ABSTRACT

Reliable electricity supply is fundamental to Uganda's economic transformation, supporting residential welfare, industrial production, agricultural processing, transport systems, and service delivery. Despite recent investments, the national grid continues to experience frequent and prolonged outages, reflecting weaknesses across generation, transmission, and distribution subsystems. This study investigates the factors that shape grid electricity reliability in Uganda, with a focus on organisational, environmental, technical, and security dimensions that influence both the frequency and duration of outages. The study uses monthly time-series data spanning 2012–2022 obtained from utility-scale power plants, the Electricity Regulatory Authority, the Directorate of Water Resources, and the Uganda Meteorological Authority. Autoregressive distributed lag (ARDL) and ordinary least squares (OLS) models were applied to estimate short- and long-run relationships between the identified determinants and grid reliability. The modelling framework enables a clear separation of immediate operational effects from long-term structural influences.

The findings indicate that organizational factors particularly system shutdowns, operational inefficiencies, and weak maintenance performance significantly undermine reliability, especially in the distribution subsystem. Environmental factors such as rainfall variability and hydrological fluctuations affect generation stability, highlighting the vulnerability of Uganda's grid to climatic and water resource dynamics. Technical challenges, including grid equipment failures, were found to be central determinants of outages across all subsystems. Security-related issues, notably theft and vandalism of grid infrastructure, further contribute to both frequent and extended outages, with pronounced effects in the transmission network. The study concludes that achieving reliable electricity supply in Uganda requires a holistic approach that strengthens operational management, improves preventive maintenance, modernizes ageing infrastructure, and mitigates environmental and security risks. Key recommendations include more efficient management of system shutdowns, enhanced investment in grid expansion and equipment upgrades, collaborative stewardship of hydrological resources, community-based strategies to safeguard grid assets, and increased allocation of financial resources towards repair and maintenance. The study provides evidence-based insights that can support policy reforms, guide utility planning, and contribute to ongoing efforts to improve grid system performance and overall reliability.