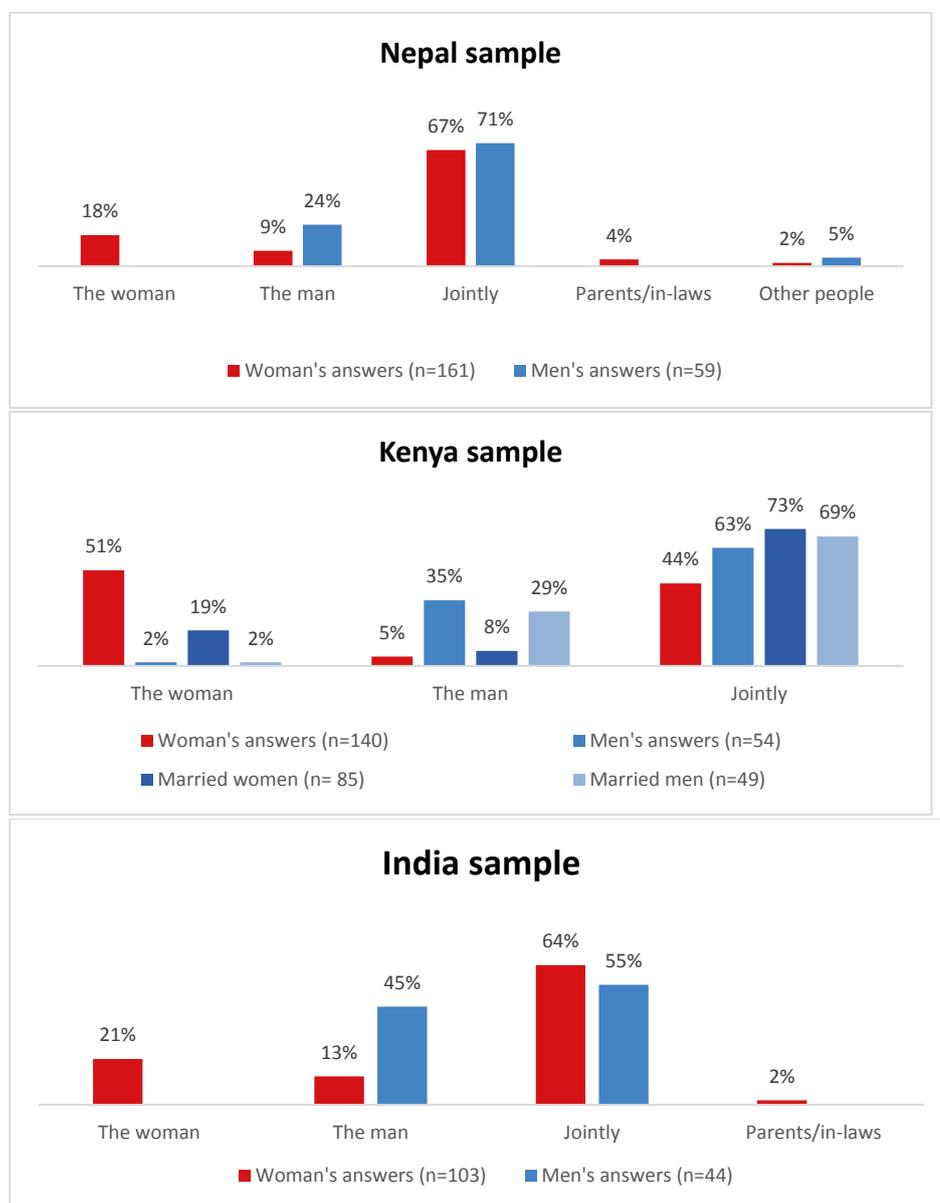


Figure 33 Women and men’s answers to who in the households tends to decide on how the money you have earned should be spent? Three study sites. (EFWEE Survey)

There are some interesting variations in women and men’s answers in each context. Among Nepalese women, 9% say that their husband tends to decide on the wife’s income, while no Nepalese men say that his wife decides over his income. In Kenya, relatively few (5%) of the women say that their husband decides, while only 2% of men say their wife decides. In India, 13% of the women say that their husband decides while no Indian men

⁷⁴ Asking questions about decision making in short survey meetings is not highly suited for understanding decision making processes, which should ideally be observed over time (i.e. ethnographic research). It is likely that respondents here gave answers that are compatible with local social norms, or gave answers they thought enumerators expected.

say that their wife tends to decide. In sum, among Indians and Nepalese, some husbands have control on their wives' incomes, but only in approximately 10% of the cases, hence women here, as in Kenya, appear relatively autonomous in terms of making decisions on their own incomes. This somewhat contrasts the norms for women's limited right/access to endowments found above.

8.5 Daily routines, division of work and drudgery chores

In the three study contexts, the distribution of roles and responsibilities between men and women mainly follows traditional convention in which the women are primarily in charge of care work activities at home such as cooking, cleaning, washing, rearing children, feeding animals and fetching water, while men are perceived as economic providers who look after productive and income-generating activities outside the home. However, as noted, a high share of the Kenyan women are also engaged in businesses, while in Nepal and India more women are involved in agricultural activities and in some cases manage additional livelihoods like goat rearing, poultry and tailoring.

As an illustration of the gender distribution of tasks, we provide a detailed example from Kenya (Table 13). It should be mentioned that this couple was of relatively old age, the husband might have less capacity to work compared to younger men.⁷⁵ However, similar gender differences in wake-up hours were reported also in other households.

Table 13 Daily schedule of a woman and her husband, Ikisaya village, October 2016

	Wife's schedule	Husband's schedule
4 am	Get up, milk cows	
6 am	Prepare tea (breakfast)	
7 am	Take tea	Wake up, take tea
9 am	Go to shamba (firewood)	Go to do other duty (collect and construct things)
12 am	Prepare lunch	
1 pm	Eat lunch	Eat lunch
2 pm	Fetch water	Rest
4 pm	Fetch firewood	Go back to work, look after goats
5 pm	Collect lantern, socialise	Sit and listen to the radio
6 pm	Prepare supper	
8 pm	Eat supper	Eat supper
9 pm	Make ropes	
10 pm	Go to bed	

Firewood collection is a chore that often falls on women in the three contexts. In India (n=239, i.e. several responses sometimes reported), 38% of the answers included using a bicycle, while the remaining went by foot.⁷⁶ Households in our Nepali sample spend most time fetching firewood, approximately 4.5 hours per week, while the Kenyans spend most time collecting water, almost 10 hours per week.

⁷⁵ The husband and several young men were present during this interview with the woman, and when asked about his daily schedule, he provided the answers himself. As the differences in the amounts of work performed by wife and husband gradually became clear, the men as well as the woman started to smile, as if they had not previously thought about this difference.

⁷⁶ Most households that reported to use bicycles had men participating in collecting firewood. Very few households with only women and girls collecting firewood used bicycle for this purpose.

Table 14 Time spent weekly collecting firewood and water (EFEWEE Survey)

Reported hours per week ⁷⁷	Nepal	Kenya	Nepal
Fetching firewood	4.57 (n=217)	1.43 (n=162)	2.53 (n=193)
Collecting water	3.96 (n=220)	9.90 (n=206)	6.85 (n=203)

Figure 34 conveys survey results on who in the households tend to collect the firewood. In addition to women, girls in Kenya contribute to this task in one-third of the cases. In the Nepali and Indian samples, also men fetch firewood regularly, but this is not reported in Kenya.⁷⁸ Both in Nepal (n=207) and Kenya (n=160), the reported means of transport was said to be “by foot”.

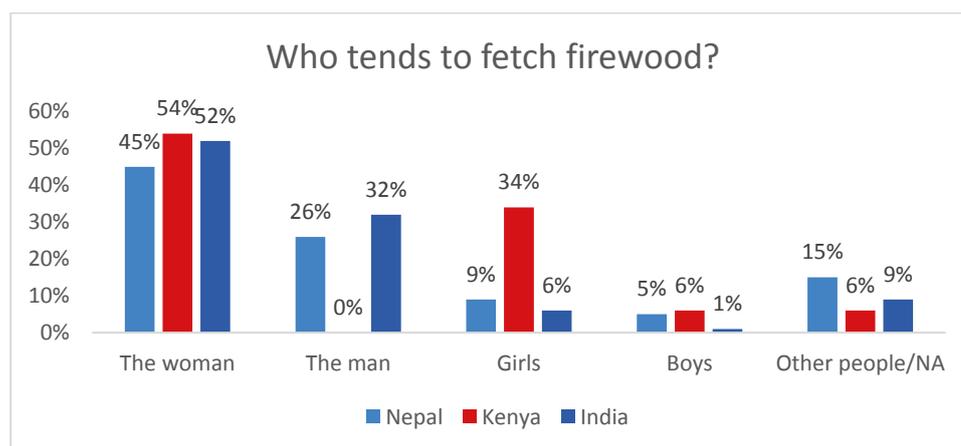


Figure 34 Who in the household tends to fetch the firewood? (EFEWEE Survey)⁷⁹

Women are also often responsible for collecting water, and here we note some differences between the answers of women and men; each of them seems to be more inclined to state that she/he takes part in the task (Figures 35 and 36).⁸⁰ Again, Kenyan girls participate, but also Kenyan boys and Nepali and Indian girls do the same.

⁷⁷ Figures are in numeric hours.

⁷⁸ Respondents were asked “Who in the household tends to fetch the firewood?” and they could mention several household members.

⁷⁹ Several responses possible, most common answers shown, adding all responses in one country to 100%.

⁸⁰ The possible answers provided were: You, your spouse, girls, boys, other people (separated by other women and other men). It is possible that the personalisation (“you”) caused expectations to confirm that the interviewed person participates. If the answers had been phrased “the woman”, “the man” etc., it might have balanced this effect.

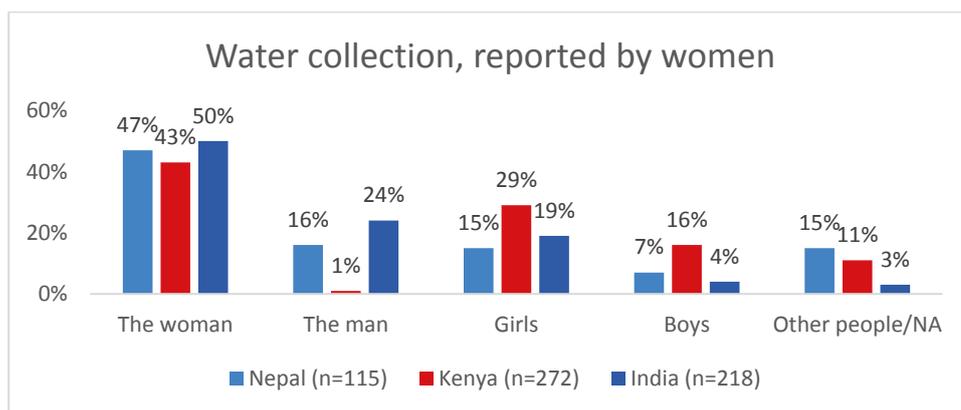


Figure 35 Women’s reporting on who in the household tends to collect the water (EFEWEE Survey)⁸¹

Nepalese and Indian men are more inclined to report that they take part in water collection (33% and 30% respectively) than what women report, but also Kenyan men are more likely to say they collect water (18%) than what women report. We do not know what causes these differences in women’s and men’s responses.

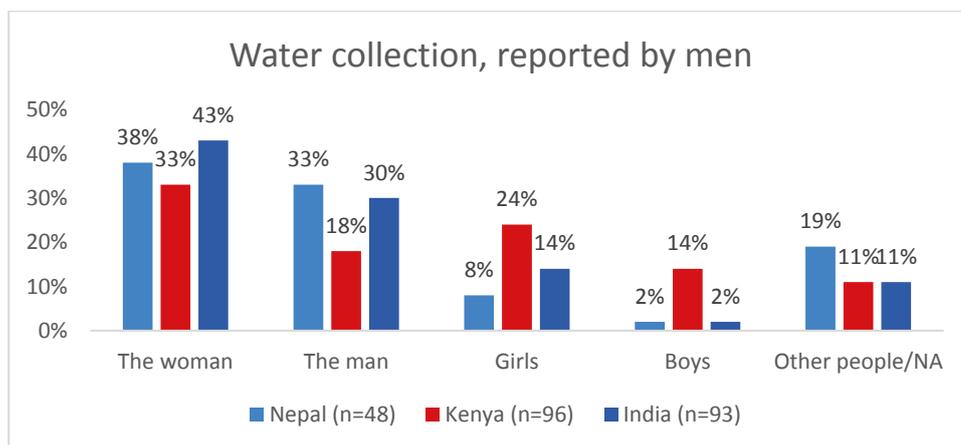


Figure 36 Women’s reporting on who in the household tends to collect the water (EFEWEE Survey)⁸²

8.6 Gender ideologies, norms and women and men’s social position

The gendered division of wealth to a large extent reflects traditional belief or knowledge systems (Barth 1989) that assign values, roles and responsibilities to women and men in specific ways. Here we briefly describe some of the recent changes in gender relations, as conveyed by our interviewees.

⁸¹ Several responses possible, the most common answers shown, adding all responses by women in one country to 100%.

⁸² Several responses possible, most common answers shown, adding all responses by men in one country to 100%.

Nepal⁸³

Generally, women are not in a position to make independent decisions about buying or selling land, property or other large assets. Decisions regarding family planning and contraception are not taken by women independently and in most cases are decided in consultation with their husbands. According to our survey responses, more than half the respondents said they make joint decisions regarding health-related issues.

Traditionally, marriages in rural Nepal are arranged by elders in the family, especially in Hindu families. However, so-called “love marriages” are becoming more common; young men and women are making autonomous decisions about choosing their partners – a phenomenon that was reported to have intensified with the use of mobile phones. While some people support love marriages and see them as informed choices made by educated and aware children as well as a relief from the burden of matchmaking, others consider such novel practices immature and careless. The dowry system is not strictly followed and depends on affordability, negotiations and religious customs. Formal divorces are extremely rare, and most communities follow traditional systems that influence how finances or assets are divided. There is usually no division of property as it belongs to the man, but he may provide some money to the wife as alimony. Children usually remain with the father, unless they are young e.g. needing breastfeeding or with high care needs. Men sometimes leave their wives to live with another woman, either abandoning the first wife or practising what is akin to polygamy. This practice which is said to be on the increase is particularly disadvantageous to the first wife, who is often treated as a free care provider for her husband’s parents and home but lacks the support of her spouse. At the same time, in some instances, married women find new partners in the absence of their husbands who have migrated for work.

Up to the highest schooling level available locally – School Leaving Certificate (SLC) level, girls and boys are provided with equal opportunities for education. For higher studies, most parents are reluctant to send their daughters away from home. Thus, even as boys and girls are increasingly being seen as equals, perceived risks of what will happen to girls being away from home or what they might do – and potentially social norms – restrict girls from moving out as boys do. This hampers girls from getting better education opportunities, even though they are considered no less valuable than boys.

Perceptions of empowerment

When asked about the concept of empowerment, a perception shared by men in the Nepali case study is that it is a state of awareness and understanding, and with respect to women, it is a matter of their rights. Some men said they consider women to be their own biggest barrier and placed a lot of the responsibility for empowerment on the women themselves (that they do not utilise opportunities or believe in themselves). Interestingly, women also confirmed this during their focus group discussion, stating that “*women themselves do not utilise the opportunities because they do not want to step out of their comfort zones*”. Other men acknowledged that a large part of the lack of women’s empowerment is due to the patriarchal structures in the country and society; but they did not see themselves as a part of that structure – at least in the way they communicated this. Some also highlighted the lack of programs to push women forward as a reason for

⁸³ The study sites in Nepal included members of Hindu castes (Brahmin and Chhetri) as well as indigenous Tamang and Chepang. The latter community appeared to practice a more gender egalitarian ideologies and practices, while the former groups generally hold a privileged position in Nepalese society.

women not becoming empowered. Women said they perceive empowerment as a collective strength and having the opportunity to progress and move forward by developing their skills. However, they felt extremely constrained by their domestic responsibilities that did not allow them to leave the house as frequently and as easily as men can, in addition to their low levels of education, technical skills and confidence.

Parents expressed high aspirations for their sons and daughters, to be better educated than them (cf. Annex 9.1 and the low level of education among respondents) – and have good jobs. However, due to the lack of good schooling or higher education opportunities at the local level, as well as due to prevalent social norms, very few children, and girls, in particular, are able to pursue quality higher education.

Kenya⁸⁴

Like in the Nepali and Indian study sites, the traditional gender norms and ideologies have been strongly oppressive for women. In both Kenyan Study areas, men have dominated women's lives, been the main decision maker, the owner of land and assets, and had the right to decide about sex. According to our qualitative interviews, polygamy is still common in the Homa Bay area. In the Kitui area, polygamy was common in the past, though men having women "on the side" is still common. Traditionally the women had to stay at home, and the girls were not sent to school.

It is clear from our interviews and observations in rural Kenya that major changes have taken place in gender ideologies and practices over the last decades. Many women may now leave the house during the day to do business or other activities. In Kenya, in general, it is common for women to run businesses and be leaders, and this is not a completely new situation. In the study area in Kitui, there were several "empowered" women years ago (when some of the team first visited the place), in terms of successful businesswomen, teachers with a strong role, young women going to colleges and women with leading jobs in public offices at the district level. Women's groups support women's economic activities, and to some extent, social positions in the community.

The gender roles in rural Kenya are dynamic, apparently moving gradually towards a stronger position for women. However, the husband's clan, to which his wife and children become affiliated, continue to be an important reference in times of conflict and resolution of moral issues. There are differences between families and individuals on how women's and men's roles are practised and perceived. Some men, especially teachers and village leaders seem to be in favour of gender equality when discussing gender roles in their marriages or when talking about their daughters' or pupils' opportunities in life.

An example of strengthened rights for women in the Homa Bay villages is that the tradition of widow inheritance (mainly found in Western Kenya) is becoming weaker. Widow inheritance implied that a man would inherit his late brother's wife. A woman's right and ability to escape this tradition seems to vary between individuals and families, depending on her network, her economic means, support from church groups and her own strength and ability to resist pressure from family, clan and others.

Perceptions of empowerment

⁸⁴ In the Kenyan study sites, the population is Christian (various churches). Survey respondents in Homa Bay are from the Abasuba and Luo tribes while a majority of people in the study site in Kitui are from the Kamba tribe.

Education stands out as one of the key factors that have empowered women in rural Kenya, both individually and as a group, and the government's education policy has been important in this regard. According to teachers at the visited schools, the number of girls who start school is similar to boys, while the dropout rates are higher for girls than for boys. The stated reasons include a lack of sanitary pads and hygiene facilities as well as pregnancies, sometimes because a girl has been raped. Problems of affording school fees affect both boys and girls. Nevertheless, many girls achieve high levels of education and some get relatively well-paid employment in cities and help their families economically. Economic independence was highlighted by our Kenyan interviewees as a key factor for empowerment. There were no strong perceptions that electricity had been central to women's empowerment.

India⁸⁵

Most of our interviews during qualitative research said they do not support discriminatory practices such as *purdah*, dowry, and domestic violence. However, there are patriarchal elements in some of the community's practices. Although the Indian law upholds equal share in the property for both boys and girls, in these villages the family property was always inherited by the son. Daughters only inherit property if there were no male heirs in the family.

Also in Bihar, men are the inheritors of family property. Practices like dowry are still being openly practised, while domestic violence was spoken of in hushed tones. The women are subservient and male child preference is high in these villages. Though girls and boys were said to be given equal opportunities to study, parents did not prefer higher education for girls as their main concern was to get them married by the age of 18 years. It was also observed that women's participation in community meetings and decision making at the village level was very low, as they lacked the confidence to express their views openly in male-dominated settings. Caste also plays an important role in determining women's level of exposure to the world outside their homes. The "upper caste" Hindu Brahmin and Bhumihar women were reportedly not allowed to go out without any male member accompanying them. These women often did not join Self Help Groups (SHG's) with other women belonging to lower castes. Overall, patriarchy in this society is deeply rooted and continues to prevail in different forms despite development initiatives for women's upliftment programmes being in place.

Perceptions of empowerment

The concept of women's empowerment⁸⁶ was perceived differently by women and men we interviewed. The understanding of empowerment aspects also varied in context as we moved from Chhattisgarh to Bihar.

In the villages of Chhattisgarh women and men viewed women's empowerment as a woman's ability to make their own decisions and to do any kind of work, to be independent, and to fight for her rights. The men listed factors like ownership of land, regular and stable employment, and owning a vehicle. To them, poverty and lack of employment were the biggest impediments to both women's and men's empowerment. However, they reasoned, in practice, both women and men are conformists and do not

⁸⁵ All the villages studied in Chhattisgarh comprise a high share of a group denoted as 'tribal'.

⁸⁶ Locally denoted *mahila sashaktikaran*.

make any conscious effort for the women to become independent. They reported that using electricity in everyday life does not alter the existing patriarchal structure.

In Bihar, the topic was perceived differently, and more men than women were aware of this concept. This can in part be attributed to development initiatives in the village. Men associated empowerment with this particular intervention. Men reported that women's association with JEEVIKA has made them more confident, independent and facilitated women's ability to be active outside the home without a male chaperone. Through the project, women have also learned to sign their name, express their problems during group meetings and manage money. However, women interviewees appeared to be unaware of – or not in a position to unbundle – the concept of the empowerment.

People's aspirations for daughters and sons were shaped by their own harsh life experiences, which led to them to wish for a better and more comfortable life for their children. In all the villages of both study sites, the main aspiration women and men had for their children (girls and boys), was for them to get a good quality education, which would help them prosper in life. As most parents interviewed were not highly educated, they wished to educate their children, which would secure their future. However, women themselves did not feel the need to educate girls beyond the age of 18 years.

8.7 Violence

We asked survey participants whether any household members had ever experienced physical violence when performing outdoor activities. In the Indian sample (Chhattisgarh), nobody confirmed previous incidents of violence. In Nepal, 5% reported such incidences.⁸⁷ In contrast, in the study area in Homa Bay, Kenya, all groups and particularly women and girls are at risk. Here, 43% said that women members of their household have been victims of violence when going to fetch firewood – and 38% said that girls have experienced the same. As to men and boys, 13% reported that these groups have been subject to violence when going to the toilet or taking a bath. Going to school has been a hazard to girls in 12% and to boys in 9% among the interviewed households.

To examine people's attitudes toward domestic violence, we asked whether a husband is entitled to use violence should his spouse not behave as a good wife. The Nepalese respondents were in unison condemning husbands beating their wives. The Kenyan respondents were split in their opinions (48% of women and 57% of men reported that it is acceptable for a husband to beat a wife), while in the Indian sample, wife beating was largely reported as acceptable by both women (73%) and men (75%), (186 responses).

8.8 Food scarcity

Experiences with food shortages are generally important markers of poverty. In the Kenyan sample, as many as 64% said they had experienced food shortage during the previous 12 months. Nobody in India and only two respondents in Nepal said they had faced food shortage. Among 75 Kenyan married respondents who confirmed that food shortages have occurred, almost 70% said that the woman would be the one not getting enough food.

⁸⁷ 12 of 220 reported incidences of violence in Nepal, of which seven had been experienced by women, three by men and three by girls (never by boys).

ANNEX 9 : NATIONAL ENERGY- AND GENDER POLICIES

9.1 Nepal⁸⁸

The passing of the Electricity Act, 1992 and the Hydropower Development Policy, 1992 (revised in 2001) paved the way for the private sector and many Independent Power Producers (IPP's) in Nepal. An important milestone was the establishment in 1996 of the Alternative Energy Promotion Centre (AEPIC), which promotes and develops renewable energy technologies. This has led to a surge in the number of renewable energy installations in Nepal, especially solar PV and micro-hydro based power systems, common in rural areas. AEPIC formulated Gender Equality and Social Inclusion (GESI) guidelines to ensure the inclusion of women, poor and marginalised groups in the supply and demand side aspects of renewable energy. Supportive policies and initiatives such as the Community Rural Electrification Programme (CREP) established in 2003, the Rural Energy Policy (2006) and the Renewable Energy Subsidy Policy (2012, revised in 2016) have contributed significantly to the increase in off-grid energy systems throughout the country. The CREP facilitates bulk buying of electricity from the National Electricity Authority (NEA) for sale to communities. The government also provides subsidies to support rural electrification including the development of micro-hydro power plants.

The Nepal power sector also gained from several international collaborations, especially in hydropower generation, with governments, private organisations, multilateral banks, financial institutions and development organisations.⁸⁹ Bilateral agreements have supported several power generation projects in the country. Electrification in the study areas and Nepal, in general, is top-down with little participation of users or communities, whether women or men.

9.2 Kenya

The Rural Electrification Authority (REA) is responsible for expanding access and implementing rural electrification projects through both grid extension and off-grid supply (e.g. installation of solar PV systems in public institutions). Completed projects are handed over to Kenya Power (the national utility) to operate and maintain under a service level agreement with the REA: whilst the assets remain the property of REA, Kenya Power covers operation and maintenance through the collection of electricity retail tariffs (Ayieko 2011). Kenya has long been known for its private sector-driven off-grid solar PV market (Hankins et al. 2009) which has developed with the support of donors (Ockwell and Byrne 2017). In recent years, diffusion of solar home systems (SHS) in rural areas has grown fast primarily due to innovative companies that offer them on favourable financing

⁸⁸ The power sector in Nepal has evolved gradually over the years, with hydropower being the major contributor (89% of the total installed capacity). The First Five Year Plan (1956-61) marked the beginning of planned development in this sector and triggered the launch of various hydropower projects. In 1985, the electricity sector in Nepal underwent an institutional overhaul that led to the merger of various electricity bodies to form a single agency, the Nepal Electricity Authority (NEA) – which is responsible for the generation, transmission and distribution of electricity.

⁸⁹ E.g. the Asian Development Bank (ADB), Japan International Cooperation Agency (JICA), KfW, and the World Bank.

terms, enabled through mobile money transfer of daily payments that match a typical rural household's expenditures on kerosene and phone charging.

In the two Kenyan study areas, there were severe problems with grid reliability, and hence access. This appears to partly derive from challenges in the organisation of the electricity sector in Kenya. In the study sites, the division of work between REA and Kenya Power appears to have created ambiguity in responsibilities, especially in the phase of handover, and render potential customers uncertain about whom to contact for "last mile" connections from a transformer to public institutions or customer households; and whose responsibility it is to carry out repairs. Another problem has been the installation of poor quality transformers, which subsequently creates problems in the management and functioning of the electricity supply (e.g. in one study village in Kitui County, the transformer had blown up and had not been repaired). This is linked to issues of political economy and rent-seeking⁹⁰ creates operational problems for Kenya Power and jeopardizes supply.

Gender equality is enshrined in the Constitution of Kenya (KLR 2010). Elective or appointed bodies should not have more than two-thirds of the members represented by the same gender; hence they should have minimum one-third women. Electrification policies in Kenya are becoming increasingly gender aware. Kenya Power has developed a gender mainstreaming plan (2010-15) and other gender strategies. This study confirms that the implementation of these policies and strategies is slow (see also Malonza and Fedha 2015, USAID 2016: 27-8).

9.3 India

In India, the state distribution companies carry out conventional rural electrification. In recent years, the central and state governments also provide off-grid supply based on renewable power generation in remote, rural areas. Incentives for off-grid power generation through renewable energy sources have been provided by some specific programmes such as the Remote Village Electrification Programme (RVEP), the Village Energy Security Programme (VESP), the Decentralised Distributed Generation (under RGGVY), and the Jawaharlal Nehru National Solar Mission (JNNSM). All these schemes offer subsidies on capital investments borne by the central and the state governments (GNESD, 2014) and they are largely gender blind.⁹¹

In Chhattisgarh, two agencies ensure rural electrification: the Chhattisgarh State Power Distribution Company Limited (CSPDCL, grid extensions) and Chhattisgarh State Renewable Energy Development Agency (CREDA, off-grid systems). Their strategies are gender blind. In 2012, the solar PV mini-grids implemented by CREDA provided electricity to close to 57,000 households spread across 1439 villages (Jain 2012). CREDA has also installed a number of Solar Home Systems (SHS) to cover scattered and remote households. These processes of electrification are funded by the state government itself, and we found no involvement of international actors in electrification.

⁹⁰ The lack of clarity about roles also led to loopholes that could be exploited. For example, from our qualitative issues, people raised the problem that REA sub-contracted companies also made some illegal connections that disturbed reliability and created confusion about costs and what could be affordable. Moreover, even when the connections were legal, contractors (this time for Kenya Power) sometimes demanded additional cash from the customers, thus raising the cost of the connections. Contractors were in some cases demanding cash of almost 10,000/- from clients, and such accounts is likely to make other potential customers unwilling to subscribe.

⁹¹ An exception is RGGVY which is gender inclusive as it encourages franchise ownership by women SHGs.

In contrast, the power situation of Bihar was dismal in the years following the bifurcation of the state in 2000.⁹² However, large-scale reforms introduced to overhaul the power sector have started to yield positive results. As a part of these measures, the state electricity board was unbundled into different components, which included dividing the distribution company into two different bodies for North Bihar and South Bihar. This electrification effort is in line with the mandate of the Bihar government to electrify all parts of the state and does not include gender-specific strategies.

Nonetheless, some Bihar villages are not part of the central grid and were instead targeted through off-grid projects, the TERI-JEEVIKA collaboration being one of them. This was initiated through the Lighting a Billion Lives (LaBL) programme of TERI (with which members of our research team are affiliated), where it collaborated with the micro-credit and livelihoods project of the Bihar government (women's self-help groups - SHG).⁹³ The main driver for accelerating the TERI-JEEVIKA project was the Jawaharlal Nehru National Solar Mission (JNNSM) through which subsidies were made available. Other national and international financiers and partners supported the work.

⁹² After bifurcation, most of the thermal power plants in Bihar went to Jharkhand. There were long hours of power cuts and very unreliable supply.

⁹³ For this specific project, being an SHG member with JEEVIKA was a condition to get access, because the project was designed to leverage the existing SHG member network to provide access. Non-members were not benefitting.

ANNEX 10 : SURVEY METHODOLOGY: LIMITATIONS

A separate publication accounts for the survey design (TERI et al. in press). When undertaking the actual survey, many of the proposed methodological steps could not be pursued. We discuss some of the limitations of the survey in this Annex.

Population size and margins of error

There were issues related to the secondary information, population size and an actual number of households under each category of access, viz. grid, mini-grid, SHS, battery/ lanterns and households without access.

- While in India, study sites had villages/ geographical units that have exclusively one type of electricity access; in Nepal and Kenya, within a single study site a co-existence of all three types of electricity access were considered as sites with the exclusive type of access were not found. As a result, the sampling strategy was tweaked to address the specific cases in Kenya and Nepal. See (Section 4.3) for a detailed discussion on Nepal's sampling design. For Kenya, based on the initial information samples were selected as the Indian samples with villages specific to a particular type of access. But, on the field, it was found that multiple types of electricity access were found in all Kenyan villages. Hence the sampling design was accordingly adjusted to match the methodology followed in Nepal.
- The total number of households that was originally used for sampling 200 households in each country was found to be different from the numbers we received later from Kenya and Nepal. For India too, we decided to change the secondary source from which we quote the population figures. The population (i.e the total number of households) was taken from Garv database while calculating the proposed sample size. But the actual margin of error reported in the summary results (Section 6.1) is based on the Census data (which is thought to be more sacrosanct and hence we decided to use this). Similarly, in Kenya, the total number of households in the proposed sampling design was reported to be much lower than what we eventually used while calculating the (actual) margin of error. In both Kenya and Nepal, the initial numbers were based on qualitative interviews which were later rechecked and corrected during the actual calculations of the margin of errors.
- While the survey sites were chosen purposively (based on our qualitative study), the selection of sample households was done through a systematic sampling method with random starting points. The overall margin of error for samples in the study sites in Nepal, Kenya and India was 5.77%, 6.41% and 5.73% respectively. The subsamples sizes of Grid, Mini Grid/ SHS and Some or No access households were dependent solely on the type of access prevalent in the specific study area/ country. For India and Nepal, the subsamples for Grid, Mini Grid/SHS and Some or No access households are comparable, with a higher (37-42%) share of both Grid and mini Grid households. For Kenya, however, because of the lack of grid connections, a similar proportion for Grid households could not be achieved resulting in a higher share of no access households.

Case-specific findings

- Because of contextual differences, the shares of householders subscribing to electricity vary in the survey study villages. In the Nepalese study area, almost all households (96%) either had access to the central grid, a mini-grid or a Solar Home System (SHS). The corresponding figure for the studied Indian context, Chhattisgarh, was 87%, which matches the national average. In the study location in Homa Bay, Kenya, only 6% of the households were found to be registered with a grid connection. When collected numbers of SHS and (a few) mini-grid connections are included, however, the reported share of households with access in the Kenyan study locations is 41%.
- The initial ambition to quantify the impact of various types of electricity access proved challenging. In many contexts (particularly in Kenya) various types of private systems for electricity supply are rapidly spreading, and many householders use several systems interchangeably, making it difficult to measure the effect of one single system against the other. Also, analysis of the gendered impact of electricity requires that one observes a given context over time (social change happens over time), where also other changes occur simultaneously. And finally, householders who do not have electricity at home sometimes have access to electricity at their neighbours' place. Attribution and establishing causality (of electricity's effect) is therefore challenging. When we present frequencies (e.g. the situation in literacy or income between households with various types of access), the differences should be understood as descriptive rather than results of electricity's impact.
- It is vital to note that the results presented in this study are specific to the study areas and do not represent the situation of the entire state/ country (though we may refer to the samples by country name for ease of reference). Further, since we are not aiming at the state level or country level estimates based on the results from our sampled study sites, survey weights were not assigned to our results.

Issues faced by enumerators in the field during the survey

Enumerators in Nepal found it difficult to ask questions related to ownership/ custody of bed, jewellery, assets, etc. Respondents felt hesitant to answer questions related to their sleep and wake up time. While most women respondents were open to answering the questions, few were very shy and enumerators had to probe. Sometimes the man in the households would intervene and try to answer on behalf of the women. Enumerators had to politely ask them not to by explaining that the focus of the survey study was women.

In India, enumerators found it difficult to register answers related to ownership of assets as the respondents could not separate the ownership between male and female of the households. Few respondents were shy and had to be probed by the enumerators to procure answers related to domestic violence and husband-wife relations.

Poor road conditions were a hindrance during the survey in Kenya: there were several days when it rained and rendered the roads impassable, even by motorbike, so interview schedules were disrupted. On one of the days, there was a funeral in the village, so most

households were not available. Because the area is predominantly Seventh Day Adventist, most households were also not available on Saturdays. The enumerators worked around these problems by adjusting the timing of their interviews and creating alternate appointments and/or splitting the interviews into two sessions. The latter was also done because at times either the enumerator or the respondent found the questionnaires to be too long.

Because of the recent prolonged election period and political tensions arising from that, we could not and did not ask questions about voting. Some HHs asked why enumerators were skipping their houses (ref the sampling procedure) – on Kiwa Island, in particular, there were some comments that this appeared to be favouring the homes of people who were supporting the same candidate for the position of MP during the election.

Overall, across all three countries, the enumerators were welcomed by the villagers and they had productive discussions with the respondents.

Issues faced during the compilation of data from the three countries and cleaning

- The Nepal Survey was done using the CAPI software in Smartphones. Some of the skips used in the CAPI application's version of the questionnaire did not work due to errors (on the part of the Survey Agency) in the logic used. Hence parts of the survey had to be redone where data was not captured at the first instance. Due to the limited time, and because of the small size of samples, we carried out the survey without going for a pilot or on field testing of questionnaires in CAPI format. However, this was a learning, that we should always test the questionnaires in a field before undertaking the actual survey.
- In India and Kenya, a paper survey was undertaken as the enumerators were more comfortable with that format. Further due to the remote areas were chosen for the survey, and lack of recharging options in remote villages where these surveys were undertaken, a paper survey was thought to be more suitable and feasible. In the Kenyan case, many quantitative questions which required numeric responses, qualitative responses were registered (eg hours of outage, etc.). Through this, we learned that one advantage of using the CAPI application is that one can restrict the entries to the type of desired responses only (Numeric, binary or qualitative responses as desired) and can even limit their length (digits/ words). The format of the data and a higher number of string/ non-numeric variables made it difficult to categorize these responses into broad categories for all the three countries.
- Challenges faced while cleaning also includes different types of response option in different countries. This occurred due to some customizations that were made to capture country-specific information. New response options that are more relevant for a specific locale were introduced in Kenya and India. While it is a good thing for country-specific reports and analysis, for an inter-country analysis, it demands a higher amount of time during the data cleaning process and in many cases renders comparison redundant.
- For Kenya and India, the unit of responses for many questions was inconsistent. For example, some of the responses for the same questions were registered in

days, weeks and months; few others, in Hours, minutes, and days. That made the cleaning process longer and tedious.

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