Mobilizing Local Assets for Sustainable Energy Management: An Asset-Based Community Development (ABCD) Approach in Rural Nepal

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Abstract
The energy insecurity is a recurring issue in rural communities despite their rich natural resources in Nepal. This paradox has not been resolved with traditional interventions from the top down, and requires approaches that go from the bottom up, tapping local strengths and community assets. This study aims to identify potential of Asset Based Community Development (ABCD) approach on sustainable energy management in the context of utilization of local assets, practice of renewable energy, economic changes, and institutional mechanisms in the rural community of Bhume Rural Municipality, Rukum East, Nepal. An integrated research approach of mixed method: case study approach consisting of census household survey (n=512), key informant interview (n=10), and focus group discussion (6-8 participants per group) was used. Descriptive statistics, cross tabulations and thematic analysis was conducted for quantitative and qualitative data respectively. The Leaky Bucket tool used local expenditure retention analysis to determine economic changes. Local assets such as forests, water, solar energy, agricultural residues and local skills are also underutilized, with utilization gaps of 5.3% for forest biomass to 65.8% for agricultural residues. The traditional biomass continues to be the main energy source (89.5%), and the use of micro-hydro (18.4%) and biogas (12.6%) is still small. Households with renewable energy projects kept 62% of energy costs within their communities versus 28% for those households who relied on imported fuels. The main success factors identified are community ownership and participatory mechanisms, but there are many challenges to overcome, such as technical knowledge (68.4%), financial resources (62.8%) and policy gaps (54.2%), as well as institutional coordination (48.6%). The ABCD approach provides a promising bottom-up tool for sustainable energy management in rural Nepal as it has proved that it can deliver tangible economic benefits in terms of energy savings and local livelihood generation. To realize the full potential of ABCD, local institutions need to be strengthened, technical capacity needs to be built, and ABCD needs to be incorporated into the energy planning of local governments, along with supportive policy frameworks. This research adds empirical data to the growing body of community energy research and offers information for community energy policy and practice in rural Nepal.

Keywords: ABCD; sustainable energy; community development; rural Nepal; renewable energy; asset mobilization

Introduction

Nepal is at a turning point in its energy development journey. The country has a huge green energy potential in terms of renewable energy resources such as hydropower, solar radiation and biomass which theoretically make it a potential clean energy leader in South Asia. However, despite these abundant natural resources, large proportion of Nepalese rural population suffers from deep energy insecurity. In Nepal, the residential sector accounted for approximately 61 percent of the total final energy consumption in 2023 (Water and Energy Commission Secretariat Secretariat [WECS], 2024 as cited in “Household cooking in Nepal”, 2026). Despite significant progress, over half (54 percent) of Nepalese households still rely on unprocessed or traditional biomass fuel wood, animal dung and agricultural residues as main energy source for cooking (National Planning Commission [NPC] 2024 as cited in "Household cooking in Nepal" 2026). Among the country's 6.66 million households, 51 percent continue to use firewood in their kitchens (Prasain, 2023). This traditional biomass use has significant environmental implications, as a survey of 240 households in Koshi Province revealed that households are using 20–30 trees a year on average, with each tree producing 18.5 tons of CO_2 per household (Sharma & Baral, 2025). This work entails collecting firewood for the household, which takes around 386.88 hours each year for women and children in these households, and indoor air pollution in 60 percent of all households is associated with respiratory illnesses and other health effects (Sharma & Baral, 2025). Per capita electricity consumption is also one of the lowest in South Asia, at around 380 kilowatt-hours (kWh) (compared to India at 1,255, Bangladesh at 497, Sri Lanka at 631, and Bhutan at 5,500) ("Green Energy Rising," 2025). This paradox of plenty and continuing energy poverty reveals the basic lack of success in the design and implementation of energy interventions in rural Nepal.

Energy policy has always been a top-down, techno-centric policy with a focus on building large infrastructure rather than on engaging communities. For decades, Nepal has been dependent on hydropower, which is responsible for around 95 per cent of the country's installed capacity. This supremacy has been touted as proof of clean energy leadership, but it is not as simple as it seems. The country is very susceptible to sudden power

shortages due to the reliance of run of river hydropower systems on seasonal river flows. Furthermore, environmental and social impacts of large hydropower such as the disruption of river ecosystems, loss of biodiversity and displacement of communities are increasingly hard to ignore. Burchett et al. (2026) recorded that river development in Nepal is carried out within an ‘epistemic regime' which constrains the nature of knowledge and the way rivers are perceived and managed, thereby making them ‘legible' in technical and financial terms and rendering relational and place-based understandings of river systems, livelihoods, and stewardship ‘invisible'. The absence of local perspectives is not only the result of consultation or implementation gaps, but also because the institutions that govern hydropower incorporate local knowledge and experience only when they decide to. (Burchett et al., 2026) The impacts of these changes on subsistence livelihoods and traditional practices of river care are forcing households to seek risky livelihoods of wage labour and migration (Burchett et al., 2026). Thousands of households have been displaced by hydropower projects, for example, the Nepal Electricity Authority's Resettlement and Indigenous Peoples Plan in 2018 found that a total of 547 households (3,919 persons) would experience displacement due to hydropower projects (Women organise to negotiate, 2024).

The drawbacks of the top-down approach to energy governance do not just apply to hydropower. The Renewable Energy Subsidy Policy in Nepal (2016) has been promoting the use of subsidized renewable energy technologies, but has not done so enough to make people more capable or free. The "solar paradox," as defined by Thapa (2026), is the tension inherent in technology-based development policy that sees increased availability of subsidized technology but a corresponding lack of increased people's capabilities and freedoms: public policies assume that distribution is success; distribution is not necessarily use, reliability, or well-being gains. Despite the benefits of decentralized renewable energy, including low cost, reliability, and empowerment of community decision-making, these projects have generally not succeeded because of the lack of participation of local stakeholders in governance processes. Biogas programs, as technology to solve complicated rural issues, have been introduced as one-way technology from above, paying little attention to local socio-cultural context. Ten districts revealed that 54 percent or estimated 1,380 biogas plants were not working, which is equivalent to over Rs110 million in lost infrastructure (Prasain, 2025). Technical issues like broken mixers made most non-functional plants unfit and even operational plants were able to generate an average of only 0.4 cubic metre of gas per day which is below their design capacity (Prasain, 2025). The most dominant failure modes identified during a socio-technical failure mode analysis (STFMA) of 384 households were non-favorable anaerobic digestion (AD) conditions, inadequate mixing, and inappropriate dilution ratios, compounded by socioeconomic challenges related to maintenance cost, and institutional shortcomings in post-anaerobic digester installation support (Shrestha et al., 2025). The issue is not biogas technology, it's lack of durability, maintenance, and lifecycle performance (The fading promise of biogas, 2025). These trends clearly indicate that technology is not the solution to Nepal's energy problems and there is a need for a paradigm shift towards community based, asset oriented solutions.

One new alternative framework is the Asset Based Community Development (ABCD) approach. ABCD was developed by John Kretzmann and John McKnight in their seminal book Building Communities from the Inside Out (1993), and centers on the idea of mapping and mobilizing community strengths, skills, and resources in place instead of deficits and needs. The ABCD model emerged in response to a "needy" community service delivery that was offered by top-down development initiatives. The idea is that there are assets in every community, including the poorest and most deprived communities, that can be mobilised through the individual, association, institutions, place-based resources and relationships for sustainable development. ABCD does not see communities as merely recipients of external assistance, but rather active agents of change who can define and mobilize their own resources to help solve community problems (Kretzmann & McKnight, 1993).

In the energy world, ABCD has become a concept to better understand community power projects that lower community reliance on centralized control and resource provision. The ABCD approach to energy (ABCD-E) is focused on the use of community ownership of energy assets as a way to build resilience in communities by engaging local stakeholders (Feldhoff, 2016). Feldhoff (2016) offered empirical evidence for this multi-sectoral, place-based policy approach, through a case study on renewable energy projects in the City of Iida, Nagano Prefecture, Japan. The tradition of central state authoritarianism, interdependency and overlapping jurisdictional boundaries in energy and regional policy areas and vested interests of powerful interest groups, however, present strong barriers to energy-related ABCD functionality in the context of multi-level governance constraints (Feldhoff, 2016). ABCD has also been used in Ethiopia, Taiwan and Guatemala, which shows how the approach can be used as a tool throughout the world but adapted to a local context (Stoltenberg, 2015). Community empowerment ("Solar Power Street Lighting," n.d.) has been a key element of ABCD-based solar street lighting programs in Indonesia, leading to infrastructure independence. The cases show how ABCD can help to create sustainable energy results by focusing on what is already working in a community instead of what needs to be done.

Despite these promising developments, there is yet a major research gap. Although ABCD has been used for a range of development purposes such as health, education, local economic development, there is little empirical research on its use in the context of sustainable energy management in rural Nepal. The literature available on the topic of mobilizing local assets for energy in the context of Nepal is limited, and there is little evidence available about any barriers to mobilization, or the economic and social benefits that can arise from asset-based energy interventions. This discrepancy is especially pronounced in the context of the federalization of Nepal's energy

governance, where rural municipalities are responsible for more decision-making power, and where opportunities have emerged for local energy planning.

To fill this gap, the present study will focus on the potential of ABCD approach for sustainable energy management in Bhume rural municipality at Rukum East in Nepal. The following research questions are derived from the study: 1. What are the local assets in the study area that can be tapped to promote sustainable energy management? (2) What is the current status of practices and assets on renewable energy? The questions addressed in this paper are: (3) What economic change has been brought about by community-based energy interventions, and (4) What institutional and participatory mechanisms enable and/or hinder ABCD-based energy interventions? This research uses mixed-methods case study design to produce empirical evidence which could help to feed into both academic debate on community energy and policymaking for rural energy development in Nepal.

This study has implications beyond the empirical results. Policy attention on how to leverage local resources for sustainable energy is emerging in a context where the national policy documents seek to achieve universally access to clean, reliable and affordable renewable energy solution by 2030 and to increase the percentage of non-hydro renewable energy to 10-15 percent by 2030 (Government of Nepal, 2025). The ABCD pathway is a bottom-up approach that builds on and does not supplant external support, and it may be a way to address the governance issues that have hampered effective past energy interventions. This research aims to inform the larger goal of creating energy resilient communities in the rural backyards of Nepal by documenting and analysing the experience of Bhume Rural Municipality.

Literature Review

Overview of Asset Based Community Development (ABCD)

While the needs-based approach to development has been criticized for its emphasis on the needs of communities over their strengths, the Asset-Based Community Development (ABCD) approach grew out of this critique. ABCD is a paradigm change in the way community development is understood and engaged in, brought about by the pioneering work of John Kretzmann and John McKnight in their 1993 book Building Communities from the Inside Out: A Path toward Finding and Mobilizing Community Assets. Kretzmann and McKnight noted that universities and other institutions only focused on the needs, deficiencies and problems of neighbourhoods, seeing the residents as clients whose needs could only be met by the outsiders. They responded with an alternative agenda that was focused on the opportunities, the potential of individuals and by extension communities, the "half full glass" instead of the "half empty glass". The approach is very different from the one that emphasizes only the problems, needs, and deficiencies of the community.

ABCD lists five broad types of community assets: People, Places, Associations, Institutions and Connections. Its approach is based on the premise that communities and neighbourhoods are healthy when they are conceived around the knowledge, interests and capacities of their people, groups and institutions. ABCD does not see communities as recipients of external assistance but as agents of change that can recognize and mobilize their own resources to meet common problems. The approach focuses on recognising and building on the strengths, skills, resources and networks that exist within the community and develop community capacity and social capital.

Theoretical Underpinnings: Social Capital and Participatory Theory,

Theoretically, ABCD is based on the social capital theory and participatory development approaches. ABCD's focus on community mobilization is at the heart of understanding social capital as the norms, trust, and networks that foster collective action and cooperation for mutual benefit. According to Putnam (2000), social capital is critical to economic development and democratic political structures. The way of approach is that relationships and partnerships among people within networks of trust and shared norms create communities that are good for everyone. Communities can build social capital through asset mapping and mobilizing activities that help to bring together a range of people and facilitate collective action and problem solving. The theory of the participatory approach also underlies ABCD by highlighting the importance of community members in identifying the problems, design solutions, and take actions to achieve sustainable development. Collective goals are the focus of ABCD, a community mobilization approach, as opposed to institutional reform. This theoretical base is also part of the general shift in the development studies, which challenges the imposed development programs and promotes the ownership and engagement of the local processes.

Global Applications of ABCD.

The adaptable approach of ABCD has been used in various geographical and sectoral settings. Stoltenberg (2015) explored three case studies of Asset Based Development in Ethiopia, Taiwan and Guatemala, showing how ABCD can be applied as a tool but adapted to a local context. The case studies here demonstrate the sustainability of ABCD through generating social capital and disrupting power dynamics in a realistic manner. ABCD gives vulnerable and marginalized groups the chance to take charge of their own development in the future, and moves beyond the current, dependency-based approach to development. Oxfam Canada tested an ABCD approach in five communities in Ethiopia and found a number of 'low hanging fruit' solutions, including composting, better irrigation, planting trees and terracing to stop soil erosion. With the community forestry programme in Nepal, ABCD has been focused on the principles of community ownership and self-reliance. The wide array of uses

shows that ABCD can be done in different cultural, economic, and political environments, and stay true to the ABCD principle of asset mobilization and community empowerment.

Investing in the Energy Sector with ABCD

ABCD has become a separate field of study for energy management. Feldhoff (2016) proposed the notion of asset-based community development in the energy sector (ABCD-E) as a valuable concept to analyze the community power initiatives that seek to diminish local reliance on the energy core executive decision-making and distribution process, and consequently, state–society and intergovernmental relations. Feldhoff conducted empirical research on the implementation of renewable energy projects in the city of Iida in Nagano Prefecture, Japan, for this multi-sectoral, place based policy approach. Promoting the use of alternative energy resources in a bottom-up manner is an important way of building community resilience through engaging local stakeholders, and community ownership of assets is one of the ways to achieve this objective. But the historical tradition of central state authoritarianism, multiple jurisdictions in energy and regions-related sectors, and entrenched interests of powerful interest groups represent significant obstacles to energy-related ABCD functionality in the multi-level governance context.

The ABCD principles have been adopted across the global community of community energy. The concept of solar street lighting based on ABCD in Indonesia has developed infrastructure independence through the empowerment of the community which is carried out in five stages, namely: discovery, design, define, delivery and destiny. The first energy community in North Macedonia was established in a small rural area, using an ABCD approach, which is proof of the possibility of citizen participation in energy production, even in small communities. Bushlight was implemented in Australia with ABCD models to community energy planning meetings in designing new solar systems for remote communities. These cases demonstrate the importance of local stakeholder engagement and community ownership of energy resources as a means to build community resilience through community engagement in ABCD-E.

Equipping for Sustainable Development and Community Energy

The link between sustainable development and community energy has been known in the literature. Community energy has been identified as a critical element to action on the climate crisis; it can enable people, strengthen local economies and rejuvenate communities. Based on the principle of local and autonomous generation of energy by and for the community, community energy is the key to socio-economic transformations, putting the citizen and the community as the primary actors in the entire energy value chain. In Nepal, CL-MHP projects have contributed to the light and opportunity for thousands of rural households, and have proven that local renewable energy can grow up, remain viable, and continue empowering rural communities. There is a clear consensus in the literature about the importance of institutional conditions for fostering democratic legitimacy, social inclusion and ecological responsibility to enable the development of community ownership and citizen participation.

Methodology

Study Area

This study was conducted in Bhume Rural Municipality, Ward 3, Rukum East District, Nepal. Bhume Rural Municipality is located in the mid-western region of Nepal, characterized by rugged terrain, rich natural resources, and a predominantly agrarian economy. The municipality comprises diverse ethnic communities, including Magar, Dalit, and other indigenous groups. The justification for selecting this study area is threefold: (1) the municipality possesses abundant natural assets including forests, water resources, and agricultural land with significant potential for renewable energy development; (2) the area has a history of conflict and marginalization, making community-led development approaches particularly relevant; and (3) the potential of ABCD for sustainable energy management in this context remains unexplored, presenting a significant research opportunity.

Research Design

This study employed a mixed-methods case study design, combining descriptive and exploratory approaches. The mixed-methods approach was selected to triangulate findings from quantitative household surveys with qualitative insights from key informant interviews and focus group discussions, thereby enhancing the validity and comprehensiveness of the research. This design enables a holistic understanding of how local assets can be mobilized for sustainable energy management while capturing both the breadth of community experiences and the depth of stakeholder perspectives.

Sampling Strategy

A census survey was conducted covering all 512 households in Ward 3 of Bhume Rural Municipality. This comprehensive approach was adopted to ensure complete representation of the community and to capture the full diversity of household energy practices, asset ownership, and socioeconomic conditions. For qualitative data, purposive sampling was employed to select key informants based on their knowledge, experience, and institutional positions relevant to energy management. Key informant interviews (KIIs, n=10) were conducted with representatives from local government, the Alternative Energy Promotion Centre (AEPC), community forest user

groups, and energy user committees. Focus group discussions (FGDs) were stratified by gender, ethnicity, and income level to capture diverse perspectives, with each group comprising 6-8 participants. This stratification ensured representation from marginalized groups including women, Dalits, and low-income households whose voices are often excluded from energy planning processes.

Data Collection

Primary data were collected through three instruments. A structured household questionnaire was administered to all 512 households, covering demographic information, energy sources and practices, awareness of local assets, participation in energy initiatives, and perceived economic changes. Semi-structured interview guides were developed for KIIs, exploring institutional roles, policy frameworks, technical capacity, and barriers to asset mobilization. FGD checklists guided discussions on community perceptions, collective action, asset mapping, and aspirations for sustainable energy. Secondary data were collected from institutional sources including AEPC reports, the Federation of Community Forestry Users Nepal (FECOFUN) records, municipal planning documents, and ministry-level energy statistics.

Data Analysis

Quantitative data were analyzed using SPSS software. Descriptive statistics including frequencies, percentages, means, and standard deviations were computed to characterize household demographics, energy practices, and asset utilization. Cross-tabulation analysis was employed to examine relationships between socioeconomic variables and energy-related outcomes. Qualitative data from KIIs and FGDs were analyzed using thematic analysis. Recorded interviews were transcribed, coded, and categorized into themes aligned with the research questions. The Leaky Bucket tool was applied to analyze economic changes, assessing the extent to which household energy expenditure is retained within the local economy versus flowing out of the community. This analysis quantifies the economic multiplier effects of asset-based energy initiatives.

Table 1: Sampling Framework

Data Collection Method	Sample Size	Description
Household Survey	512 households	Census survey of all households in Ward 3
Key Informant Interviews	10	Local government, AEPC, user group representatives
Focus Group Discussions	6-8 per group (4 groups)	Stratified by gender, ethnicity, income level

Table 2: Data Collection Instruments and Sources

Instrument	Data Collected	Source
Household Questionnaire	Demographics, energy practices, asset awareness, participation, economic changes	Household heads
KII Checklist	Institutional roles, policy frameworks, barriers, technical capacity	Government/AEPC officials, user group leaders
FGD Checklist	Community perceptions, collective action, asset mapping, aspirations	Community groups
Secondary Data	Energy statistics, policy documents, program records	AEPC, FECOFUN, municipal reports

Results

Demographic Profile of Respondents

A census survey of 512 households in Ward 3 of Bhume Rural Municipality was conducted. The demographic profile reveals a predominantly agrarian community with diverse ethnic composition. The majority of households identified as Magar (42.6%), followed by Dalit (23.8%), Chhetri (18.4%), and other ethnic groups (15.2%). The average household size was 5.4 members, consistent with rural Nepali norms. Agriculture was the primary occupation for 67.2% of households, while 18.8% engaged in wage labor and 14.0% in small businesses or other activities. Annual household income ranged from NPR 50,000 to NPR 250,000, with a mean of NPR 128,500. Education levels remained low, with 41.2% of household heads having no formal education and only 12.3% having completed secondary education or higher. These demographic characteristics are comparable to findings from other rural areas of Nepal, where energy poverty and limited access to modern energy services remain persistent challenges.

Table 3 : Demographic Characteristics of Respondents

Characteristic	Category	Percentage (%)
Ethnicity	Magar	42.6

	Dalit	23.8
	Chhetri	18.4
	Other	15.2
Primary Occupation	Agriculture	67.2
	Wage Labor	18.8
	Business/Other	14
Education (Household Head)	No formal education	41.2
	Primary (1-5)	28.5
	Secondary (6-10)	18
	Higher Secondary+	12.3
Average Household Size		5.4 members

Utilization of Local Assets for Energy

The study identified five categories of local assets available in Bhume Rural Municipality: individuals (skills and knowledge), associations (community groups and cooperatives), institutions (local government, schools, health posts), place-based assets (forests, water resources, agricultural land), and relationships (social networks and trust). However, asset utilization for energy purposes remained significantly underutilized. Forest biomass was the most widely recognized and utilized local asset, with 89.5% of households reporting collection of firewood from community forests. Community forestry user groups (CFUGs) manage these forests, providing regulated access to member households. Water resources were identified as the second most significant asset, with 63.2% of respondents acknowledging the potential for micro-hydro power generation. Despite this recognition, only 18.4% of households currently benefit from micro-hydro electricity. Solar potential was recognized by 54.8% of respondents, yet solar home systems were present in only 22.6% of households. Agricultural residues and animal dung potential sources of biogas were available in 78.4% of households, but only 12.6% had installed biogas systems. The gap between asset recognition and actual utilization highlights the core challenge that ABCD seeks to address: assets exist but remain unmobilized due to technical, financial, and institutional barriers.

Table 4: Local Asset Recognition and Utilization

Asset Type	Households Recognizing Asset (%)	Households Utilizing Asset for Energy (%)	Utilization Gap (%)
Forest Biomass	94.8	89.5	5.3
Water Resources	63.2	18.4	44.8
Solar Potential	54.8	22.6	32.2
Agricultural Residues/Dung	78.4	12.6	65.8
Local Skills/Knowledge	42.6	15.4	27.2

Status of Renewable Energy Practices

The survey revealed a mixed picture of renewable energy adoption in Bhume Rural Municipality. Traditional biomass remained the dominant energy source, with 89.5% of households relying on firewood for cooking and heating. This finding aligns with national data indicating that more than half of household energy consumption in Nepal is derived from biomass, mainly firewood. In Koshi Province, a study of 240 households found average firewood consumption of 14,977.44 kg annually, contributing to the felling of 20–30 trees per year and emitting 18.5 tons of CO_2 per household. Micro-hydro systems were operational in only 18.4% of households, despite the presence of suitable water resources. This is considerably lower than the national context, where over 3,000 micro-hydropower projects currently provide electricity to more than 300,000 households. Solar home systems were present in 22.6% of households, while improved cookstoves had been adopted by 34.2%. Biogas systems, despite their potential to reduce firewood use by up to 90%, were installed in only 12.6% of households. Liquefied petroleum gas (LPG) was used by 15.2% of households, primarily as a supplementary cooking fuel.

Table 5: Energy Sources and Practices

Energy Source/Practice	Households Using (%)
Firewood (Primary)	89.5
Micro-hydro Electricity	18.4
Solar Home Systems	22.6
Improved Cookstoves	34.2
Biogas Systems	12.6

LPG (Supplemental)	15.2
Kerosene (Lighting)	8.4

A study in Kaski District found that while electricity and biogas were identified as the most sustainable energy sources, their usage remained limited due to cost, reliability concerns, and lack of awareness. Similarly, in Bhume, the gap between awareness and adoption suggests that technical interventions alone are insufficient; community engagement and capacity building are essential.

Economic Changes from ABCD in Energy

The economic impact of community-based energy initiatives was assessed using the Leaky Bucket tool, which analyzes money flowing into and out of the local economy. The analysis revealed notable economic benefits for households engaged in renewable energy initiatives.

Households with access to micro-hydro electricity reported average monthly savings of NPR 1,200 on kerosene and battery expenses. Those with biogas systems saved approximately NPR 850 monthly on LPG and firewood purchases. Improved cookstove users reported 30-40% reduction in firewood consumption, translating to annual savings of NPR 8,000-10,000. These findings are consistent with community-led micro-hydropower projects elsewhere in Nepal, which have enabled over 1,000 energy-based enterprises in off-grid areas, benefiting more than half a million people.

Table 6: Economic Benefits of Energy Initiatives

Initiative	Average Monthly Savings (NPR)	Primary Savings Category
Micro-hydro Electricity	1,200	Kerosene, battery replacement
Biogas Systems	850	LPG, firewood
Improved Cookstoves	700-850	Firewood reduction
Solar Home Systems	600	Kerosene, mobile charging

Local income generation through energy-based enterprises was also observed. In Kharbang, Baglung, a 75 kW mini-grid powers over 50 small businesses, including welding shops, mobile repair shops, an ice cream parlour, and a cybercafé. Similarly, in Jumla, the Chukeni Khola Mini Hydropower Project (998 kW) now supplies reliable electricity to over 9,500 households, with 3,453 shareholders 40% of them women. In Bhume, 14.2% of households reported engagement in energy-based micro-enterprises, including agro-processing, tailoring, and small retail businesses. The Leaky Bucket analysis revealed that communities with renewable energy initiatives retained approximately 62% of their energy expenditure within the local economy, compared to only 28% for households dependent on imported fuels such as LPG and kerosene. This represents a significant economic multiplier effect, as money spent on local energy services circulates through the community, supporting local businesses and employment. When energy systems are linked to livelihoods, their impact extends far beyond electrification, contributing to income generation, job creation, and local economic resilience.

Table 7: Leaky Bucket Analysis

Expenditure Category	Money Retained Locally (%)	Money Leaving Community (%)
Local Energy (Micro-hydro, Biogas)	62	38
Imported Energy (LPG, Kerosene)	28	72
Firewood (Community Forests)	85	15

Community Participation and Institutional Support

Community participation in energy initiatives varied considerably across different activities. Participation was highest in forest management (76.4%), reflecting the long-established community forestry program in Nepal. Participation in micro-hydro management (28.6%) and biogas programs (18.2%) was substantially lower. Women's participation, while mandated in many programs, remained limited, with only 32.4% of female respondents reporting active involvement in energy-related decision-making.

Table 8: Community Participation Levels

Activity	Participation Rate (%)
Community Forest Management	76.4
Micro-hydro Management	28.6
Biogas Program Participation	18.2
Solar System Maintenance	12.8
Energy Planning Meetings	22.4

Key informant interviews and focus group discussions revealed several barriers to effective community participation and asset mobilization. Lack of technical knowledge was identified by 68.4% of respondents as a

major constraint. Policy gaps and weak institutional coordination were cited by 54.2% of key informants. Limited financial resources (62.8%) and inadequate government support (48.6%) were also identified as significant barriers. These findings align with research on micro-hydropower sustainability in Nepal, which consistently identifies four interlinked dimensions: technical, economic, social, and environmental.

Table 9: Barriers to Asset Mobilization

Barrier	Respondents Citing (%)
Lack of Technical Knowledge	68.4
Limited Financial Resources	62.8
Policy Gaps	54.2
Weak Institutional Coordination	48.6
Inadequate Government Support	46.2
Low Awareness	42.8

Local government support was perceived as inadequate by 46.2% of respondents, although the WISIONS Innovation Lab project in Nepal has demonstrated that partnering with local governments, MHP cooperatives, and community organizations can establish systematic, iterative, and scalable models for rural energy access. The Chukeni Khola Electricity Cooperative Ltd. in Jumla exemplifies inclusive, democratic energy governance with its 19-member executive committee and dual focus on electricity supply and savings-and-credit services, creating a virtuous cycle between energy access and local economic prosperity.

Discussion

ABCD Potential Realized but Not Fully Realized.

The results of this study have confirmed that there are some potential local resources in Bhume Rural Municipality that can be tapped for sustainable energy management, such as forests, water resources, agricultural residues, solar resources, and local skills. That said, however, the difference between asset recognition and utilization (5.3% to 65.8% for forest biomass and agricultural residues, respectively) suggests considerable potential for ABCD has not yet been realized. This validates the central tenet of Kretzmann and McKnight's (1993) work that communities may have assets that they are not using that go to the core of sustainable development.

The fact that forest biomass is also very well recognized (94.8%) and also very well utilised (89.5%) shows that the forest biomass is the most well established asset in the forestry sector in Nepal, having been transferred to community forestry user groups that in turn play an important part in the restoration of degraded forests and in ensuring the regulated access of member households. This shows the positive effects that can come in from institutional arrangements that facilitate asset mobilization. The low levels of utilization of water resources (18.4%) and agricultural residues (12.6%) indicates that technical and institutional factors are impeding the realization of the full potential of ABCD.

Alignment with Social Capital and Participatory Theories

The study's results are consistent with social capital theory which focuses on the importance of networks of trust, shared norms and relationships for collective action for mutual benefit. There was an association of higher participation in community forestry and micro-hydro management with higher level of asset utilization and economic benefits in the communities. This strengthens the ABCD premise that relationships and partnerships that develop through networks of trust create communities that are good for everyone.

The community ownership and participative approach are also supported by the results of participatory theory, which is that the outcomes of sustainable energy are dependent on community ownership and participative approach. The Chukeni Khola project in Jumla, which is managed by 3,453 shareholders and 19 member executive committee, is an example of inclusive and democratic energy governance that is strengthening local institutions, empowering marginalised groups and anchoring long-term sustainability. Likewise, the community-based approach in the construction of micro-hydropower plants under the Rural Energy Development Programme (REDP) project by UNDP provided a blueprint for other organizations.

To compare with Global ABCD Cases.

The results of this research echo the findings of similar ABCD projects in the energy industry on a global scale. Feldhoff (2016) showed that asset-based community development in the energy sector (ABCD-E) can be a helpful tool for conceptualizing community power initiatives to lessen local reliance on fundamental decision making and resource distribution by the core executive. But central state authoritarianism, overlapping jurisdictional boundaries and vested interests are formidable impediments to functioning ABCD for energy, noted Feldhoff. The policy gaps (54.2%) and weak institutional coordination (48.6%) were also reported as major constraints in Bhume.

In Indonesia, the solar street light programs using the ABCD approach have developed infrastructure independence through community empowerment, which is developed in five stages: discovery, design, define, delivery, and destiny. The establishment of the first energy community in North Macedonia is a good example of

citizen-led energy production being possible even in small rural communities, making it possible to use an ABCD approach. Bushlight introduced ABCD models to the design of community energy planning meetings for new solar systems in Australia.Bushlight used ABCD models to design new solar systems in remote communities in Australia at community energy planning meetings. These cases demonstrate that the focus of ABCD-E is on community ownership of energy assets to enhance community resilience by engaging community stakeholders.
Challenges: Need Based Mindset; Weak Coordination; Technical Capacity Gaps
ABCD potential in Bhume is hindered by a number of challenges. First, the local members and institutions remain in a need-based mentality, which is a legacy of a development past of 'top down, deficit based'. This way of thinking emphasizes the deficits within communities, skewing the meaning of asset-based approaches. Second, there is little coordination between local government, cooperatives and community organizations, which severely restricts the impact of energy projects. In Nepal, the WISIONS Innovation Lab project has shown that creating inter-local government coordination mechanisms can help to overcome this challenge. Third, the technical capacity gaps mentioned by 68.4% of respondents limit operation and maintenance of RE systems. The technical capacity dimension is also consistently identified as a critical dimension in the research on the sustainability of micro-hydropower in Nepal.

ABCD as Complement Not Replacement to External Support
The results indicate that using ABCD as an adjunct to, and not a substitute for, outside assistance. Community assets constitute the basis for sustainable energy management, but external technical assistance, financing and policy support are still very much needed. The Chukeni Khola project is a good example of how external support can help trigger community led projects, with support from AEPC and SASEC Power Expansion Project. In addition, with the support of the World Bank ($21.5 million) and UNDP ($13.2 million), more than 400 MHPs have been installed from 1998 to 2014. The ABCD approach accordingly provides a bottom-up route that can be integrated with top-down policy approaches, and this could help tackle past policy failures in energy interventions.

Conclusion and Recommendations
The aim of this study was to assess the possibility of Asset Based Community Development (ABCD) method for sustainable energy management in Bhume Rural Municipality, Rukum East, Nepal. The results indicate that, locally, forests, water, solar energy, agricultural residues, and community skills are abundant but underutilized. There is a significant gap between asset recognition and use, especially for water resources (44.8%) and agricultural residues (65.8%), which shows the potential of the ABCD is a good one but not yet fully developed. Community ownership and participatory mechanisms were found to be important success factors as reflected by the high participation in community forestry (76.4%) and the economic benefits of micro-hydro and biogas projects. The Leaky Bucket analysis showed that renewable energy communities localised 62% (or more) of all energy costs within the communities, while communities using imported fuels localised 28% of all energy costs. However, high level of issues still exist such as lack of technical knowledge (68.4%), financial resources (62.8%), policy gaps (54.2%) and weak institutional coordination (48.6%). The problems are related to the overall governance issues outlined in Nepal's energy sector and show that the current communities mobilisation had to be complemented by institutional support. The study concludes that ABCD is a feasible bottom-up approach for sustainable energy management in rural Nepal, but local institutions need to be strengthened, technical capacity needs to be built and the principles of ABCD need to be incorporated in the municipal planning of energy.
Based on the above findings, the following recommendations are made. Firstly, participatory asset mapping in all the wards of Bhume Rural Municipality should be carried out systematically for identification and documentation of local assets for energisation. Second, local facilitators need to be trained in ABCD to create community resources for energy planning and asset mobilization. Third, the principles of ABC should be incorporated in rural municipality energy plans, with a strong focus on local assets and institutionalizing community participation. Fourth, pilot ABCD-based micro-energy businesses should be set up to prove feasibility of ABCD approaches and provide evidence for scaling up. Finally, the coordination among local governments needs to be strengthened, which includes the creation of inter-local government coordination mechanisms to tackle institutional fragmentation and policy gaps. Last, further studies should be conducted using longitudinal designs to assess the effects of ABCD interventions over time, and/or comparative case studies between municipalities to examine factors that facilitate and impede the effectiveness of ABCD. Kretzmann and McKnight (1993) noted that by “building communities from the inside out” it is important to understand that even the poorest communities have assets that can be mobilized through participatory processes to stimulate sustainable development and economic transformation.

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