

Documentos de Trabajo Sobre Economía Regional y Urbana - Adaptation to Broken Mitigation: Social and Economic Impacts of Solar Mini-Grid Electrification in Colombian Island

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Electrification is a necessary condition for local development, but it is not sufficient when it is not accompanied by reliable systems and complementary policies that strengthen the economic and social capacities of communities.

Publication Date: Wednesday, 19 of August 2026 **Approach**

This paper examines the social and economic effects of mini-grid electrification in three island communities located in Colombia's Non-Interconnected Zones (Zonas No Interconectadas, ZNI): Isla Fuerte, Isla Múcura, and Santa Cruz del Islote. Unlike studies that focus primarily on the technical or financial aspects of energy systems, this research adopts a perspective centered on the transformations that electricity brings to the daily lives of local communities.

To this end, the study combines semi-structured interviews, focus groups, and secondary statistics on education, health, and demographics to assess changes in cultural practices, consumption patterns, economic opportunities, gender roles, education, and access to healthcare services. Particular attention is given to the consequences of the declining reliability of electricity service, analyzing how households, businesses, and the broader community have adjusted their consumption, production, and day-to-day organizational decisions in response to persistent energy constraints.

Contribution

The paper's main contribution is to show that access to electricity alone does not guarantee sustained improvements in well-being or local economic development. The study provides empirical evidence demonstrating that the impacts of mini-grids depend on institutional, social, and governance factors that often receive limited attention in the design and implementation of energy projects.

In addition, it documents how the progressive deterioration of solar power systems and insufficient capacity to accommodate growing demand have compelled households and businesses to resort once again to coping and adaptation mechanisms. The paper also expands the rural electrification literature by incorporating relatively underexplored dimensions, including effects on community interactions, gender dynamics, young people's educational aspirations, and the adaptive responses of local populations to energy insecurity.

In this regard, the paper argues that electrification projects should be conceived as comprehensive development interventions, complemented by investments in training, education, healthcare, and local infrastructure, so that their benefits can be sustained over the long term.

Results

The findings show that electrification led to significant improvements in the quality of life of the communities studied by facilitating access to refrigeration, ventilation, telecommunications, and new household technologies. The availability of electricity supported the expansion of economic activities related to tourism, the commercialization of refrigerated food and beverages, fish preservation, and the emergence of small-scale businesses.

Changes in gender roles were also observed, as some women became more actively involved in productive activities owing to the reduction of time-intensive domestic tasks and access to new business opportunities. However, these advances have been constrained by the growing unreliability of electricity service. Frequent power outages, the degradation of solar energy components, and high operating costs have reduced the ability of mini-grids to meet local demand.

As a result, many households and businesses once again depend on private diesel generators, face losses from food spoilage, encounter limitations in expanding their economic activities, and struggle to fully realize the benefits of electrification. Overall, the findings suggest that electrification is a necessary condition for local development but not a sufficient one when it is not accompanied by reliable systems and complementary policies aimed at strengthening the economic and social capacities of communities.