

## **Capabilities in the Shadows**

*An Ethnographic Study Exploring the Gendered Implications of a Solar Electrification Project in Rural Eastern Nepal*

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A thesis submitted in partial fulfillment of the requirements of Lund University International  
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The front picture was taken by the author. Miklajung, Nepal, March 2023.



## **Abstract**

Access to electricity is vital for rural development in the Global South, but its impact on local power dynamics, especially gender relations, remains underexplored. This thesis examines a solar electrification project in Eastern Nepal to uncover gender-related challenges in experiencing project benefits. By applying the Capabilities Approach and Kabeer's Empowerment Theory, the research identifies that solar electrification significantly influences women's daily lives and eases their domestic responsibilities. However, a deeper analysis of power structures reveals that women's energy experiences remain tied to predefined gender roles, limiting their ability to take control and exercise agency. To address these limitations, this study recommends integrating agency training into rural electrification projects and placing stronger focus on the productive usage of energy. This research contributes to discussions about the relationship between rural energy initiatives and gender dynamics, advancing the understanding of the gender-energy nexus and its implications for local sustainable development in Nepal.

Keywords: Solar Electrification, Nepal, Gender Studies, Empowerment, Capabilities

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# Table of Contents

<b>1</b>	<b>Introduction .....</b>	<b>1</b>
1.1	Rural Electrification and Development.....	1
1.2	Solar Electrification in Miklajung .....	2
1.3	Thesis Aim and Research Question .....	3
1.4	Thesis Outline .....	3
<b>2</b>	<b>Setting the Scene.....</b>	<b>4</b>
2.1	Country Profile: Nepal .....	4
2.2	Miklajung.....	4
2.3	The Electrification Program .....	5
<b>3</b>	<b>Literature Review .....</b>	<b>7</b>
3.1	Solar Electrification in Nepal.....	7
3.2	Gender-Energy Nexus.....	9
<b>4</b>	<b>Theoretical Basis .....</b>	<b>11</b>
4.1	Capabilities Approach.....	11
4.2	The Theory of Empowerment .....	13
4.2.1	<i>Operationalization .....</i>	<i>14</i>
<b>5</b>	<b>Methodology .....</b>	<b>15</b>
5.1	Ontology and Epistemology.....	15
5.2	(Micro)-Ethnography .....	15
5.3	Methodological Limitations .....	21

5.4	Positionality .....	21
<b>6</b>	<b>Results and Discussion .....</b>	<b>23</b>
6.1	Locally Valued Capabilities in Miklajung .....	23
6.2	Unlocking Human Potential .....	25
6.2.1	<i>Solar Home Systems</i> .....	26
6.2.2	<i>Solar Water Lifting Pumps</i> .....	29
6.3	Comparing and Reflecting on Capabilities .....	31
6.4	Empowerment and Equality: Gendered Differences in Capabilities.....	33
6.4.1	<i>The Question of Choice: Gendered Differences</i> .....	33
6.4.2	<i>Socialized Gender Differences</i> .....	34
6.4.3	<i>Development and Responsibility</i> .....	35
6.5	Beyond Politics: Recognizing the Limitations of Political Representation .....	36
6.5.1	<i>Male-Centricity and Homogeneity in Energy Matters</i> .....	37
6.5.2	<i>Cultural and Educational Barriers</i> .....	38
6.6	Future Implications .....	39
<b>7</b>	<b>Conclusion.....</b>	<b>41</b>
	<b>References .....</b>	<b>42</b>
	<b>Appendix.....</b>	<b>49</b>

## **List of Abbreviations**

CA = Capabilities Approach

CR = Critical Realism

GIZ = German Internationale Zusammenarbeit

KII = Key Informant Interviews

PV = Photovoltaic

SHS = Solar Home System

SWP = Solar Water Lifting Pump



# List of Tables and Figures

- Table 1 KII Interviews in Kathmandu and Biratnagar ..... 16
- Table 2 SHS Interviews in Miklajung ..... 18
- Table 3 SWP Interviews in Miklajung ..... 19
- Table 4 Identified Capabilities in Miklajung ..... 24
  
- Figure 1 Rabi, Miklajung. Photo taken by author..... 5
- Figure 2 SHS on a roof. Photo taken by author. .... 7
- Figure 3 SHS components. Source: Kabir et al (2017). .... 7
- Figure 4 SWP: panels and tank. Photo taken by author..... 8
- Figure 5 SWP components. Source: Kunen et al. (2015)..... 8
- Figure 6 Relationship between energy, services and outcomes. Source: Day et al. (2016). .... 12
- Figure 7 SWP interviews. Photo by author..... 20
- Figure 8 SHS Capabilities. Own illustration. .... 26
- Figure 9 Household with SHS. Photo taken by author ..... 27
- Figure 10 Unused kerosene lamps in an SHS household. Photo by author. .... 27
- Figure 11 SWP Capabilities. Own illustration. .... 29
- Figure 12 Explanation of the SWP distribution. Photo by author. .... 30
- Figure 13 Solar Technician Workshop. Photo by author..... 32
- Figure 14 SWP Site Visit. Photo by author. .... 37

# 1 Introduction

## 1.1 Rural Electrification and Development

*“Human development, as an approach, is concerned with what I take to be the basic development idea: namely, advancing the richness of human life, rather than the richness of the economy in which human beings live, which is only a part of it.”*

- Sen, 2004

What constitutes a good life? This keystone question of human development remains elusive and contentious among scholars, politicians and the development community (Day et al., 2016).

However, prior research generally confirms that access to electricity is a key factor in achieving a satisfactory and equitable life, as evidenced by the high correlation between electricity consumption and the Human Development Index (Arnaiz et al., 2018; Sarkodie & Adams, 2020). Despite this consensus, as of 2022, approximately 155 million people in Developing Asia were still lacking access to electricity with particularly rural areas being disproportionately affected (IEA, 2023). For example, in Nepal, while 90 % of the households in urban areas have the national grid as their primary source of energy, only 67 % of rural areas have access to it (Bhandari & Jana, 2010; Pinto et al., 2019).

Consequently, electrification in rural Nepal has emerged as a topic of significant interest, with a focus on decentralized renewable energy systems (Alternative Energy Promotion Center, 2017; Bhattacharyya & Palit, 2016; Shakya et al., 2015).

Nonetheless, access to energy should not be viewed as the *ultimate goal* alone, but rather as the means to promote social progress and enhance human well-being (Arnaiz et al., 2018; Mahara, 2015). Furthermore, while the connection between electrification and development appears obvious, scholars like Halff et al. (2014) and Cole (2018) emphasize how the actual changes in livelihoods are nuanced and complex, reflecting back the local societal structure. Gender in particular emerges as a crucial aspect in electrification, with women in rural areas spending disproportionately more time in the household than men. Hence, any changes in rural household electrification will affect them first (Halff et al., 2014; Sedai et al., 2022). Many development organizations acknowledge this gender component, but in reality, a lack of clarity on how to measure gender disparities and how to understand and address them in the context of localized energy projects is still persistent (Burney et al., 2017). This leads to many energy interventions remaining largely gender-blind, with men being

the primary decision-makers as well as impact assessments lacking inputs of local power dynamics (Halff et al., 2014).

## **1.2 Solar Electrification in Miklajung**

Within this context, the municipality of Miklajung in Eastern Nepal serves as an interesting case study to explore the multidimensional relationship between rural electrification and gender dynamics. Originally excluded from the national grid, solar electrification in Miklajung started in 2016 through a collaboration between the *Government of Nepal* and the *Deutsche Gesellschaft für internationale Zusammenarbeit (GIZ)*. By providing financial and technical support, dozens of households gained access to energy for the first time. While such an introduction of electricity can bring about a substantial change in the daily lives of locals, Standal & Winther (2016) emphasize how it can also reinforce gender structures by perpetuating women's primary role as caregivers and limiting other economic chances. In Miklajung, the electrification presumably had tremendous effects on locals' life quality, but no impact assessment on the gender dynamic impacts has been conducted yet.

Therefore, this thesis, grounded in ethnographic research, aims to investigate gender disparities in electrification outcomes, using Miklajung as a case study to illustrate. The two conceptual frameworks guiding this study are the Capabilities Approach by Amartya Sen and Martha Nussbaum, and the Empowerment Theory by Naaila Kabeer. The Capabilities Framework allows an assessment of an individual's well-being beyond merely the resource access (Day et al., 2016), in this case, the electricity input. Capabilities are hereby understood as effective opportunities, or freedoms, that people have and that indicate the lives that people value living (Cole, 2018). The Empowerment Theory, on the other hand, focuses on the ability to exercise choice for individuals, and how this is dependent on their access to resources, their ability to apply agency and their set of achievements (Kabeer, 1999). Combining these frameworks allows for a nuanced understanding of rural electrification impacts and gendered disparities in experiencing the benefits.

### **1.3 Thesis Aim and Research Question**

The analysis examines the actual livelihood changes after the introduction of solar electrification. Moreover, through the Empowerment Theory, this thesis illustrates how these changes and benefits are influenced by gender relations and by implicit power structures in the cultural and political spheres. The objective is not to neglect the positive livelihood impacts of rural electrification initiatives but to propose a crucial complementary understanding of the relationship between energy access and gender.

This paper adopts the following three Research Questions:

*RQ1: How have locals in Miklajung benefited from the solar electrification?*

*RQ2: In which ways have local power structures and social norms influenced these benefits for women?*

*RQ3: What future implications can be drawn from the implementation of the solar electrification program in Miklajung?*

### **1.4 Thesis Outline**

In the upcoming sections 2 and 3, I provide the context for my fieldwork investigation into solar electrification in Eastern Nepal, and elaborate on the entangled relationship between gender and energy. Subsequently, in chapter 4 I proceed to introduce the theoretical foundation, while detailing my research methodology in chapter 5. In chapter 6, I present the results of my research, accompanied by an ongoing dialogue that incorporates relevant literature and outlines potential future implications. Finally, in chapter 7, I conclude by summarizing the key findings and recommendations for future rural electrification projects.

## **2 Setting the Scene**

### **2.1 Country Profile: Nepal**

Nepal, a landlocked country in the Himalayas, has a population of approximately 29 million people and is characterized by a geography of 83 % mountains and hills (Asian Development Bank, 2017; IEA, 2023). This distinctive topography creates significant challenges to conventional energy grid extensions and to the provision of modern and sustainable energy across the entire nation (Asian Development Bank, 2017; Bhattarai et al., 2018). Consequently, as previously mentioned, the share of rural households connected to the national grid is substantially lower than the share of urban households connected to the national grid (Pinto et al., 2019). Therefore, off-grid solutions such as hydropower and solar energy have become particularly popular for rural areas, offering a practical means to lower the expenses associated with grid extensions (Bhandari & Jana, 2010). As of 2020, the primary source of energy consisted of biofuels and waste, followed by oil, coal and hydropower (IEA, 2023). Despite Nepal's naturally high solar radiation (Sapkota, 2020), solar energy displayed less than 1 % of the total energy supply in the country (IEA, 2023).

### **2.2 Miklajung**

Miklajung, situated in Province One, Panchthar District, is one of the rural municipalities shaped by the 2015 Nepali Constitution. This municipality emerged from the amalgamation of six formerly distinct village development committees: Aarubote, Sarangdanda, Rabi, Kurumba, Limba, and Durdimba. Covering an area of 166.61 km<sup>2</sup>, it has a population of 21,061 people - an approximate of 5,500 households - of which 49.6 % are male and 50.4 % are female. The average family consists of 4.4 members (National Statistics Office, 2021).

Miklajung is organized into eight wards, and its administrative center is based in Rabi. Currently, in the area, several castes live jointly together with the Limbu caste comprising the greatest share at 36 % followed by the Rai at 25 % and the Tamang at 11 % (Milan, 2019). The primary source of household income in Miklajung is agriculture, constituting 35.5%, followed closely by remittances at 27.75%, and business enterprises at 13.25%. A smaller proportion of households rely on government services (8%) and private services (3.5%). Regarding agricultural practices, the predominant crops cultivated include rice, maize, wheat, buckwheat, cardamom, and potatoes (National Statistics Office, 2021).



Figure 1 Rabi, Miklajung. Photo taken by author.

### 2.3 The Electrification Program

The solar electrification, which started in 2016, was a response to the lack of electricity and running water faced by many households in this area. According to GIZ's survey numbers, in 2016, out of 5.500 households in Miklajung, almost 470 households did not have access to any form of electricity and 270 households had no access to running water. The following electrification program - the Renewable Energy for Rural Areas (RERA) – was established as a cooperation between the Government of Nepal (GoN) and GIZ (AEPC, n.d.). Beneficiaries included households with little to no access to modern energy services (GIZ, 2018). It aimed “to ensure efficient and effective service delivery of decentralized RE<sup>1</sup> through improved outreach and enhanced local cooperation in federalized Nepal” (GIZ, 2018, p. 1).

The first phase of electrification under the program lasted until 2020 and targeted 150 households for electrification. The second phase, which is currently ongoing, is part of a continuation under another Nepali Energy program - *Renewable Energy and Energy Efficiency* - and targets 170 households. This phase is expected to last until December 2023 and will continue with other project objectives such as technical and political support afterwards. Following the previously mentioned assessment, the dissemination of services was based on priority: first targeting older, single women and households with students, then targeting all remaining households. The technical electrification included one micro-hybrid solar/wind grid, SHSs and SWPs. Since December 2018, in addition to the

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<sup>1</sup> Rural Electrification

solar electrification, the national grid extension to Miklajung has been initiated. As of this year, approximately 85-90% of households in Miklajung have gained access to electricity through the national grid. However, especially during monsoon season, this connection is very unstable and unreliable and, therefore, solar systems display a necessary basis for villagers in Miklajung.

Due to the scope of this thesis, only households who gained access to either SHSs or SWPs have been included in the analysis.

### 3 Literature Review

#### 3.1 Solar Electrification in Nepal

The origins of solar electrification in Nepal date back to 1989, when 3 mini-grid PV systems were installed with French government support (Adhikari et al., 2009). Within the solar installations, SHSs in particular were considered suitable for communities in rural areas due to their comparatively low investment costs and easy installations (Kabir et al., 2017; Sapkota, 2020).



Figure 2 SHS on a roof. Photo taken by author.

A typical SHS comprises several components, namely a solar panel, a charge regulator or controller, one or several batteries, cables and safety switches (Kabir et al., 2017). Furthermore, it includes an inverter to facilitate the conversion of direct current (DC) to alternating current (AC) for grid-compatible AC appliances (Kabir et al., 2017). While providing several positive implications for areas such as health, education and access to information (Adhikari et al., 2009), there are also challenges associated with the adoption of SHSs in Nepal. For example, while SHSs displayed a breakthrough in Nepal in the 1990s, the energy supply of this type of solar electrification is limited in terms of capacities and reliability (Laufer & Schäfer, 2011). Other means of solar electrification, such as mini-grids, provide higher electricity services and are thus favored by development practitioners. Beyond ensuring reliable energy supply, these additional means address the challenge of providing enough energy for economical means (Aziz & Chowdhury, 2021). Thus, addressing a development goal emphasized by Kabeer (2019) that “people can live off of it but also have some surplus to invest, to save and to build sustainable pathways out of poverty”.

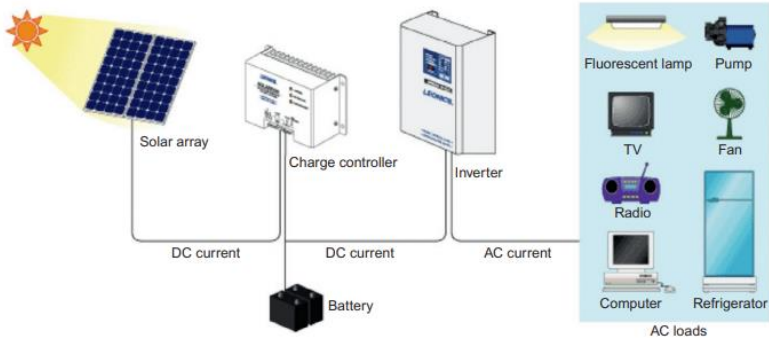


Figure 3 SHS components. Source: Kabir et al (2017).





Figure 4 SWP: panels and tank. Photo taken by author.

The second electrification system analyzed in this thesis are Solar Water Lifting Pumps (SWPs). SWPs have become increasingly popular due to their possibility of matching the seasonal availability of solar energy with the seasonal demand for water (Foster & Cota, 2013). Having solar energy as the power source, SWPs usually include a PV array, a motor, a pump and a water storage tank (Foster & Cota, 2013). In Nepal, SWPs are considered essential for providing reliable water supply in upstream

mountain areas and where the power grid is unreliable or nonexistent (Kunen et al., 2015).

Furthermore, since SWPs are independent from the national grid, they provide reliable supply without major electric power outages (Kunen et al., 2015).

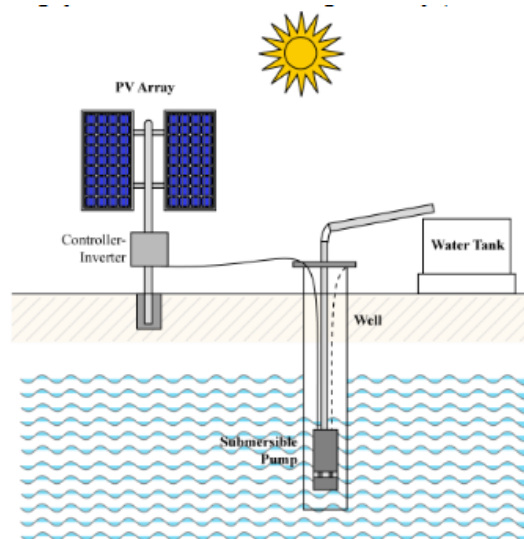


Figure 5 SWP components. Source: Kunen et al. (2015).

Two of the main benefits of SWPs are their long-term lower costs in comparison to diesel or gasoline-powered pumps and their generally low environmental impact (Foster & Cota, 2013). In addition to the provision of drinking water, SWPs are an essential component in providing sufficient water sources for irrigation (Ranabhat & Khadka, 2019). This is particularly necessary in a country like Nepal where most farmers are reliant on the monsoon for water (Ranabhat & Khadka, 2019).

### 3.2 Gender-Energy Nexus

The Gender-Energy Nexus highlights differences in access to and utilization of energy services between women and men (Feenstra & Özerol, 2021). In other words, how differing roles, needs, and interests result in different implications from energy access for women and men (Mahat, 2011). These differing implications stem out of the socially constructed concepts of gender, representing a system of defined roles and attributes related to women and men, such as labor allocations, distributions of resources, authority assignment, and decision-making powers (Kabeer, 2005).

Nightingale (2011) highlights in her research how gendered differences in Nepal emerge and are intertwined with the material and symbolic world. Symbolic, stemming from the ideas of differences in gender and gender responsibilities, materialized in the distribution of labor, for example (Nightingale, 2011). Through her investigation, she concludes that cultural categories, such as *women*, are “dynamic results of contested practices” (Nightingale, 2011, p. 161). For instance, in Nepal, men have typically held positions of authority and decision-making power, both within the household and in wider social and political spheres. In contrast, women in Nepal have traditionally been assigned domestic responsibilities and caregiving roles. They are expected to take care of the household chores and raise children (Rana et al., 2018). The more individuals act on such pre-defined roles, the more they are socially manifested as *natural* gender differences (Nightingale, 2011). While gender is dynamic and roles are diverse and complex, these ideas of division are mostly (re)produced through everyday activities such as agricultural work and food preparation, reflecting back on both the symbolic and the materialized dimensions (Nightingale, 2011).

Connecting this back to energy, Nepal’s traditional gender roles heavily influence energy usage, with women being primarily responsible for ensuring the daily energy supply through the gathering and transportation of biofuels, and men being responsible for outdoor labor and household decision-making (Mahat, 2011). Particularly in rural areas, women’s workload is directly interconnected with household energy needs like cooking and caring for children (Mahat, 2011). Scholars like Clancy et al. (2007) point out how energy in rural settings is often considered “women’s businesses” and responsibilities around domestic chores stay within women’s task distributions. Despite this direct connection, as highlighted by Govindan et al. (2020), the uptake of solar electrification in Nepal entails a predominant gender-blind approach in policies, stemming from policy assumptions that electricity access itself provides benefits to men and women equally. Further scholars like Mahat

(2004) emphasize how few opportunities have been given to incorporate gender concerns into rural energy planning and policies or to ensure women's involvement in initiatives related to energy technologies. If gender is put into consideration, energy projects usually rely on quantifiable aspects as their success measure, instead of local empowerment dynamics. Quantifiable measures include numbers of households electrified, changes in labor market structures, time used on specific tasks etc. (Winther, 2015). While these are necessary aspects of energy development, questions of control over assets, decision-making power and women's and men's relative rights, as well as the underlying structures in the economic, social and political spheres are far less common, but would be essential explorations to understand gender-energy gaps (Winther, 2015).

## 4 Theoretical Basis

### 4.1 Capabilities Approach

The capabilities approach (CA) focuses on the idea that development's main purpose is to expand people's choices, instead of solely targeting economic growth (Fernández-Baldor et al., 2014). In other words, it aims to measure the impacts of development initiatives based on what they specifically enable people to do (Day et al., 2016). This approach's origins date back to the 1980s, when economist Amartya Sen's work on welfare economics led him to question traditional measures of wealth and well-being (Qizilbash, 2008). The Capabilities Approach, as it is now known, has been developed with philosopher Martha Nussbaum in the 1990s, and has been widely applied to policy areas and influenced development measures worldwide (Day et al., 2016). At the heart of this approach are capabilities, which can be understood as

*"the real opportunities that people have reason to value, rather than merely the formal rights and legal freedoms that they possess. [...] The capability to do something -- to be adequately nourished, to be able to participate in the life of the community, to appear in public without shame, to have a reasonable expectation of living to old age -- is a kind of freedom."*

- Sen, 2000, p. 11

Agency, hereby, plays a central role in achieving the aforementioned capabilities. Sen defined the freedom of agency as "what the person is free to do and achieve in pursuit of whatever goals or values he or she regards as important." (Sen, 1985, p. 203). According to this understanding, agency has intrinsic values. Therefore, its goals differ from individual to individual (Hanmer & Klugman, 2016). While Sen and Nussbaum's understanding of individual or universally aligned aspects of agency differed, both of them recognized that people have different aspirations, and, therefore, by promoting individual's agency, people are able to choose the life they value most (Nussbaum, 2003).

Electrification seen through a capabilities lens serves as an enabler of services (e.g. lighting, space heating, water heating) that further translates to secondary capabilities (e.g. washing clothes, storing and preparing food, accessing information) that result in mechanisms through which basic capabilities (e.g. maintaining good health, having social respect, being educated) can be actualized (Day et al., 2016). Fig. 6 illustrates the visual explanation of this interlinkage between energy and capabilities.

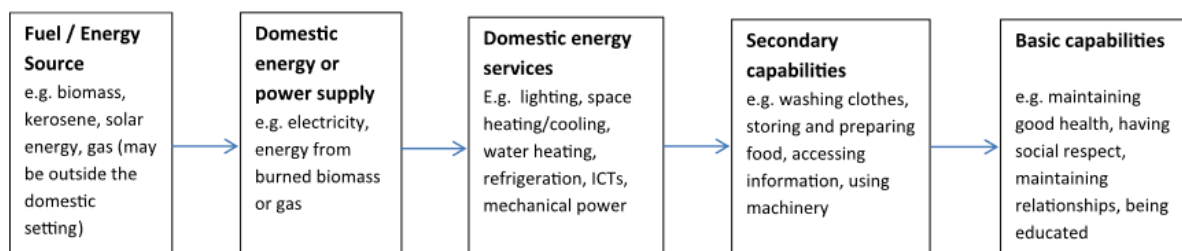


Figure 6 Relationship between energy, services and outcomes. Source: Day et al. (2016).

While CA can be a useful framework for understanding the impacts of energy projects on people's lives, it has several limitations when applied to specific contexts, such as rural electrification in Eastern Nepal. For example, CA tends to focus on individual agency and freedom, while potentially overlooking power structures and social norms that limit people's ability to exercise agency, a concern shared with most deliberative and participatory processes (Day et al., 2016; Smith & Seward, 2009). Scholars emphasize how capturing the social complexities of development demonstrates itself as context-dependent, normative and multidimensional (Smith & Seward, 2009). For example, in the case of Miklajung, women may have gained new capabilities, but their ability to fully realize these capabilities might be influenced by power structures and gender norms that limit their decision-making abilities.

To overcome such limitations, it is recommended to complement this approach with further theories and frameworks that uncover the networks of social relations in which individuals are embedded (Cole, 2018; Smith & Seward, 2009). Like this, CA can be utilized in a way that incorporates social factors and respects social complexities (Smith & Seward, 2009). For the realm of this thesis, not only the enabled capabilities but the issues of power and underlying structural constraints ought to be analyzed. The development economist Naila Kaber addresses such development limitations and suggests an approach through her *Theory of Empowerment*, which is used complementarily in this thesis.

## 4.2 The Theory of Empowerment

*“Empowerment is rooted in how people see themselves - their sense of self-worth. This in turn is critically bound up with how they are seen”*

- Kabeer, 2005, p.15

Kabeer’s Theory of Empowerment is a framework for understanding the ways in which gender structures work and how female empowerment is constrained by several interlinked dimensions. At the core of her theory is the emphasis on choice, as Kabeer sees that empowerment involves a form of “process by which those who have been denied the ability to make strategic life choices acquire such an ability” (Kabeer, 1999, p. 435). Hence, Kabeer refers to empowerment as a process of change, in which those who have been disempowered can choose the lives they can imagine for themselves, rather than having to live lives imposed by custom, norms and society’s laws (Kabeer, 2005). Furthermore, as illustrated in the citation above, she highlights how empowerment is a process from within, where women acknowledge their own aspirations and potentials by being offered the possibility of choice from the outside (Kabeer, 2005). The ability to exercise choice, and therefore, the ability to create change, can be thought of in three different but interrelated dimensions: Resources, Agency, and Achievements (Kabeer, 1999).

**Resources** refer to material as well as non-material assets such as land, credit, education, and healthcare. As the other dimensions, access to resources reflects the rules of the society, with allocations and distributions being determined by societal norms (Kabeer, 1999). While equal access to resources illustrates an essential component of empowerment, Kabeer (1999) highlights the *potential* choice, rather than the actualized choice deriving out of it. For example, women gaining access to energy needs to be thought of together with their ability to exercise control over this respective resource, not only the access to the material resource itself (Kabeer, 1999). Therefore, resources should only be considered as *one* potential input for women gaining greater control over their lives (Kabeer, 1999).

The second dimension of **agency** can be understood as “the ability to define one’s goals and act upon them” (Kabeer, 1999, p. 438). While the concept of agency has taken varying forms in different disciplines and fields, Kabeer particularly highlights its interconnection with power and social structures. In her understanding, agency cannot only be seen as decision-making power but as the power to shape and change the social norms and structures that influence one’s life (Kabeer, 2005). She highlights how, in some cases, power is exercised explicitly in order to undermine other groups’

agency, but how power can also operate in a much more subtle way. This is done through unquestioned power, where groups accept inequalities by not explicitly acknowledging them as such (Kabeer, 1999). In the previous example of energy access, unquestioned power could be considered as the overarching decision-making influence of male family members about resource utilization, as Kabeer (1999) frequently encountered.

Lastly, **achievements** relate to the actualized outcomes of development interventions, such as improved health and increased economic independence (Kabeer, 1999). Particularly important for this dimension is the connection with underlying motives. Women taking up outdoor work, for example, could be the outcome of empowerment efforts, or a “distress sale of labour” (Kabeer, 2005, p.15). Therefore, when using it as an indicator of empowerment, combining it with the other dimensions of resources and agency is essential (Kabeer, 2005).

Altogether, each of these dimensions mutually interconnect and they together constitute the process of empowerment. However, according to Kabeer (2005), agency in particular serves as the leverage point for all further processes: “Agency represents the process by which choices are made and put into effect. It is hence central to the concept of empowerment. Resources are the medium through which agency is exercised; and achievements refer to the outcomes of agency.” (Kabeer, 2005, p.14). Therefore, due to the limited word count of this thesis, the focus lies particularly on analyzing and discussing the agency aspect of the solar electrification project in Miklajung.

#### **4.2.1 Operationalization**

Kabeer sees capabilities and agency as intertwined and reinforcing. For example, expanding education is crucial for increasing agency (Kabeer, 2005). In the same way, minimized agency directly affects women’s ability to gain and benefit from capabilities (Kabeer, 2005). Furthermore, Kabeer emphasizes the *Transformative Potentials* that are intended to occur from capability enhancements (Kabeer, 2005). This concept refers to the long-lasting changes in individuals’ lives, originating from a change in previous unjust social structures in which they were situated (Kabeer, 2005).

Building up on this, in this thesis I adopt a measurement based on examinable gendered differences in women’s and men’s daily lives following the introduction of solar electrification. In terms of agency, differences between passive forms, where actions are taken because there are little other choices, and of active forms of agency, with actions mirroring purposeful behavior, will be included (Kabeer, 2005).

## **5 Methodology**

### **5.1 Ontology and Epistemology**

This analysis is grounded in critical realism (CR), an approach that holds a double recognition where first, an objective world exists independently of people's awareness and second, subjective interpretations influence how parts of this world are perceived (O'Mahoney & Vincent, 2014). CR highlights the importance of ontological understandings to illustrate that things are real, even if we cannot observe them (Ingen et al., 2020). Moreover, continuing to epistemological understandings, CR emphasizes how people's opinions influence the perceived and accepted truth. Therefore, in this thesis, I differentiate between what is real and what is perceived, understanding knowledge as a social product (Yucel, 2018).

CR is guiding this investigation by highlighting the underlying notions of gender constructions and how these are part of the conditions for experiencing the world (Sims-Schouten & Riley, 2014). Focus is placed on social relations and social transformations as part of overarching power structures (Ingen et al., 2020). Moreover, it follows the idea that social phenomena cannot be investigated separately from observed occurrences, since they are inherently interconnected with surrounding systems (O'Mahoney & Vincent, 2014). Attributions and understandings that are connected to different social groups are, therefore, merely interpretations and subjective understandings, instead of fixed universal truths (Ingen et al., 2020). Therefore, conceptualizations of gender arise from observed occurrences, and make up subjective understandings of gender roles and relations.

### **5.2 (Micro)-Ethnography**

This study applies ethnography as an approach to answering the research questions. Ethnography is a research methodology used to describe cultures through direct observation and participation within the place or context where the culture occurs (Hesse-Biber, 2012). Micro-ethnographic studies are especially suitable for dissertations or small projects since they require specialization in a particular aspect of professional or everyday life (Clark et al., 2021).

The fieldwork in Nepal was carried out for 10 weeks (13.02.2023-19.04.2023), where five weeks were spent in Miklajung (04.03.2023-06.04.2023). During these 10 weeks, a total of five Key Informant Interviews, 13 household interviews from solar beneficiaries and one focus group interview were



carried out. Furthermore, during the five weeks in Miklajung, my daily life included interactions with local families, first-hand experiences with energy constraints, and informal encounters with market workers and technical workers. The study was positioned around the focus of concrete social livelihood changes after the introduction; therefore, reflections on the technology of the intervention were not included in the result analysis.

Since solely using the ethnographic approach would usually require a longer and more in-depth involvement in the researched area, this research is complemented by prior gathered information as well as a simultaneous undertaken literature review. For all interviews, a male local energy project coordinator served as a field assistant for translation and cultural explanations.

The Key Informant Interviews (KIIs) included various stakeholders such as government and project officials, rural electrification and development researchers, and gender experts. The aim was to gather specific background knowledge on solar electrification and to identify potential economic, political and cultural influences on the implementation of rural electrification projects. Conducted semi-structured interviews are listed below.

Table 1 KII Interviews in Kathmandu and Biratnagar

<i>Date</i>	<i>Name</i>	<i>Position</i>	<i>Interview Aim</i>	<i>Length</i>
20.02.2023	Dr. Anzoo Sharma	Centre for rural technologies Nepal; deputy manager	Getting insights into rural electrification programs and common measurements of impacts	38 min
21.02.2023	Dr. Indira Shakya.	Gender and Energy Expert Independent Consultant	Getting insights into Gender Equality and Social Inclusion in the Nepalese Energy sector from the governmental to the local level	42 min

24.02.2023	Prof Sagar Sharma,	Dean of Kathmandu University, School of Arts	Discussing rural development, particularly energy development, in Nepal.	43 min
	Prof Sudarshan Dahal	Professor at Kathmandu University	Discussing out-migration. What should be considered and aimed for when conducting rural development research	
02.03.2023	Banuraja Shrestha	Individual RE Expert and Former Executive Member of AEPC (Alternative Energy Promotion Centre)	Clarifying the historical and political developments of Renewable Energy in Nepal. Discussing Rural Electrification.	75 min
03.03.2023	Lavamani Rajbhandari	RE Supplier and Company Owner	Getting insights into the solar technologies used in rural Nepal	59 min

Nearly all KII interviews were transcribed with the website otto.ai and coded with the software NVivo before travelling to the research area. The coding approach was inductive, where no set of codes has been developed before and they directly derived from the data (Skjott Linneberg & Korsgaard, 2019). Identified codes can be found in Appendix 1. During the fieldwork in Miklajung, this prior gathered expert knowledge paired with the theoretical outline supported the structuring of interview data. While I was aware that scholars like O'Reilly (2012) suggest a completely open and inductive approach for ethnographic research, as a novel researcher, there was a big risk of the process becoming too complicated (Skjott Linneberg & Korsgaard, 2019). Therefore, a mixed approach helped to find guidance in problems that were prior identified to be important.

In the research area, descriptions and observations were collected in a fieldwork book and interpretations from the gathered information were collected separately. For the focus group as well

as for the semi-structured interviews, notes were directly taken during the interviews. In other situations, such as conversations or observations from dinner times or daily activities, I memorized relevant information and wrote them down as memory descriptions separately. Out of the 13 interviewed households, 9 were equipped with SHS and 4 gained access to a SWP. The first two SHS interviews were particularly used to refine interview questions around electrification and to set the scene for further interview topics. Only for the SHS interviews 2-9, contextual factors such as numbers of people residing in the household and level of education were explicitly included. Generally, all interviewed SHS households relied on agriculture as the main source of income. All SHS interviews were conducted with either the wife of the male household head or a female household member, except for the last one where the male household head served as the main spokesperson. However, since the husband and/or children as well as the male translator were present at all times, there has not been any *only female-led* interview. All households were male-headed and the education level for both, household head and wife was basic<sup>2</sup>. All SHS interviews were conducted outside of the house with, in many cases, neighboring children or adults coming to observe. No household had any access to electrification before the installation of the SHS. While at the time of the interviews, the national grid had been extended, only one out of the 9 SHS interviewed households had access to it. And even then, the supply was very unreliable, particularly during monsoon seasons when there could be days without electrification from the national grid. Therefore, SHSs displayed for many households the sole means of electrification.

Table 2 SHS Interviews in Miklajung

#	Time of Access	Type of income	N of people	Level of educ	
				Male Household Head	Wife
1	2018	Agriculture	/	/	/
2	2021	Agriculture	9 Family Members	/	/
3	2022	Agriculture (Potato, Rice)	2 Adults	Basic	Basic

<sup>2</sup> In Nepal, the schooling system is divided into basic education (1<sup>st</sup> – 8<sup>th</sup> grade) and secondary education (9<sup>th</sup> to 12<sup>th</sup> grade)

4	2022	Agriculture (Potato, Rice)	4 Adults	Basic	Basic
5	2022	Agriculture	2 Adults, 3 Children	Basic	Basic
6	2022	Agriculture	5 Adults, 1 Child	Basic	Basic
7	2022	Agriculture	3 Adults	Basic	Basic
8	2022	Agriculture	2 Adults, 2 Children	Basic	Basic
9	2022	Agriculture & Construction Work	3 Adults, 3 Children	Basic	Basic

For SWP households, due to limited availability and time constraints, all interviewed participants were male. Since the households were very scattered from each other, interviews were conducted in a public gathering place instead of inside the households. While this gave little insight into the female perception of changes, I used the answers particularly to reflect back on gender structures and expected gender roles. The table below illustrates contextual information and differences for all four households. While it was recommended to not address issues of caste and financial status, based on the type of income it can be assumed that the SWP households had better financial stability than the interviewed SHS households.

Table 3 SWP Interviews in Miklajung

#	Time of Access	Type of income	N of people	Level of education HH	Level of education HW
1	2020	Timber	2 Adults, 4 Children	Basic	Basic
2	2020	Agriculture	4 Adults	Bachelor	Bachelor
3	2020	Agriculture, Government Officer	6 Adults, 1 Children	Secondary	MA Education

Lastly, one focus group discussion with male solar technicians was conducted to capture the particular social structures underlying individual behaviors. The focus group consisted of 9 men from Miklajung who were undertaking a solar technician training at the municipality at the time. The setting of the focus group, however, potentially had a big influence on the type of answers given. It first started outdoors, but due to weather changes the group was moved indoors. The upcoming storm required a sudden haste since some participants still needed to travel home afterwards. I took on the moderation of the focus group, with the translator repeating all instructions to the participants and giving their answers in return. After some time, I changed the process to a stronger individual focus, by stating statements like “Women would be suitable for the job as solar technicians” and requiring them to state their sentiment towards it. By doing so, extra translation time could be saved. However, the group discussion aspect got lost due to this change in the end. Details on participants differing economic backgrounds can be found in the Appendix.



Figure 7 SWP interviews. Photo by author.

For the results and discussion, I will refer to information gathered from household interviews with **(INT + Type of solar electrification)**, information gathered from informal fieldwork interviews with **(FW-INF)**, KII interviews with **(KII + Number of interview)**, information gathered in the focus group with **(FG)** and to field observations with **(OBS)**.

### **5.3 Methodological Limitations**

While ethnographic studies have many strengths, such as their ability to provide detailed livelihood information and insights into social phenomena (O'Reilly, 2012), they also have limitations to consider.

Firstly, a notable constraint in this specific research lies in the use of a male translator for all interviews, which stemmed from restricted availability and time constraints, making it challenging to address. This limitation is significant because it may have introduced gender-related biases into the interpretation of participants' responses, potentially misguiding the nuanced gender-based impacts of the solar electrification program. To limit this bias, I made a constant effort to engage in ongoing conversations with female locals in informal contexts throughout the entire research process. However, it remains essential to acknowledge this limitation.

Secondly, intersectionality in terms of different livelihood experiences based on intersections of class, age *and* gender could not be included as full parameters in the analysis of the results. While this study is guided by a gender lens, it is essential to recognize that the experiences of women in Nepal are diverse, and assuming homogeneity among them would be misleading.

Thirdly, the subjective nature of this study inevitably influenced the direction of the results (O'Reilly, 2012). Furthermore, the limited number of interviewees, as highlighted by Winther et al. (2017), raises challenges in drawing broad conclusions from a single case study. The lack of systemic procedures further complicates this issue of compatibility in a holistic sense (Hammersley, 2006). To mitigate these limitations, I strove to provide full transparency in the coding and interpretation processes of the data, aiming to establish a foundation for replicable research and minimize potential biases and constraints.

### **5.4 Positionality**

Coming from the Global North and studying a community development project in the Global South, the highest emphasis needed to be placed on positionality and ethical standpoints. In my case, as a white, 25-year-old, Austrian-raised, cis-gendered woman, my positionality includes several aspects.

First, my identity as a feminist influences how I interpret the gendered implications of solar electrification projects. My worldview, which has been strongly influenced by Neo-Marxist feminists such as Nancy Fraser, limits my understanding of gender relations and female empowerment in Eastern communities. Additionally, my worldview is not solely shaped by the work of theorists, but also by my socialized and learned perception of status' associated with different tasks and roles, that

potentially differ to the perception in Eastern communities. For example, my understanding of women's liberation has been connected to equal representation in all work forces outside of the household, whereas in Eastern communities, household work could be considered more valuable than in my socialized perception. To limit the influence of these inherent subliminal perceptions, a strong emphasize was placed on working with Kabeer's theory of choice, which focuses on the freedom of choice rather than the outcomes achieved. Furthermore, working with a theoretical guide created by an Indian-born British Bangladeshi development feminist supported a structure based on intersectional understandings.

Right from the beginning, I disclosed my research purpose to every encountered individual, aiming to not include information locals would have not wanted me to share. I constantly discussed my findings with locals in casual conversations, reaffirming whether my observations align with lived realities and therefore creating triangularity. During the fieldwork itself, mostly male locals supported my data gathering and contextualization. While these interviews were complemented by observations and casual conversations with female locals, the high male representation has undoubtedly played a big role in the type of data gathered. Furthermore, studying a community in Eastern Nepal as an outsider, influenced my access to information, my ability to understand the local context and my interpretation of the data. Not only did these affect how I perceived the research, but how others around me perceived and interacted with me, for example, by often being asked for my caste and social background during observations.

By acknowledging and reflecting on how these different points have influenced my research findings, wrong interpretations can be prevented and transparency can be achieved. However, it is still important to recognize the biases that have arisen as a result of my positionality.

## **6 Results and Discussion**

To answer the research questions guided by both theories, I structured the results and discussion into two themes: (1) Identifying the locally valued capabilities and how solar electrification has contributed to these and (2) analyzing the ways in which power structures and social norms influence these benefits. Furthermore, particular emphasis is placed on gendered differences in experiencing these capabilities.

### **6.1 Locally Valued Capabilities in Miklajung**

To overcome the first interpretative fallacies due to my differing cultural background, an effort was put to identify the general capabilities among the researched households in Miklajung. Like this, connections on the influence of rural solar energy, as the source, on local realities could be drawn. Therefore, all interviews included open-end questions on the constituents of a good life and the benefits participants hoped future generations would enjoy. Although these questions were not directly related to energy, they provided valuable insights into the community members' aspirations and needs. Particularly considering the energy project coordinator's presence, solely talking about the solar project might have led to too strongly influenced answers. To avoid this, this approach enabled a more nuanced understanding of how solar electricity contributed to these capabilities. Below, the following section summarizes the six substantive freedoms that were identified across households and that were eventually related to energy. The numbering serves only as a reference point and does not reflect their perceived importance.



Table 4 Identified Capabilities in Miklajung

	<b><i>Desired Capability</i></b>	<b><i>Explanation as by the households</i></b>
1	Capability to access quality education	Education was referred to as the “ <i>key for a good life</i> ” and was mentioned by every single household as the component for a valuable life. Education was hereby referred to as everything connected to children’s and youth development in the institutional setting (INT-SHS; INT-SW).
2	Capability to maintain good health and access to healthcare	Expressed wishes hereby were “safe drinking water, free from viruses and cholera” (INT-SWP). This value was especially prevalent among SWP households, who previously struggled with contaminated water sources. For both SHS and SWP households, smoke-free cooking was expressed as a wish connected to good health (INT-SHS; INT-SW). Some households further referred to good health as the availability of sufficient livelihood supplies, i.e. enough agricultural output, fewer physical burdens and safe drinking water (INT-SHS; INT-SWP).
3	Capability to access a reliable energy supply	Due to the 2021 disastrous landslides in Miklajung, previously reliant energy sources such as hydropower dams were destroyed in many cases. As a result, nearly every interviewee mentioned the importance of a reliable energy supply that is resistant to natural hazards (INT-SHS; INT-SWP).
4	Capability to maintain and repair energy without the dependency on outer institutions	Households expressed their desire to become self-reliant in maintaining energy systems in the future, rather than relying on external organizations (INT-SWP).

5	Capability to have agricultural machinery as means to improve productivity	Currently, the interviewed households reported that their agricultural activities are conducted fully manually. Better facilities such as automated mills and irrigation systems were wished for to increase productivity and create better opportunities (INT-SHS); INT-SWP).
6	Capability to achieve greater self-sufficiency and have less time consuming work tasks	All female interviewees emphasized the importance of reducing their reliance on natural resources and external factors. This included becoming less dependent on daylight for household chores and having a readily available water supply within their homes, as opposed to the need to fetch water from the river. Across all households, this capacity was often seen as a pathway to leading an <i>easier and more balanced life</i> (OBS; INT-SHS; INT-SWP).

## 6.2 Unlocking Human Potential: The Contributions of Solar Electricity to Capabilities

Having pointed out the desired capabilities among researched households, these aspirations are further placed within the solar electrification project in Miklajung.

Generally, the resulting services from SHS and SWP included lighting, pumping groundwater and charging phones. Houses that had access to SHS but were not considered for SWP systems were located in downstream mountain areas and, therefore, had sufficient access to river water flows. Households that gained access to SWPs had an average walking time of 1h to the next water source before the installation. Not surprisingly, all observed households experienced significant livelihood changes after the adoption of solar electrification. Costs for SHS installations were fully covered by the program, and costs for SWP stayed at 20% self-funding from the community (FW-INF; INT-SHS; INT-SWP). Figure 8 and Figure 11 illustrate the identified capabilities. 8 out of the interviewed 13 households – all SHS households - did not have access to the national grid at the time of the interview. However, even for households with national grid access, the electricity supply was very unreliable. As locals have pointed out, SHSs have become a necessary substance for continued power supply, especially during the monsoon seasons (INT-SHS).

6.2.1 Solar Home Systems

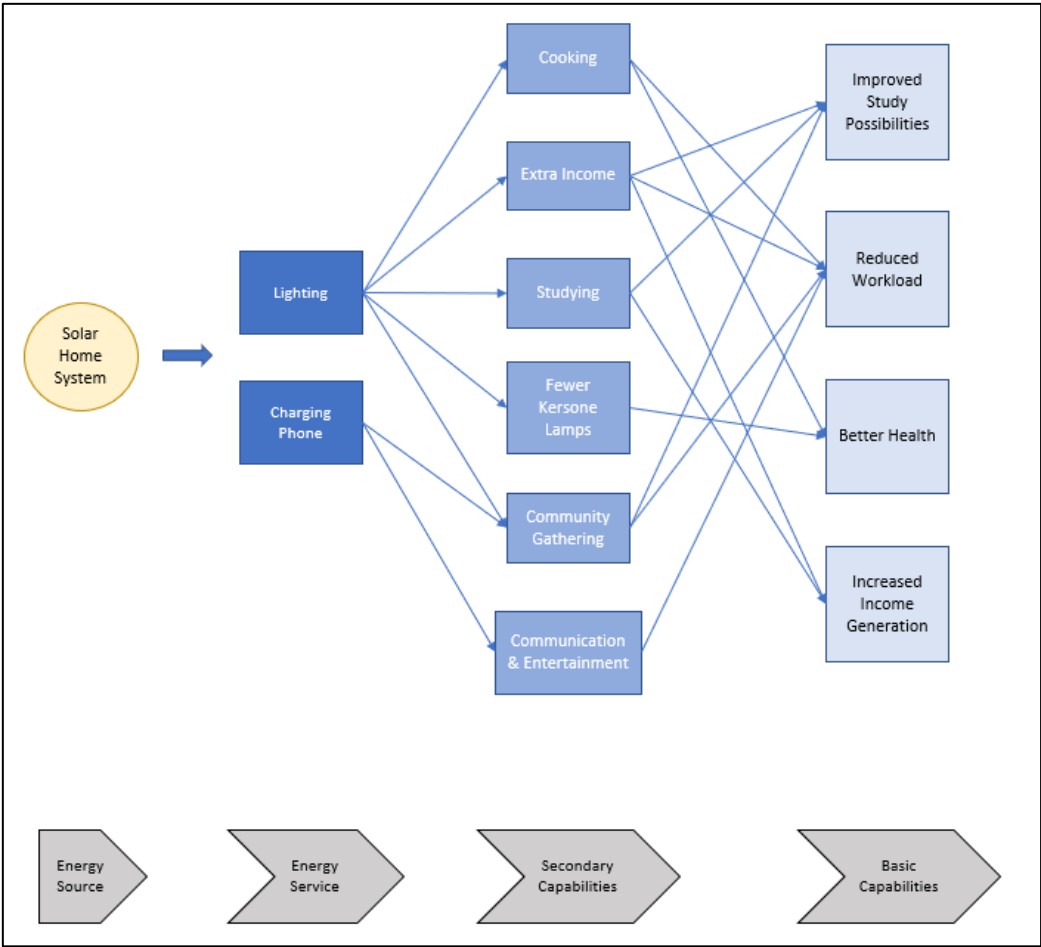


Figure 8 SHS Capabilities. Own illustration.

For SHS households, the most often mentioned capabilities that were expanded through solar electrification were *Improved Studying Possibilities* and *Reduced Workload*.

*Improved Study Possibilities* were achieved through two specific means: (1) extended study times for children due to lighting and (2) extended income-generating opportunities made possible by lighting (such as operating a mill at night) that can be used to fund children's education. Furthermore, SHS lighting allowed multiple people to use the same light at the same time, enabling all children to study simultaneously. Before the electrification, lighting from kerosene lamps or lighting batteries was limited to a small area spanning only a few square meters (INT-SHS). Hence, particularly the oldest children had to leave earlier and provide space for younger children (INT-SHS). *Improved Studying Possibility* as the capability was valued and mentioned by all, female and male participants to the same extent. However, when it comes to supporting children in their study time, it was primarily women who were the main responsible (OBS).

The second achieved capability, *Reduced Workload*, referred particularly to changes in the way women carry out their daily activities. The availability of solar energy has led to increased flexibility by rescheduling household tasks from day to night. Through lighting and phone communication, women's primary role as caregivers and indoor workers was supported, with cooking being the most valued activity (INT-SHS). Prior to



Figure 9 Household with SHS. Photo taken by author

the electrification, cooking for dinner was considered unsafe and exhausting due to the use of kerosene lamps, which could lead to unintentional chemical drips into the food and attract insects (INT-SHS). Through SHS lighting, women gained the ability to oversee the entire kitchen, effortlessly multitasking between chopping vegetables at one end and cooking food at the other. This significantly reduced their physical and mental workload, leading to a decrease in stress (INT-SHS). However, when asking questions about reduced resting time for women due to longer working hours into the night, women did not recognize this potential negative impact. It is important to acknowledge that the presence of the project coordinator during the interviews might have added a significant influence, potentially creating an uncomfortable atmosphere that hindered women from openly discussing this matter.



Figure 10 Unused kerosene lamps in an SHS household. Photo by author.

Even though the positive impacts of solar energy on health were never primarily stated by SHS interviewees, the introduction of solar energy has led to the complete abandonment of kerosene lamps during summer months in the observed households, directly minimizing negative health impacts (OBS). *Better Health*, therefore, represents the 3<sup>rd</sup> identified capability. In all SHS households, women were working indoors and therefore benefited the most from less kerosene lamp usage and less mental stress about the low availability of sunlight (OBS). Differences in gendered experiences, particularly labor distribution, therefore, directly translate to differing health benefits as a result of solar electrification.

Another point to mention is that households still rely on firewood for cooking, which is linked to respiratory diseases (Malla, 2021). The interview with the health post revealed that respiratory diseases were the

most common health issue in Miklajung, and women were the majority of patients (FW-INF). However, health workers in the hospital also mentioned male-out migration and differing perceptions of the importance of health as potential reasons for more female patients (FW-INF).

The fourth capability most frequently identified was *Increased Income Generation*. This capability was enabled through the possibility of extra income-generating activities in the evening hours, such as mill grinding (INT-SHS). However, while solar electrification played a crucial role in improving *possibilities* to engage in income-generating activities, the electricity generated was insufficient to enable *direct* productivity gains (e.g., through irrigation, electrified mills, etc.). In other words, while solar electricity contributed to income generation, it was not adequate to facilitate services directly related to agricultural productivity enhancement and increasing secure and safe employment (OBS). In section *Comparing and Reflecting on Capabilities*, I will place greater emphasis on this connection.

In addition to the previously mentioned capabilities, the provision of lighting had a direct positive impact on the community by facilitating household gatherings in the evening and enabling children to study together (INT-SHS). The interviewees highlighted that electricity was often shared among households, with children gathering to study or using their phones for entertainment purposes (INT-SHS). The primary use of phones in households was for communication with relatives, as many households lacked sufficient energy supply for Wi-Fi connections (INT-SHS). When the connection was good, phones were also used for entertainment purposes, such as social media and music, particularly when children were present (OBS).

6.2.2 Solar Water Lifting Pumps

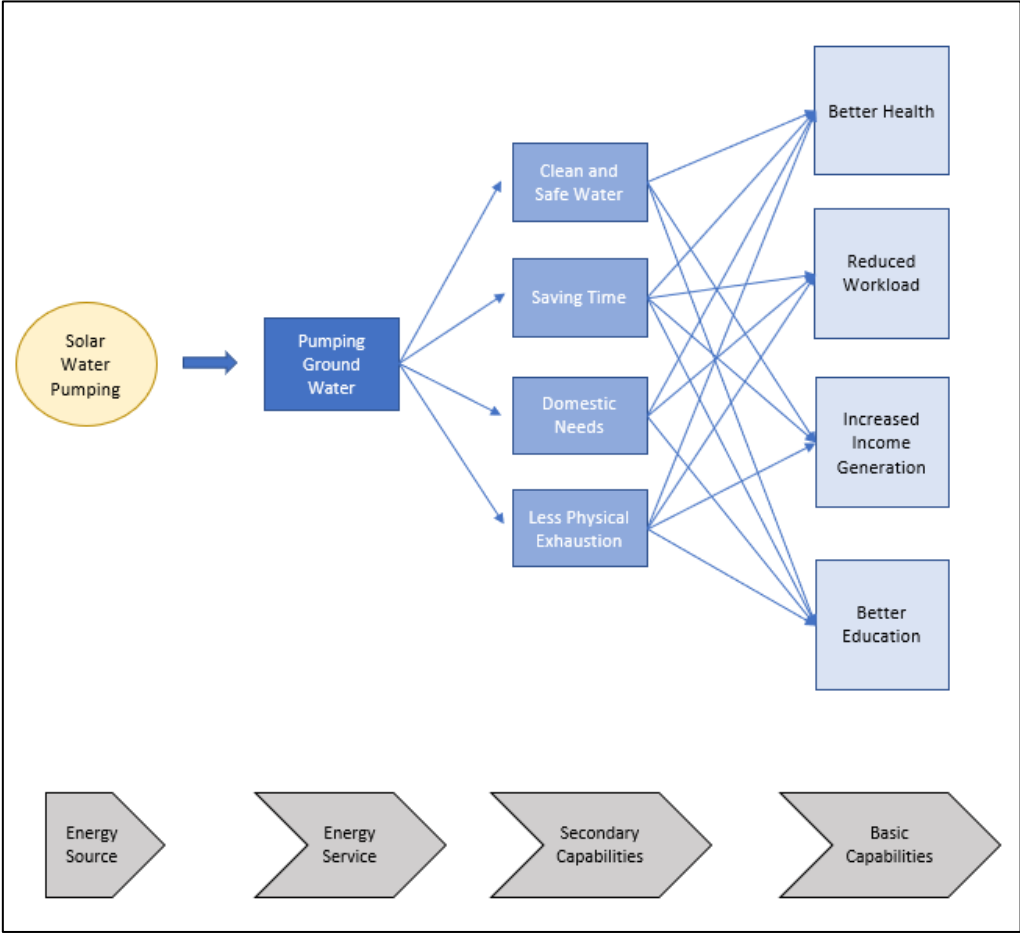


Figure 11 SWP Capabilities. Own illustration.

For SWP households, the enabled capability that was valued the most was *Better Health*. Households previously faced contaminated water during monsoon seasons, which was especially hazardous for children and elderly household members. Through SWP systems, clean drinking water is directly provided to the households. While *Better Health* due to cleaner water targets both men and women in the household equally, women seemed to have had a particular relief in physical burdens connected to water fetching. Water fetching has most traditionally been considered women’s and girls’ work. However, some households, particularly those with better educational backgrounds, recognized it as a shared responsibility for both men and women (INT-SWP). In households where only women were responsible for the water supply, interviewees reported that women were expected to continue fetching and transporting water even during pregnancies (INT-SWP).

The second most often mentioned and most valued capability was *Reduced Workload*. The reduction of water fetching directly contributed to more saved time. Within the households, three possibilities

were stated for how this extra time was used: (1) income generation (2) taking care of family or (3) to rest. It is to note, that more time to rest was only mentioned by SWP households, but never by SHS households (OBS). In households with children, the extra income was used for children’s education (INT-SWP). Household activities such as cooking and cleaning became easier and more accessible due to the close availability of running water (INT-SWP). This domestic usage displayed another area where women were considered the main beneficiaries since men were mostly expected to work on the field or to engage in business activities (OBS).

Clean and safe water has further contributed to two more capabilities: *Increased Income Generation* and *Better Education*. Physical as well as mental relief led to better concentration and more strength, particularly among the children in the household. By having more extra time, members in the households were able to engage in other income-generating work tasks such as supporting on the vegetable field or finding jobs outside of the household. One interviewee emphasized how his wife, employed as a teacher, had now more time to concentrate on her job preparations, than when she had to spend the same time fetching water (INT-SWP).

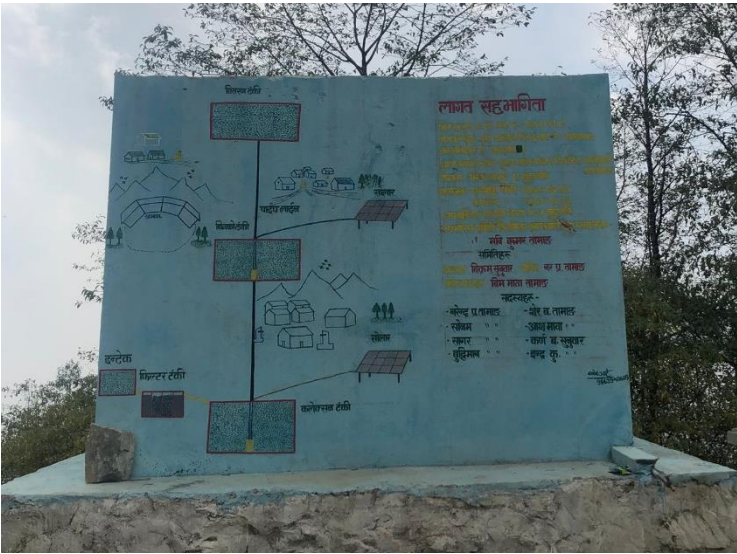


Figure 12 Explanation of the SWP distribution. Photo by author.

Moreover, the provision of running water has led to the creation of new community spaces (OBS). Previously unused areas began to be transformed into gathering spots as more villagers settled down in nearby regions due to the water availability. In the specific area where the SWP households interviews were conducted, a new SWP was currently being constructed to supply all the recently relocated villagers (INT-SWP).

### 6.3 Comparing and Reflecting on Capabilities

Generally, the research outlined how solar electrification has contributed either directly or indirectly to the following four capabilities: Better Health, Better Education or Study Possibilities, Increased Income Generation, and Reduced Workload. By enabling the services lighting, phone charging and pumping groundwater, several activities and therefore capabilities could be addressed. Women in particular have profited from the capability enhancement by facilitating several work tasks in a faster manner. Reliability and Resistance, as previously mentioned, displayed keywords in conversations about future aspirations (INT-SHS; INT-SW). Solar energy hereby served as the necessary component for such reliability, with households experiencing it as the necessary backup for every electricity outage (OBS).

When comparing it to all identified capabilities associated with energy among the households, however, it becomes evident that certain aspects, particularly those related to agricultural machinery and reduced dependencies, were not addressed. In line with sustainable rural development, these observations were especially apparent considering the differentiations between poverty reduction and poverty alleviation, a concept highlighted by scholars like Laufer and Schäfer's (2011) case study analysis of SHS appliances in Sri Lanka. Laufer and Schäfer emphasized that while access to basic energy levels can improve living conditions (*poverty alleviation*), the actual reduction of poverty needs additional improvements in sectors like economic activities and independent financing options (Laufer & Schäfer, 2011). This goes align with KII interviews that highlighted the need for an increase in energy capacities for rural electrification, not only an increase in access. In Miklajung, due to very scattered households and a limited budget, a majority of households were not applicable for bigger capacities such as mini-grids (FW-INF).

KII-4 and KII-6 too emphasized how economic activities through electrification are mostly not yet prioritized in Nepal, while local households would often wish for it. Furthermore, all KII emphasized the importance of agricultural productivity in creating sustainable uplifting's for rural communities. For instance, focusing on the provision of in-household economic activities such as electrified mills enabled through electrification, instead of solely focusing on the provision of lighting (KII-6). Furthermore, concerning the maintenance and repair, especially water pumps and solar batteries were found to require extensive work (OBS). Until now, this work had to be executed by external support, creating new dependencies. On that note, KII-2 mentioned that the ability to maintain a



newly introduced technology without the constant reliance on external assistance is crucial for achieving sustainable development. During my fieldwork, a solar technician workshop was organized by GIZ to address this issue. However, only male technicians were included, leaving an important potential for women’s empowerment untapped (OBS).



Figure 13 Solar Technician Workshop. Photo by author.

Concerning the capability of *access to quality education*, among locals, there was a strong perception that education was not prioritized in the governmental budget (FH-INF). Fieldwork interviews revealed that solar electrification had enabled computer access in schools, but this only applied to 8 out of 56 schools in the whole area of Miklajung. SHSs enabled easier and more accessible studying at home, however, a greater focus on systemic electrification in the educational system would be needed to ensure a holistic and sustainable development.

## 6.4 Empowerment and Equality: Gendered Differences in Capabilities

*“Today’s inequalities are translated into the inequalities of tomorrow as daughters inherit the same discriminatory structures that oppressed their mothers.”*

- Kabeer, 2005, p. 16

As previously addressed, according to Kabeer (1999), all development achievements should be analyzed based on their transformative potentials. Otherwise, the achieved changes stay in the realm of paternalist multi-dimensional structures and limit women’s abilities to fully realize their agency (Kabeer, 2005). In the case of solar electrification in Miklajung, this refers to the achievements of Better Health, Better Education/Better Study Possibilities, Increased Income Generation, and Reduced Workload. While the limited word count of this thesis restricts an analysis of each section individually, an overall assessment connected to literature reviews, KII interviews, and informal conversations in Miklajung is conducted in the following sections.

### 6.4.1 The Question of Choice: Gendered Differences

As aforementioned, actualized agency means mirroring purposeful behavior, instead of when actions are taken because of little other choice (Kabeer, 2005). The concept of free choice hereby illustrates whether the electrification has led to a genuine expansion of choice, or to an extension of passive forms of behavior alongside resource access. Kabeer (2005) highlights that for actual free choice to occur, the possibilities of having chosen otherwise must exist *and* be perceived to exist. For energy interventions and this thesis this means that instead of focusing on the achievements as elaborated earlier (e.g. women working more productively in the household), the focus lies on the conditions that create the situation.

In Miklajung, although women stated that they highly value the free choice of doing a task whenever they want because of solar electrification (INT-SHS), according to my observations, these actions do not reflect back on free choice. The two conditions of (1) other possibilities to exist and (2) be perceived to exist did not apply to any observed situation. Instead, the observed behaviors refer back to passive forms of agency. This is due to the fact that the benefits of electrification in Miklajung are tied to traditional gender roles, where women handle household tasks and childcare, while men pursue employment outside the home if resources are in place (FW-INF). These gender-specific expectations translated and manifested in different energy experiences, with women’s work being directly associated with electrification (OBS). Although energy access alleviated some domestic workloads, it was considered a given that women bear the burden of unpaid care work. Furthermore,

during my fieldwork observations, the possibilities of entering the labor market through solar electrification by joining solar technician training were reserved for men (OBS).

Women seemed to have full agency over their executed tasks (such as what to cook and when to cook), however, overall decision-making processes that have the potential of affecting first-order choices, which inherently entail the exercise of power, were seemingly reserved to male household heads (FW-INF; FG). This observation can be considered effective power structures, as outlined by Kabeer (1999), since they were not perceived as such. For example, the labor and therefore task division considering household duties and outside job opportunities was considered a naturalized social order by most interviewed locals (FW-INF; FG). Throughout the entire research process, from casual conversations to semi-structured interviews, individuals consistently highlighted the positive impacts of electrification for women. However, the potentially unjust nature that led to these outcomes has never been addressed but was rather referred to as “Simple Nepalese Culture” (OBS). Therefore, the significant impact of electrification on women’s daily lives, while men did not personally experience such great changes, highlights the disparities in their everyday realities (OBS). Drawing on Nightingale’s (2011) research on gender construction in Nepal, through the unquestioned acceptance of the daily task distribution at hand, ideas of gender were (re)produced and perpetuated to future generations (OBS).

#### **6.4.2 Socialized Gender Differences**

While pre-assumed roles apply to both men and women, it is important to acknowledge the inherited power structures such roles perpetuate. Personal conversations with the female, as well as male locals, showed that biological differences were often given as a reason for gendered differences in task distributions (FW-INF). Men were considered more suitable for outdoor labor and physical intense work (FG). However, certain discrepancies with applying this reasoning to all gendered tasks reveal their unequal nature. For example, as elaborated above, water fetching including its hours of carrying baskets was traditionally considered women’s and girls’ work. Furthermore, decision-making and business engagements fell under men’s traditional tasks, work that does not involve any physical outlet (FG). While many observed female tasks required strong physical labor, women were not actively aware of the intensity of the work (OBS). Kabeer (2005) suggests that agency starts from within through the meaning, motivation, and purpose women attribute to their own action. This in turn is influenced by how the external world perceives and treats them (Kabeer, 2005). According to my observations, the maintained gender role distributions through the solar electrification could potentially reinforce women’s internalized roles. Therefore, leading them to adopt obedient

positions when making choices and accepting electrification-related tasks as naturally female's responsibility (OBS).

*"Women are the backbone of our society (...) but as you say, they are deprived" (KII-6)*

While in Miklajung, interviewed households did not talk about underlying power structures, particularly younger people have started to openly express their wish for a change in gender dynamics. Conversations with young girls revealed that they perceived independence as their primary struggle (FW-INF). They were stating examples of how boys in their age were not required to provide explanations about where they were going, while girls were always being carefully watched and controlled, creating social expectations and assumptions from a very young age. This aligns well with other scholars who emphasize the significance of social norms, arguing that women are conditioned to be subservient from a young age, leading to limited power and freedom in their lives (Govind Kelkar & Dev Nathan, 2021). During speeches on International Women's Day (IWD), girls as young as 9 years were openly discussing the unjust nature of the "Simple Nepalese Culture", and how this translates into several different areas.

*"It's not only the mentality given to us by culture and government, it is the mentality given to us by our own families" (IWD Speech)*

#### **6.4.3 Development and Responsibility**

Connecting this back to energy, electrification in Miklajung has led to women's greater productivity, but not to women's greater empowerment in choosing the life they aspire to live (OBS). Solar electrification has been essential in achieving certain valuable living standards, such as better health and better education, but the transformative potential in terms of the "ability to act on the restrictive aspects of these roles and responsibilities in order to challenge them", as outlined by Kabeer (2005, p. 5), has not been addressed. While capabilities were undoubtedly enabled, not accompanying them with deeper agency training and questions of dominant gender discourses has perpetuated a one-dimensional view of electrification and empowerment. Taking this discourse forward, however, raises a different question considering the implementation of rural electrification programs in

general. Namely, can it even be expected by rural electrification initiatives to cover and transform local power dynamics? If not by those, whose responsibility is it otherwise?

Referring back to the outline from section *The Theory of Empowerment*, according to Kabeer (2005), resources display the medium through which agency is exercised. The solar electrification can therefore be understood as a way to potentially change agency settings. In Miklajung, while the rural electrification had tremendous positive impacts on local's life quality, the responsibility of aligning resources with local empowerment dynamics has not been prioritized. According to KII 2 to 5, however, particularly this responsibility would be with the development organizations. The interviewees emphasized the continuous need for introducing rural electrification alongside other development interventions such as capacity training and entrepreneurial opportunities. KII-2, for example, listed examples of successful energy projects in Nepal that simultaneously created job possibilities for local women such as energy coordinators and community support. These findings align with other studies that highlight that a gender-equitable and sustainable implementation of energy projects requires the accompanied input from other change processes and rural development efforts (Bhattacharyya & Ohiare, 2012; Sedai et al., 2022).

## **6.5 Beyond Politics: Recognizing the Limitations of Political Representation**

In Miklajung, interviews with the municipality women's branch as well as with households revealed that efforts have been made to increase women's representation throughout the solar electrification project as well as in governmental offices. Particularly for SWP systems, user committees have been created that ought to include more than 30 % of women representation (FW-INF). These committees are the focal decision-makers for site selections and maintenance work (FW-INF). On the municipality level, an energy development committee has been created that covers questions of processing, planning and implementation of electrification (INT-SWP). In Miklajung, out of nine members in this committee, four are women. Furthermore, for the municipality office, most job openings are under a certain women's quota. Connecting these findings to Kabeer (2005), she highlights that political representation is challenging to achieve, making it significant that it has been prioritized in Miklajung. However, while women's representation is a necessity, she also highlights how it does not directly translate into gender-sensitive policies and practices (Kabeer, 2005). During my fieldwork in Miklajung, Biratnagar and Kathmandu, two critical observations regarding the political representation could be drawn.

### 6.5.1 Male-Centricity and Homogeneity in Energy Matters

While it was clearly stated that women quotas have been put into place, the institutions were still very male-centric (OBS). Every single local decision holder or project coordinator that I was in contact with has been male. This is particularly concerning considering the higher numbers of women living in Miklajung, as addressed by KII-3:

*“Because contextualization is so important. So you really have to understand the dynamics of that society. Who is there? Who are the ones who are making decisions regarding energy? And if it's only men, let it be men. But if there are more women than men, and only few men are making business, then that's a problem.” (KII-3)*

As mentioned in the beginning of this section, water pumping committees involve women, but based on my observations, the execution of the entire project primarily relied on men. All the project information interviews I conducted were with male informants. During one field site visit that included a local municipality discussion about the SWP systems, only men joined the meeting (OBS). Technical details were all considered to be in the men's task knowledge



Figure 14 SWP Site Visit. Photo by author.

(OBS). Kabeer (2005) too highlights the difference between quotas that consider the presence of women as a legitimate and necessary form of representation, and quotas that consider the presence of women as a simple *token*. Based on her research, it is the difference in implementation of how the outcome of quotas is changed. For actualized empowerment, it is essential that women are actively mobilized and involved in all stages of transformation, rather than being referred to in the end (Kabeer, 2005). Moreover, while increasing the share of women in political matters is important from a broader gender representation perspective, it does not ensure that the needs of women from poor and marginalized groups are met (Kabeer, 2015). In the words of KII-3:

*“You know, and just because the leadership changes from one group to another doesn't make it encouraging. Yeah. I mean, that's the that's the illusion you falling. Yeah. It's only the change in power structure. But it's still exclusive.” (KII-3)*

Therefore, simply the fact of ensuring political representation does not directly transform into just and equal policies. Rather, based on KII interviews and Kabeer's literature, a combination of women with differing backgrounds who are being mobilized from the beginning on can lead to political representation as actual transformative change.

### **6.5.2 Cultural and Educational Barriers**

In Miklajung, while political possibilities are there, there is a strong perception that women seemingly lack the will of pursuing them, as the quote below illustrates.

*"Although the policies [...] encourage women for decision-making, but they, the women, they hesitate." (INT-Women Section)*

This occurrence could be connected to two things: culture and education (OBS). As previously mentioned, through internalized social statuses, women's agency is limited by their own beliefs and perceptions. Culturally, women in Nepal are taught to follow men's rules and decision-making (OBS). Rarely, they are encouraged to create transformative agency and go beyond expected gender roles (OBS). Furthermore, KII interviews emphasized the differences in education, with boys in the family often receiving greater possibilities for pursuing higher education. Below are two quotes, emphasizing the cultural and educational barriers when it comes to women's inclusiveness.

*"(...) they don't want to speak in the mass, usually. Because education level of women here is quite low and they consider themselves that they are not capable. Their voice is immature. So whatever they say, it might sound stupid or something, so they'd not want to speak." (KII-1)*

*"(...) these things that are driven by culture and tradition within specific communities also. Now of course, (...) there are women who are not able to raise their voice. That is because one is culture. The second thing is about education and which you know, it does not allow them to focus on things for a long time." (KII-2)*

Moreover, while I was not able to investigate this issue further, Kabeer (2012) raises concerns about how such hesitance to greater involvement is often connected to how it could potentially affect the unpaid care work women are supposed to do. Therefore, only women with greater resources to begin with could even consider pursuing such a position.

In sum, while political space and decision-making roles for women were being created alongside the rural electrification, such strategies also need to align with work that aims to unravel culturally-created gender roles that women and men are supposed to fulfil. Based on my observations, only by directly working with women and men together, identifying their aspirations and encouraging them on the symbolic and material level, can political representation actually be achieved. Otherwise, the creation of political positions might remain in the same realm as the currently assumed fully inclusive constitution in Nepal, as outlined by KII-3:

“Our constitution says how our constitution values social inclusion, how it says that every human being, every person born in Nepal is equal. How it says, there is going to be no exclusion whatsoever in the name of sex, gender, you name it. There's no exclusion whatsoever. If we look at the Constitution, it's very progressive. Is it actually happening in practice? Is it happening? Do we actually see it? That's a totally different game.” (KII-3)

## 6.6 Future Implications

Winther et al. (2017) suggest through their literature review that particular the two themes of **sociocultural aspects**, such as cultural gender expectations, and **material resources**, such as limited appliances constitute the two most significant barriers to women's empowerment through electrification. Sociocultural, by involving women in every step of the implementation process and enabling training for solar technicians, for example, cultural gender expectations could be addressed and an “expansion in the type of roles considered possible and appropriate for women” as outlined by Winther et al. (2017, p. 406), could be achieved. This can be done through agency training, aiming to highlight new potentials and establish gender discourses. KII-1 and KII-2, for instance, suggested the creation of agency training that involves local capacity leverages for women and gender dynamic workshops for households. Important to mention, according to KII-2's experience, the benefits of female agency trainings that do not involve male household heads remain limited and short-term.

Furthermore, to address the material resources, increasing the possibility of productive appliances through agricultural electrification could be one potential possibility for sustainable rural development in Miklajung, as also outlined by KII-3. Overall, increasing agricultural productivity through electrification plays a significant role in changing people's capabilities and enhancing people's quality of life (Bridge et al., 2016). Several scholars emphasize how technological advancements in agricultural productivity in Nepal have significant contributions in areas including



but not limited to household food security (Morioka & Kondo, 2017), smallholder poverty reduction (Paudel et al., 2023), and increased gender equality (Aly & Shields, 2010). While the currently adopted electrification in Miklajung has enabled women to work and fulfil their tasks with greater efficiency and easier access, it did not promote the development away from unequal and limiting power structures. By creating possibilities for electric-powered machinery, irrigation systems, and efficient storage and processing technologies, new income possibilities and working fields for women could be generated (Sedai et al., 2022; Winther et al., 2017). This, of course, has to be implemented in line with the previously mentioned agency trainings. Without addressing underlying structures of resource control and material opportunities, structural changes and poverty reduction remain limited to gendered barriers. Scholars also highlight the importance of actively involving the local population and creating bottom-up approaches to electrification (Bhattacharyya & Ohiare, 2012). While the local administrative level in Miklajung was actively involved in disseminating the local solution, in terms of the gender context, my findings suggest that stronger emphasis needs to be placed on assessing women's localized needs and establishing active female involvement and voice.

## 7 Conclusion

In conclusion, the introduction of Solar Home Systems and Solar Water Lifting Pumps has had significant contributions to the capability enhancement of Better Health, Better Education/Better Study Possibilities, Increased Income Generation, and Reduced Workload. Women, in particular, have experienced positive changes in their ability to fulfil tasks in a more productive manner, such as cooking and caring for children. Furthermore, Solar Water Lifting Pumps have reduced the drudgery of water collection, allowing women to experience less physical exhaustion and have more time to rest or to participate in farming activities. However, while electrification as currently adopted is necessary, it is not sufficient to achieve sustainable development. The productive usage of energy for agriculture particularly emerges as a critical point that demands attention.

Subsequently, by applying the Capabilities Approach in combination with Kabeer's Empowerment Theory, broader cultural constraints that limit women's agency and ability to fully benefit from solar electrification could be identified. While capabilities for both women and men have been enabled, their benefits are solely related to gender-specific tasks and expectations. Women's role as caretakers limit their ability to go beyond expected tasks, and energy access perpetuates current roles in many cases. When addressed, inequalities were not perceived as such, making them even more difficult to overcome. Furthermore, while efforts have been made to increase women's representation in decision-making institutions, the project structure was very male-centric. Cultural and educational barriers limit women's participation and greater emphasis on women's involvement throughout the whole process is needed.

The findings emphasize the need for implementing programs that address cultural constraints and the necessity of increasing women's agency. By working directly with women and men, understanding their aspirations, and promoting reflections on gender structures, transformative potentials through electrification can be achieved. Concrete steps involve political participation, capacity-building, and the focus on productive energy usage in agriculture.

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## Appendix

### Appendix 1: Identified Coding Scheme from KII Interviews

Code	Sub-Code
Gender	Empowerment
	Entrepreneurship
	GESI
	Power Challenges
Macro-Events	Culture
	Legal Aspects
	Male-Out Migration
	Politics
	Technology
Sustainability in Rural Electrification	Independence
	Reliability
	Equity

## Appendix 2: List of Focus Group participants

<i>#</i>	<i>Age</i>	<i>Status</i>	<i>Number of People in Household</i>	<i>Number of Children</i>	<i>Level of Education Household Head</i>	<i>Level of Education Household Woman</i>	<i>Type of Income</i>
1	35	Married	3	1	Basic	Secondary	Farmer
2	40	Married	4	2	Basic	Basic	Farmer
3	27	Married	4	2	Secondary	Secondary	Farmer
4	29	Married	4	2	Secondary	Secondary	Farmer, Business
5	39	Married	4	2	Basic	Secondary	Farmer
6	29	Married	4	2	Secondary	Secondary	-
7	45	Married	6 (Mother + Father in Household)	2	Secondary	Basic	Farmer, Shopkeeper
8	36	Married	3	0	Basic	Secondary	Technician

### Appendix 3: Interview Guide SHS

1)	When did you get the SHS?
2)	Are you satisfied with the energy you get?
3)	What are you using the energy for? How is that different than to before?
4)	What are the benefits that you connect with energy?
5)	What do you like best about having access to electricity? And why do you like it best?
6)	What do you think has changed in your day-to-day life since the implementation of the solar home-based system?
7)	Do you think women have different benefits from the SHS than men? If so, how?
8)	What appliances did you have before the SHS project? (Example: Phone, Stove, Radio, TV )
9)	What appliances do you have now? What has changed in the usage? (Example: different stove, charging the phone more often)
10)	What are the things or opportunities you would like your children to enjoy in the future?
11)	How is this good life associated with everyday interactions with electricity?
12)	Complete the following sentences - I like solar home-based systems because now...  - I don't like solar home-based systems because now...
13)	Who made the decision for the SHS-based system and why?
14)	How much, in proportion to your household income, did you pay for the solar home-based system?

Gender:

Age:

Full Name:

#### Appendix 4: Interview Guide SWP

1)	When did you get access to the SWP?
2)	Do you have access to the national electricity grid? If yes, since when? If not, do you have another source of electrification for your households?
3)	Are you satisfied with the amount of water you get?
4)	What changed after you gained access to the SWP? (day-to-day and greater structure)
5)	Which change is most important to you?
6)	Do you think there is a difference between how women were impacted by the water access vs how men were impacted?
7)	Do you think solar energy is resistant to national disaster?
8)	How reliable is the water flow?
9)	How is the maintenance and repair for the SWP?
10)	What are the things/opportunities connected to energy that you would like your children to enjoy?
11)	What do you think is the biggest challenge for SWP and solar electricity?
12)	What do you think is most important to live a good life?

Gender:

Age:

Full Name: