

# Mapping energy use portfolios and household outcomes in Nepal

## Insights from farm and household surveys in the Terai and the Mid-hills

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This is the second in a series of three policy notes on South Asia, drawing from intrahousehold surveys conducted in India, Nepal, and Pakistan. In this series we analyze the on- and off-farm energy use portfolio of rural households in the region, and the benefit streams from clean energy use.

### Introduction

Rural energy access remains a critical challenge in developing economies, with profound implications for agricultural productivity, household welfare, and gender dynamics. Nepal's diverse geographical landscape—spanning the plains of Terai to the challenging Mid-hills and mountain regions—presents a unique context for understanding energy poverty and its multifaceted impacts.

This study examines the intricate relationships between energy infrastructure, household economic status, and social outcomes in rural Nepalese communities. By investigating electricity access, cooking fuel technologies, and agricultural mechanization, we reveal how energy transitions are not merely technical interventions but complex social processes that reshape household labor, economic opportunities, and gender relations.

Our research highlights the significant disparities in energy access between different geographical regions and wealth quintiles. Beyond infrastructure, we explore how energy technologies interact with dietary diversity, women's empowerment, and agricultural productivity. The findings underscore the need for nuanced, context-specific energy policies that consider local socioeconomic and geographical variations.

### Data

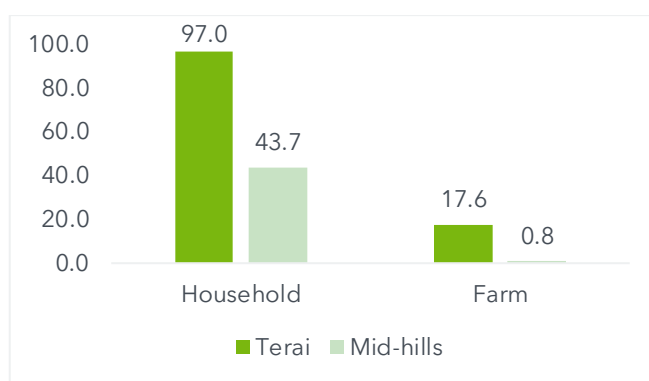
The data used in this study come from a farm household survey conducted in February 2023 in Nepal as part of CGIAR's Nexus Gains Initiative. In Nepal, the survey was conducted in Madhesh province which shares a border with India is largely characterized by plains and flatlands (Terai), and Karnali province, which is predominantly hilly (Mid-hills). The survey sampled households across Nepal using a multistage probability method. Across the two provinces, 42 wards were selected, with 12

households randomly chosen per ward. This resulted in 1,008 farm households surveyed, with 998 retained after removing incomplete data. Two separate surveys were conducted in each household: one for male and one for female respondents. The surveys collected comprehensive data including demographics, socioeconomic status, agricultural practices, food consumption, and food security. Standardized questionnaires like the Diet Quality Questionnaire and the Food and Agriculture Organization’s Food Insecurity Experience Scale were used. A community-level survey supplemented the household data.

## Energy Portfolio Composition

Figure 1 highlights the significant disparities in electricity access between households and farms in Nepal's Terai and Mid-hills regions. While 97.0 percent of households in the Terai have electricity, only 43.7 percent in the Mid-hills are connected, underscoring the challenges faced by more remote areas in securing reliable household electricity. The gap is even more pronounced for farms, with 17.6 percent in the Terai having access compared to a mere 0.8 percent in the Mid-hills. This severe lack of farm electricity in the Mid-hills suggests a reliance on traditional energy sources, potentially limiting agricultural productivity and the adoption of modern farming technologies.

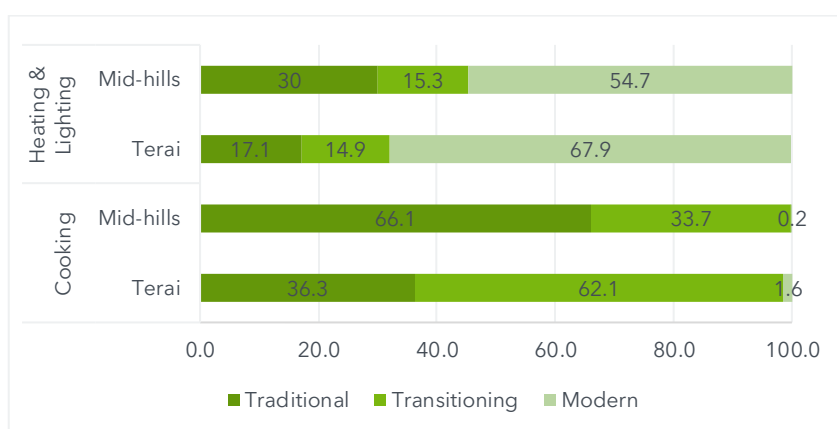
**Figure 1: Percent of sampled households by electricity connection in the Terai and the Mid-hills**



Source: Nepal CGIAR NEXUS Gains survey.

Figure 2 compares types of energy used for cooking and heating/lighting by households in Nepal’s Terai and Mid-hills regions, highlighting significant regional differences in energy portfolios. For cooking, traditional energy sources such as firewood and biomass dominate in the Mid-hills, where 66.1 percent of households rely on these unclean sources. In contrast, a much lower percentage (36.3 percent) of Terai households depend on traditional energy for cooking.

**Figure 2: Type of energy used for cooking and heating/lighting in the Terai and the Mid-hills**

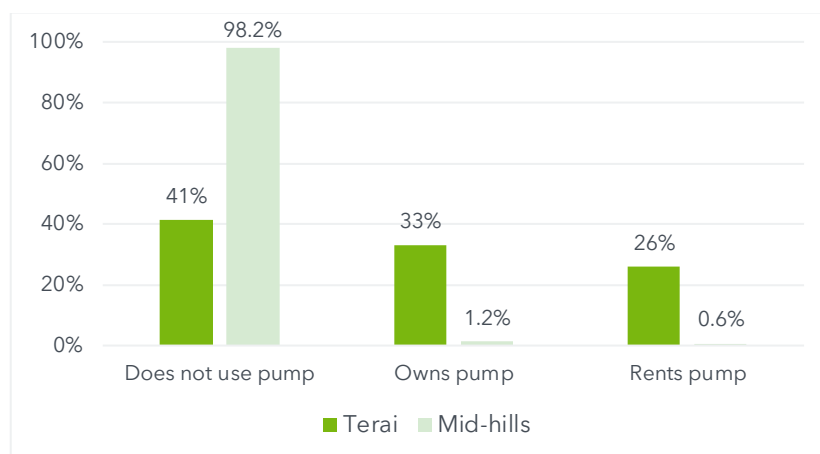


Source: Nepal CGIAR NEXUS Gains survey

Households in Terai show a higher adoption of transitioning energy sources, with 62.1 percent of households using a mix of traditional and modern fuels, compared to 33.7 percent in the Mid-hills. However, the exclusive use of modern, clean energy sources for cooking remains minimal in both regions, at only 1.6 percent in the Terai and an almost negligible 0.2 percent in the Mid-hills.

In the Mid-hills, 54.7 percent of households use modern energy sources, such as electricity and solar power, a notable contrast to the lower adoption rate of modern fuels for cooking. Meanwhile, in the Terai, 67.9 percent of households use modern energy sources for heating and lighting, indicating a more significant shift toward cleaner energy in these domains. Traditional energy use for heating and lighting is more prevalent in the Mid-hills (30.0 percent) than in the Terai (17.1 percent), reflecting the challenges in accessing modern energy infrastructure in more remote areas.

**Figure 3: Access to and ownership of irrigation pumps in the Terai and the Mid-hills**



Source: Nepal CGIAR NEXUS Gains survey.

Figure 3 depicts the disparity in access to and ownership of irrigation pumps between the Terai and Mid-hills regions. In the Terai, a significant proportion of households either rent (26.0 percent) or own (33.0 percent) irrigation pumps, while 41.0 percent do not use pumps. Conversely, in the Mid-hills, the vast majority of households (98.2 percent) do not use irrigation pumps, with only 0.6 percent renting and 1.2 percent owning pumps. These findings highlight a stark contrast in irrigation infrastructure accessibility between the two regions, with the Terai exhibiting much greater integration of irrigation technologies compared to the Mid-hills.

**Table 1: Households with energy access by wealth quintile**

Wealth quintile	Electricity connection	Clean cooking fuel	Modern			N
			lighting & heating fuel	Mechanized irrigation	Mechanized threshers	
Q1	18.5	11.5	40.5	0.0	7.5	200
Q2	51.0	35.5	54.5	0.5	6.0	200
Q3	85.4	54.3	56.8	30.2	55.3	199
Q4	98.0	63.5	71.5	53.0	89.0	200
Q1	99.0	79.4	65.3	66.8	92.0	199
P-value (Chi-squared test)	0.000	0.000	0.000	0.000	0.000	998

Note: Chi-squared test p-values indicate the statistical significance of the relationship between wealth quintiles and energy access for each service.

Source: Calculated by authors based on the Nepal CGIAR NEXUS Gains survey

## Rural Energy Access and Household-level Outcomes

To examine if households benefit from gaining access to cleaner and more efficient sources of energy for domestic and productive uses, we check for significance in the associations between their energy portfolio and selected outcomes of interest. Table 2 presents these findings for rural Nepal, drawing from samples in the Mid-hills and Terai regions. The use of clean cooking fuel is positively associated with improved dietary diversity and greater women's energy empowerment, indicating its dual benefits for nutrition and women's decision-making. Furthermore, it is significantly correlated with reduced hours spent on agricultural activities by primary women, suggesting time-saving benefits in productive use. Households relying solely on modern fuels for heating and lighting see a reduction in domestic work hours, reflecting time-saving advantages, and increased agency women in decision-making related to energy use, though this comes with a trade-off in reduced food diversity. Interestingly, access to water pumps is linked to increased time spent by women on household chores, suggesting that mechanization may not always alleviate domestic labor burdens. Finally, while access to threshers likely enhances agricultural productivity, it is significantly negatively associated with women's empowerment in energy use, raising concerns about the potential constraints on women's agency despite the availability of agricultural technology. These findings therefore reveal the complex effects of energy access on household dynamics, particularly in terms of labor and gender roles.

**Table 2: Associations between indicators of household energy choices and selected household outcomes**

Variable	FGDS	WEES	Hours of agriculture work	Hours of domestic work
Uses clean cooking fuel (=1)	0.358*** (0.12)	0.0525*** (0.02)	-0.352* (0.19)	-0.147 (0.12)
Only uses modern fuel for heating & lighting (=1)	-0.291*** (0.10)	0.0316** (0.02)	0.070 (0.17)	-0.320*** (0.10)
Access to water pumps (=1)	-0.051 (0.15)	0.011 (0.02)	-0.306 (0.25)	0.290* (0.15)
Has access to threshers (=1)	-0.049 (0.17)	-0.0467** (0.02)	0.063 (0.28)	-0.207 (0.18)
Observations	972	972	972	972
R-squared	0.19	0.18	0.21	0.25
Mean	4.60	0.55	4.37	2.19

Notes: FGDS (Food Group Diversity Scores) represents the number of food groups consumed by the primary woman in the last 24 hours; [Women's energy empowerment score](#) (WEES) is a weighted score ranging from 0 to 1 suggesting the extent of women's agency in energy choices for domestic and productive use; Hours of agriculture work represents hours in a day spent by the primary woman on crop farming, horticulture, livestock rearing, etc.; Hours of domestic work represents hours in a day the primary woman spent on household chores, including cooking, cleaning, fetching water, etc. All regressions include controls for the characteristics of the primary household decision-maker, household characteristics, controls for village infrastructure, and regional fixed effects. The models are estimated using Ordinary Least Squares, and the coefficient estimates are shown with robust standard errors in parentheses. \*\*\*Significant at the 0.01 level; \*\*Significant at the 0.05 level; \*Significant at the 0.1 level.

Source: Calculated by authors based on the IFPRI NEPAL NEXUS Gains survey.

## Conclusion

Energy access in rural Nepal reveals stark regional and socioeconomic disparities. The Terai region demonstrates substantially higher electricity and irrigation technologies compared to the Mid-hills region. Clean cooking fuels show promising dual benefits, positively associated with improved dietary diversity and increased women's energy empowerment. However, energy technologies present complex impacts on household dynamics, with mechanization not always reducing women's domestic labor burdens. Understanding the differences in energy portfolios between these two regions within Nepal is crucial, as local conditions influence energy availability and adoption, impacting household well-being, economic productivity, and environmental sustainability. Insights from this type of disaggregated will help inform targeted interventions to promote equitable and sustainable energy access in rural Nepal.

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