



Nepal's rapid rural electrification achievement: A review

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Abstract

Nepal has been able to accelerate electricity access to rural areas very rapidly from early 2000s. Though the existing literature provides insights into the factors, enablers, challenges, and institutional models influencing rural electrification in Nepal, there is currently very little assessment of the specific factors that led to Nepal's rapid rural electricity access in the first two decades of this century. This review paper investigates what spurred this rapid rural electrification in Nepal. The study employs a literature review approach and uses the multi-level perspective and energy justice frameworks for a holistic interpretation of findings of the literature review. Analysis of the findings from the literature review indicate that Nepal's rapid electrification can be assessed primarily through the perspectives of governance and policies. The discussion also touches on the institutional context, the politics surrounding the electrification transition, and policy innovations. The effectiveness of the policies is also analysed through an energy justice perspective. The analysis highlights challenges and disparities in geographical distribution and energy justice. The paper argues that Nepal's rural electricity access was boosted by political and socio-economic conditions, like advent of democracy and large-scale foreign employment, and was propelled by innovative government policies for grid based and off-grid rural electrification. However, it also concludes that work still needs to be done from an energy justice perspective to bring about geographical and economic equity in the effort.

Keywords: Rural electrification; Energy transition; Energy access

1. Introduction

Electricity in rural households greatly improves quality of life [1]. It provides improved lighting for cooking, studying and extended working hours for household or income generation activities, security, information and entertainment. Table 1 [2] presents the results of a study on the impact of rural electrification that shows various benefits from rural electrification in Nepal.

Overall, the economic benefit of rural electrification outweighs the investment required [3]. However, a study has also concluded that electricity alone does not stimulate economic development unless households are willing and able to make additional investments to use and benefit from electricity [4]. This corroborates studies done in the neighboring country of India [5]. On the other hand, unreliable electricity supply can have a negative economic impact on households because of the additional costs that they need to spend to address the unreliable electricity supply [6].

Unlike many economies, where electricity access is high, but generation is carbon intensive. Nepal, in the early 2000s, had electricity almost entirely from renewable sources but had low electricity access. This reminds us that energy transition is also important from an energy justice perspective [7]. Inadequate electricity services in rural areas can have adverse economic, political, social, environmental, and health impacts [8]. Therefore, providing electrification helps fulfil a nation's human development and environmental goals [7].

There are two options for providing rural electrification. The first is from the national electricity grid. This method of electrification, usually to provide electricity to urban or peri-urban areas is expensive to extend in remote areas. It is also vulnerable to natural and human threats, and many times it is weak and unreliable due to long lengths. For these reasons, many remote rural

areas are provided "off-grid" electricity, usually generated from small renewable energy systems not connected to the national grid. However, these systems suffer from being able to provide only limited supply of electricity. Experience has also shown that they usually have inadequate technical backstopping [9,10]. There are also various institutional models for rural electrification. They include electrification from the national grid by public power companies, rural electric cooperatives, private or decentralized distribution companies. For areas unreachable by the national grid, off-grid approaches are used. These include providing electricity through community owned small grid systems or by household systems [11].

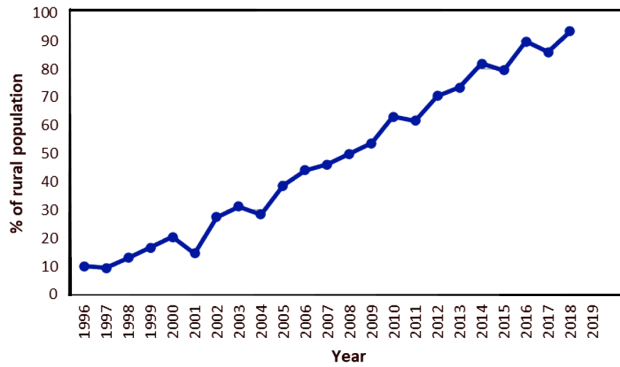
In Nepal, all these approaches have been utilized for rural electrification. It has been undertaken from the national grid by Nepal Electricity Authority (NEA), the national public utility, through its own resources or through donor funding. The Asian Development Bank (ADB) has provided technical and financial assistance to Nepal for preparing and implementing both on-grid and off-grid rural electrification projects [12]. Rural electrification is also carried out by a private company like Butwal Power Company or through community rural electrification by local electric cooperatives. Off grid electrification accelerated after mid-1990s with the establishment of the Alternative Energy Promotion Centre. It has been done through either micro/mini hydro or solar PV mini grids or solar home systems [13]. The government previously had a strategy to electrify the hilly district headquarters through mini-hydro projects [14].

Rural electrification is usually an interplay between the technical, social, economic and political aspects of a nation. As in many developing countries, rural electrification in Nepal is often driven by political rather than technical or cost-effectiveness parameters [9,15]. In many cases, the basis of choice for grid or off-grid rural electrification has not always been clear and has often been influ-

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Table 1: Impacts of rural electrification in Nepal [2].

Indicators	Beneficiary Group	Control Group
Impacts of Rural Electrification in Nepal	NPR 213,051	NPR 182,688
Women holding leadership positions in self-help groups	23.6%	23.6%
Reduced workload of women	50% compared to control group	
Electric lighting	100%	40%
Access to information from television	72.7%	27.3%
Number of children (6-15 years) going to school	98.4%	90.1%
Children's average study time at home	114 minutes	95 minutes

**Figure 1:** Rural access to electricity in Nepal [16].

enced by politics [13].

The rural electricity access transition in Nepal began in 1990s, when less than a third of Nepal's population had access to electricity and this percentage was even less in rural areas [12]. However, Nepal was able to accelerate electricity access to rural areas very rapidly from the 2001, as can be seen in Fig. 1 [16].

The rural electricity access transition in Nepal is a transition of the electricity subsystem of rural household energy use. Rural Nepali households use electricity for lighting and charging mobiles. About half the households use it for TV and a quarter for radio. Kerosene, previously used for lighting, has been mostly replaced by electricity [17].

However, household cooking and heating, for which firewood is predominantly used, is not part of this transition. In fact, firewood use has increased over the years (1.43 m³ per person in 2018 from 0.64 m³ in 1990), mainly because of community forestry, one of Nepal's internationally recognized success stories, which has made firewood more easily available to rural households. On the other hand, sale of liquid petroleum gas is increasing, mainly driven by its accessibility and affordability [18,19].

At the start of the electricity access transition, Nepali rural households had a heavy dependence on kerosene, candles and torch lights for lighting and batteries to power radios [17]. Furthermore, rural electrification at that time was mainly through grid extension, which in Nepal's difficult hilly topography and very scattered human settlement pattern was expensive. Another important factor was that at that time rural priorities of drinking water and irrigation came before electricity [20].

Therefore, this review investigates the spurring factors for Nepal's rapid rural electricity access.

2. Literature review

The reviewed papers that discuss rural electrification in Nepal are listed in Table 2.

Other papers pertaining to rural electrification in the region, in developing countries or in other countries were also reviewed.

Various studies have identified many factors that enable rural electrification. It is seen that rural electrification happens faster when electricity is considered a right rather than just a commodity. When there are other enabling conditions and priorities for rural development, such as water supply, health, education and roads, rural electrification follows soon after, if not concurrently. From a technological perspective, rural electrification is expedited when it is technologically agnostic and when there is effective collaboration between government and academia for research and development. Adequate human resources for installation, operation and maintenance are other enablers, as are community representation and involvement [21].

Suitable business models and appropriate electricity pricing, including lifeline pricing also expedite rural electrification. From a financial perspective, enablers include financial incentives (such as tax rebates, smart subsidies) as opposed to "blanket subsidies", reasonable capital cost recovery, addressing upfront cost problems and provision of low-cost options. It is also widely acknowledged that most rural electrification require a dedicated institution and public financial support to separate the commercial and social aspects of electricity [9,10]. Government commitment and effective coordination are other important enablers of rural electrification [22, 23]. Anti-corruption measures, standardized practices and banning of bargain agents are also important drivers of rural electrification [24].

There are also many challenges in implementing rural electrification. Low power consumption in rural areas combined with the high cost per connection from the national grid makes rural electrification financially unfeasible. Despite this, political leaders want to keep extending the grid because rural communities want grid supply. Trying to reduce the cost of installing and operating rural electrification systems results in low supply quality [24].

Subsidies, though important in rural electrification, if badly designed or implemented can act as an important barrier [24]. Effectiveness of subsidies is an often debated subject [25]. Rural communities say that even though off-grid solutions are temporary measures for remote rural households not yet connected to the national grid, they are made to pay the capital and operation and maintenance costs. On the other hand, more affluent households in urban and peri-urban areas get electricity from the national grid on a "plug and play" basis. This supply is permanent, and the households can use more electricity, but the government makes the capital and O&M investments. This gives rise to energy justice issues, which can be addressed by subsidies. On the other hand, the government says that subsidies result in market inefficiencies and should thus be replaced by credit mechanisms. Thus, there is divided opinion among bureaucrats and politicians on phasing out subsidy [26].

Literature has also identified various institutional models and pathways for rural electrification. Institutional models include public power companies, rural electric cooperatives, private or decentralized distribution companies and off-grid approaches through

Table 2: Papers pertaining to rural electrification in Nepal.

Author (s)	Name of Paper	Summary	Reference
Hashemi	The economic value of unsupplied electricity: Evidence from Nepal	Quantifies the economic losses incurred due to electricity supply interruptions in Nepal, highlighting significant costs to businesses and households	[6]
Shahi et al.	A study on household energy-use patterns in rural, semi-urban and urban areas of Nepal based on field survey	Investigates household energy-use patterns across rural, semi-urban, and urban Nepal	[17]
Poudel	Quantitative decision parameters of rural electrification planning: A review based on a pilot project in rural Nepal	Examines quantitative decision parameters for rural electrification planning, drawing on a pilot project in rural Nepal.	[23]
Bhattarai et al.	Are renewable energy subsidies in Nepal reaching the poor?	Analyses whether renewable energy subsidies in Nepal effectively reach poor populations.	[25]
Malla et al.	An Economic Comparison between Grid Based and Isolated Rural Electrification in Nepal	Compares the economic viability of grid-based versus isolated rural electrification in Nepal.	[26]
Yadoo & Cruickshank	The value of cooperatives in rural electrification	Examines the effectiveness and benefits of using cooperatives to achieve rural electrification in developing countries.	[27]
Lyndon B. Johnson School of Public Affairs	Extending Electricity to Rural Nepal	Explores strategies and challenges for extending electricity access to rural Nepal.	[29]
Dhakal	Access to Energy Revealing through Socio-economic Status Survey of the Local People for Rural Electrification in Nawalparasi	Discusses the socio-economic status and energy access issues of local people in Nawalparasi based on a survey.	[30]
Sanjel & Baral	Technical investigation of Nepalese electricity market – A review	Investigates technical aspects of the electricity market in Nepal, focusing on rural electrification challenges.	[31]
Gurung et al.	Roles of renewable energy technologies in improving the rural energy situation in Nepal: Gaps and opportunities	Discusses role of renewable energy technologies in enhancing rural energy access in Nepal and identifies existing gaps and opportunities	[32]
Islar et al.	Feasibility of energy justice: Exploring national and local efforts for energy development in Nepal	Explores the concept of energy justice in Nepal, analysing national and local efforts to ensure fair and equitable energy development.	[35]
Adhikari et al.	Analysis of Rural Electrification Policy Provisions in Nepal	Analyses policy provisions for rural electrification in Nepal, highlighting their strengths and weaknesses.	[43]

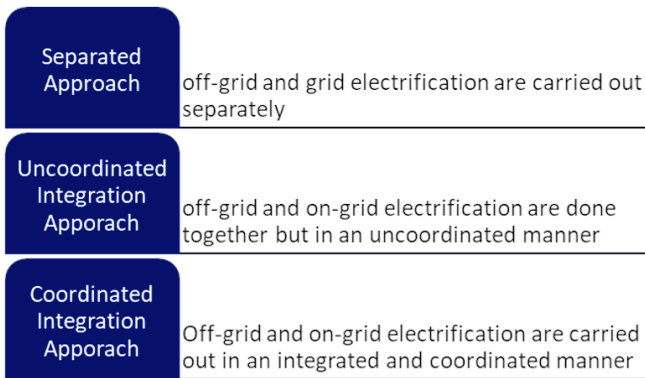


Figure 2: Three approaches to rural electrification.

small grid or household systems [11]. NEA carries out grid based rural electrification through community rural electrification, Asian Development Bank grants or its own resources. Private companies like Butwal Power Company, Salleri Chialsa Electricity Company and Khumbu Bijuli Company also carry out rural electrification. Off-grid rural electrification is mostly carried out by AEPD [26, 27]. The three main pathways for rural electrification are off-grid, mini-grids, and national grid. However, the basis of choice is not always clear and often influenced by politics. In Nepal, rural electrification through off-grid systems significantly increased after early to mid-1990s [13]. However, it is also acknowledged that no one technology, institutional or business model will provide the total solution. Importantly, though it is acknowledged as the top priority for rural electrification and the goal of national electrification policies [28], the national grid pathway alone cannot provide universal energy access [22]. Urpelainen (2014) discusses three approaches to rural electrification with focus on coordination and integration of off-grid and on-grid electrification. This is pictorially depicted in Fig. 2.

The first and second approaches can result in duplication, unequal services being provided and redundancy of off-grid generation assets once grid reaches an area. The second approach has been carried out in Nepal. The third approach needs a long-term, comprehensive and consistent national policy and better coordination between government ministries and agencies.

Yadoo & Cruickshank [27] assert that rural electrification through local cooperatives is more efficient and effective than that implemented by either public or private entities and can provide electrification at a faster rate. They argue that local cooperative led RE provides better services, is more responsive and accountable, and reduces theft of electricity. It also promotes equity because it is more successful in reaching disadvantaged groups. With appropriate financial and institutional support, cooperatives can represent a good delivery model for rural electrification in developing countries.

Many barriers to promoting rural electrification have also been identified. They include physical infrastructure (e.g., roads), technical capacities [29] and financial resources [23]. Other barriers include institutional weaknesses, power supply shortages, unrealistic power tariffs, and unwillingness or the inability to pay for electricity [24,30,31]. Barriers to promoting off-grid rural electrification have been identified as insufficient policies, centralized decision making, bureaucratic hurdles, lack of integrated planning, heavy dependence on subsidy, lack of technical capacity and insufficient quality assurance [32,26].

Many facilitative actions by the government to accelerate electricity access through private sector participation have also been discussed. They include establishing an enabling policy environment, catalysing finance, building human capital and integrating

energy access with other development programs [33].

Political economy also plays an important role in rural electrification. People value electricity and its externalities, giving it high political clout and opening it to political influence. Electricity distribution is seen as a collective action challenge. On the one hand, the availability and reliability of electricity supply is seen as a public service and a responsibility of government. On the other hand, it also has private good nature susceptible to market failures, such as monopoly, externalities and information asymmetry. The private nature of electricity requires strict regulation, but the public nature of electricity often results in rent seeking, inefficiencies, underinvestment and poor maintenance [34].

The existing literature provides valuable insights into the factors, enablers, challenges, and institutional models influencing rural electrification in Nepal. However, one of the identified knowledge gaps is an assessment of the specific factors that led to Nepal's rapid rural electricity access in the first two decades of this century. The literature briefly mentions various technologies, institutional models, policies for rural electrification, but a more in-depth analysis of the role of each of these technologies, models, policies in the rapid rural electrification in Nepal is lacking. Such an assessment could provide valuable insights for policymakers. Addressing these gaps in the existing literature will not only enhance our understanding of the rural electrification landscape in Nepal but also provide actionable insights for policymakers, researchers, and practitioners working towards sustainable and inclusive energy access.

3. Theoretical Framework and Methodology

The study employs the following theoretical frameworks and methodological approach to analyse the factors contributing to Nepal's rapid rural electrification.

3.1. Theoretical Frameworks

3.1.1. Mutli-level Perspective (MLP)

The MLP framework will be utilized to investigate the reasons behind the rapid acceleration of rural electrification in Nepal. It will analyse Nepal's socio-technical transitions in rural electrification from a landscape, regime and niche levels to understand the interconnected dynamics.

3.1.2. Energy Justice Framework

The paper will also use an energy justice framework to identify and analyse equity issues associated with the rapid transition in rural electrification. Drawing from Grant et al. [7], this framework provides a lens to assess the justice dimensions in the distribution of electricity access benefits.

3.2. Methodology

3.2.1. Literature search

Scholarly and grey literature dealing with Nepal's rural electrification efforts were searched through Google Scholar. The search terms and keywords used to identify the pertinent literature were "Nepal rural electrification", "Nepal rural energy" and "Nepal electrification". The literature search explored a range of sources to provide a comprehensive context for the study.

3.2.2. Literature selection

The literature, both scholarly and grey, identified through Google Scholar search, as described above, that substantially dealt with rural electrification in Nepal, including its chronology, drivers, obstacles and impacts were selected for the review.

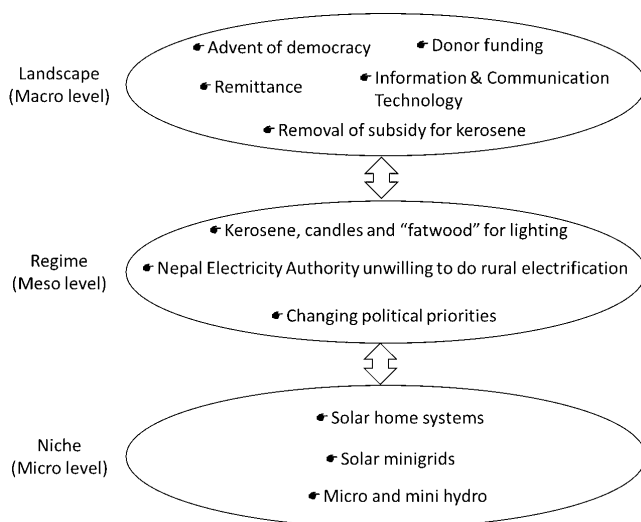


Figure 3: Multi-level perspective analysis of Nepal's electrification.

3.2.3. Data extraction

The key findings and conclusions of the selected scholarly literature were extracted for analysis. Relevant data and information from grey literature such as newspaper and news articles were also extracted to fill in gaps and provide context to the data extracted from the scholarly articles.

3.2.4. Synthesis and analysis

The literature review indicated that most of the factors related to Nepal's rapid rural electrification centred around governance and policies. Therefore, the data from the literature review were synthesized and analysed from the perspective of governance and policies. Furthermore, the theoretical frameworks were applied for a holistic interpretation of findings.

4. Results and discussion

Analysis of the findings from the literature review indicates that Nepal's rapid electrification can be assessed primarily through the perspectives of governance and policies. From a Multi-level Perspective framework perspective, the electrification landscape is shaped by factors such as the advent of democracy in the 1990s, strong donor funding, and the increasing demand for electricity. The dominant regime is driven by NEA's reluctance for rural electrification and the niche is characterized by off-grid renewable energy systems, supported by various actors beyond the government. The discussion also touches on the institutional context, the politics surrounding the electrification transition, and policy innovations. The effectiveness of the policies is also analysed through an energy justice perspective. The analysis highlights challenges and disparities in geographical distribution and energy justice.

4.1. Governance through a Multi-level Perspective Lens

The multi-level perspective framework can help to explain some aspects of Nepal's rapid electrification. This framework is pictorially depicted in Fig. 3.

The factors that shaped the landscape include the advent of democracy in Nepal in early 1990 that empowered the rural population to freely express their needs and aspirations. In addition, there was very strong donor funding for the energy sector. Mobile phones and televisions became an integral part of rural households. In parallel, there was a dramatic increase in inflow of remittance



Figure 4: Actors in Nepal's rural electrification efforts.

income from Nepalis working overseas to buy these and other electrical appliances. As importantly, the subsidy for kerosene, which was used widely in rural areas for lighting was removed. Therefore, there was increased demand for electricity in rural households for lighting and powering electronic equipment and appliances.

On the other hand, switching of cooking to electricity did not happen for the following three reasons.

- Traditional fuels were freely available
- Fossil fuels could be easily transported [43], and
- Negative health impacts of use of traditional and fossil fuels was not well appreciated.

The regime for Nepal's electricity access transition is aptly described by Grant et al. [7] as a "pre-fossil fuel dependency transition". It is a regime characterized by households used to burning kerosene, candles and "fatwood" for lighting and the national electricity utility. It also encompasses NEA's unwillingness to do rural electrification, which it still sees as a loss-making proposition. This is further complicated by a fragmented political leadership with changing priorities resulting in policy discontinuities.

The niche is the solar PV home systems, solar PV mini-grids and micro hydro plants promoted by AEPD [32]. These systems have helped to bring the focus of rural electrification to remote rural areas and highlighted the importance of providing electricity to rural households. They have also been instrumental in pressuring governments to extend the national grid for rural electrification, where technically and economically feasible.

4.1.1. Actors and regime elements beyond the government

Energy transformation has many dimensions, including technology, social, economic, institutional and financial [8]. Consequently, many actors besides the government have been involved in Nepal's rural electricity access transition, as depicted in Fig. 4.

The first are community cooperatives. They have been successful in mobilizing communities to extend grid connected distribution lines in rural areas. Secondly, international development agencies have collaborated with the government in providing electricity access to rural communities [35]. The Asian Development Bank has supported NEA for expanding grid based rural electrification and agencies like the World Bank, UN, and the governments of

Norway, Denmark and US has supported Nepal's off-grid rural electrification efforts through micro hydro, solar home systems, solar mini-grids. These supports have been significant and contributed immensely to Nepal's rural electrification efforts. However, there are concerns of 'aid dependency' where the government has become heavily dependent on foreign grants in the electricity sector, specifically for rural electrification [20]. Other significant actors include local governments, user groups, non-government organizations and the private sector [35].

The niche of off-grid renewable energy systems has been shielded by ensuring that they are safe, reliable, and affordable. This has been done by establishing quality standards and regulations that ensure the safety and reliability of the systems. They have also been made affordable for low-income households through provision of subsidies or affordable credit financing.

Nepal's off-grid electricity development has been nurtured by provision of training, education, and technical support to individuals and communities. Local community members and technicians have been trained to install, repair, maintain and manage the systems.

Communities undertaking off-grid electricity systems such as micro hydro and solar mini grids have been empowered through community participation in decision-making and involving local businesses in the supply chain for the systems.

Some policy feedback effects have also been seen in the rural electricity access transition in Nepal. Electricity access has created economic opportunities through income generation and enterprise development. It has also increased access to better education, healthcare, information and entertainment. Access to electricity has provided women with more opportunities to participate in education, business, and decision-making processes [32].

4.1.2. Institutional context

One of the main reasons for very slow rural electrification until the 1990s in Nepal was the NEA's monopoly on electrification. NEA always suffered from the dual pressure to be commercial and fulfill government's social obligations at the same time. Consequently, NEA has never been very keen on expanding its electricity distribution network in rural areas which it views as loss making. This has been expressed many times by NEA officials in conversations with the author.

However, after the advent of democracy in early 1990s, electricity provision became a very important political consideration, as it has also been seen in Africa [51]. Furthermore, with the establishment of AEPC in 1996, the rural energy subsidy policy provided the necessary nurturing and shielding of the nascent off-grid rural electrification efforts, which developed as a strong niche for rural electrification.

4.1.3. Politics of the transition

The major political economy issue for rural electrification in Nepal has been a tussle between NEA, which has always advocated for a government driven centralized approaches and AEPC, which has a more donor and private sector driven decentralized approach. This has often created issues firstly in areas where the national electricity grid is extended where previously it was served by off-grid electrification like micro hydro and solar mini grids. In many instances, significant community investments have been wasted because NEA supplies electricity in these areas but does not buy electricity from the micro hydro or solar mini-grids, rendering these assets non-functional. Secondly, in areas where the grid is expected to reach in a few years, many times neither does the grid reach there for many years nor are they provided with off-grid electrification leaving them in the "dark". Sovacool, et. al [36] suggest that in Nepal, people realize the need for clean cooking in rural

Nepal for its health and economic benefits but consider promotion of solar PV and micro hydro systems, as mostly promoting "Western technology". However, the author has not had that perception after working in the sector for over 30 years.

4.2. Policy innovation

4.2.1. Key policies

The key policies influencing Nepal's rural electrification is summarized in Table 3.

Nepal adopted a two-pronged approach to accelerate electricity access. It accelerated its grid based rural electrification efforts by NEA. With the establishment of AEPC, it piloted and scaled up its off-grid electrification efforts. This was initially through micro hydro projects and solar home systems, but later with solar PV mini grids.

NEA carried out rural electrification projects by expanding distribution lines from the grid with concessionary loans from the Asian Development Bank. Other development partners like the World Bank and the governments of Denmark and Norway have also supported NEA with grid-based rural electrification. Concurrently, NEA also adopted a community-based approach. NEA's Community Electricity Distribution Bye Law. This byelaw allowed rural electrification through community management of extension of distribution lines for rural electrification [35, 43]. These projects were co-financed by government grants (80% of project costs), with the communities covering the remaining 20% [35]. The community organizations distributed electricity, set tariff rates and controlled nontechnical losses such as theft [35]. The government provides free electricity to households consuming up to 10 kilowatt-hour (kWh) per month, and 25% and 15% discounts for monthly consumption of up to 150 kWh and 250 kWh respectively. [19]. However, how much this last policy impacted rural electrification has not yet been studied.

AEPC, through its Renewable Energy Subsidy Policy provides subsidies for solar home systems for remote households and micro hydro for remote communities far from the national grid. The Electricity Act of 1992 exempted the generation, transmission or distribution of electricity up to 1000 kilowatt from licensing requirements, thereby giving a jumpstart to micro hydro development in Nepal [43]. Furthermore, micro hydro projects also received significant government subsidy. Grants to the Government of Nepal for promoting off-grid rural electrification were provided by many bilateral and multilateral international development partners [12]. Studies showed that significant portions of the subsidy went to very poor households, with one study revealing that about 25% households who received subsidies were below the poverty line [25].

4.2.2. Policy formulation and implementation

There is no specific documentation on how the rural electrification related policies were specifically designed. However, in general, Nepal's policy design is driven by high self-interests of bureaucrats or politicians in the government. They are also influenced by strong and organized sectoral interest groups from the private sector, non-governmental sector or international development partners. Therefore, political economy rather than policy analysis drives policy making in Nepal [44].

As with many other policies, Nepal has suffered from weak implementation of policies and regulations [43]. Furthermore, centralized decision making, and opaque and cumbersome policy implementation procedures have reduced the effectiveness of otherwise innovative policies [32].

Table 3: Key policies for Nepal's rural electrification.

Policy	Implication for Rural Electrification
Nepal Electricity Act, 1984	Mandate for grid connected rural electrification [37]
Electricity Act, 1992	Exempted generation, transmission or distribution of electricity up to 1000 kilowatt from licensing requirements, facilitating off-grid rural electrification [38]
NEA Community Electricity Distribution Bye-Laws, 2003	Initiated community-based grid-connected rural electrification [39]
Rural Energy Policy, 2006	Initiated off-grid rural electrification through renewable energy technologies [40]
Renewable Energy Subsidy Policy, 2000-2022	Provided financial upfront subsidies for rural electrification through off-grid electricity [41]
Renewable Energy Subsidy Delivery Mechanism, 2000-22	Provided the procedures for delivery of subsidies provisioned by the RE Subsidy Policy [42]

Table 4: Province-wise rural electrification in Nepal in 2021 [47].

Province	Access to Electricity
Koshi	93.70 %
Madhesh	97.90 %
Bagmati	97.33 %
Gandaki	97.60 %
Lumbini	93.67 %
Karnali	49.63 %
Sudur Paschaim	81.28 %

4.2.3. Regime destabilisation and phase-out policies

The most significant regime destabilisation and phase-out policy adopted in Nepal to promote rural electrification in rural areas was the removal of kerosene subsidy in 2014. This policy dramatically reduced use of kerosene for lighting in rural households [19]. Besides this, there have not been any other such destabilization policies.

4.3. Policy effectiveness through an energy justice lens

Even though data shows that Nepal has been very successful in accelerating its rural electrification efforts, there have been some areas in which it has not been effective.

Firstly, there was and continues to be a wide geographical disparity in electricity access [45]. A study jointly conducted by NEA and AEPC shows that the eastern Provinces of Nepal have over 90% electrification, but the two westernmost provinces have electrification of only 54% and 85% respectively [46].

As given in Table 4, electrification from the national grid in the Karnali and Sudurpaschim provinces are 49.6% and 81.3% respectively [47]. In these provinces, a large population still do not have electricity and many school children use kerosene lamps for studying [19].

Secondly, World Bank's experiences in Nepal and other similar developing countries have shown that even when a village or community is electrified, a certain percentage of household remain un-electrified. They either cannot pay the initial connection costs or do not have the legal papers to get an electricity connection [48].

Thirdly, provision of electricity for productive use and enterprise development in Nepal's rural areas is still weak [20].

Finally, many rural households are still dependent for cooking and heating on firewood, agriculture waste and animal dung, as represented in Table 5. In many other areas, these fuels are being supplanted not by electricity but by imported LPG.

Therefore, from an energy justice perspective, there is still unequal geographical distribution of electricity access in Western Nepal because of inadequate infrastructure and low-income levels. Furthermore, even with federalism, most energy development related policies and decision are made centrally, with limited participation of local governments and consumers. Many of Nepal's energy policies are designed through a "one-size-fits-all" approach without being responsive to the unique needs and priorities of different communities. Therefore, Nepal's rural electricity access still has not been able to fully ensure distributional, procedural, and recognition energy justice.

4.4. Future scenario for rural electrification in Nepal

The future of rural electrification in Nepal appears promising. The Concept Paper of Nepal's 16 Five-Year Plan highlights transition from traditional and fossil fuels to clean energy [49]. Highlighting that 98% of the population already have electricity access, the Government of Nepal's Plans and Policies for fiscal year 2024-25 stated that all unelectrified areas in the Karnali and Sudurpaschim provinces will be electrified through on-grid and off-grid electrification during the fiscal year [50]. In line with its domestic targets and international commitments like the Sustainable Development Goal 7 the government plans to secure resources through its own resources and funding from international donors, such as the World Bank and the Asian Development Bank. Overall, with concerted efforts and strategic investments, Nepal is on track to significantly improve rural electrification, enhancing economic development and quality of life in rural areas.

5. Conclusion

This review has assessed why there was a dramatic increase in rural electrification access from the mid-1990s. It attributed this to the democratic changes in the country, the sharp rise in foreign employment bringing revenue into the country along with aspirations for a better quality of life in rural areas. It was spurred along by some innovative policies like subsidy provision, community based rural electrification and a significant increase in international development assistance. However, geographical and socio-economic disparities still persist, which needs to be addressed. This is important to ensure that the fruits of this rapid electrification are meaningful for the rural population of Nepal.

Past lessons have indicated the need for some new approaches to ensure that the rural electricity access transition is truly meaningful. First there needs to be more private sector participation. Since it has been seen that markets alone or government agencies alone cannot spur transitions, they need to work together [36]. Secondly,

Table 5: Cooking and heating fuel in Nepal [47].

Province	Cooking Fuel						
	Firewood	Dung	Kerosene	LPG	Biogas	Electricity	Others
Koshi	53.38%	3.38%	0.04%	41.18%	1.32%	0.52%	0.19%
Madhesh	58.61%	10.92%	0.03%	28.71%	0.71%	0.82%	0.20%
Bagmati	28.95%	0.01%	0.05%	69.79%	0.60%	0.57%	0.04%
Gandaki	47.14%	0.03%	0.05%	51.54%	0.99%	0.21%	0.03%
Lumbini	53.68%	2.08%	0.05%	42.21%	1.51%	0.41%	0.06%
Karnali	82.22%	0.14%	0.18%	16.86%	0.44%	0.10%	0.06%
Sudur Paschim	70.28%	0.08%	0.04%	25.84%	3.42%	0.28%	0.07%

the unbundling of NEA needs to happen because institutional reforms and good governance are also imperative together with technological interventions [20]. Some other reforms needed are ensuring an independent and well-functioning regulator, providing greater role for local governments and most importantly addressing the inefficiencies, corruption and dependence on foreign aid in Nepal, which are bigger governance issues.

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