Impact Evaluation of the AfDB-supported Kenya Last Mile Connectivity Project, Phase I

Executive Summary

March, 2022
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Introduction

This summary report presents the findings, conclusions, lessons, and recommendations of an impact evaluation of the Last Mile Connectivity Project (LMCP, or the project) Phase I financed by the African Development Bank Group (AfDB, or the Bank) under the Thirteenth African Development Fund (ADF-13) in the Republic of Kenya. The project loan was approved by the AfDB Board of Directors in November 2014 for a value of UA 90 million (USD 131 million) excluding the Government of Kenya’s contribution of UA 9.20 million. The project became effective in March 2015 with a planned completion date of December 2019. However, the closing date for the project was extended to December 2022 due to challenges such as contractor non-performance for two lots and the recent COVID-19 pandemic.

The main objective of the project was to support the Government of Kenya’s aim to provide universal electricity access for all Kenyans by 2022, particularly for low-income groups in peri-urban and rural areas. Access to energy is considered vital for economic development. It is, therefore, a major goal for the international community, the Bank, and its Regional Member Countries (RMCs). In line with the United Nations (UN) Sustainable Development Goal 7 which calls for “affordable, reliable, sustainable and modern energy for all,” the Bank aims to achieve universal energy access in Africa by 2025 through its High 5 priority area on “Light Up and Power Africa” and the New Deal on Energy for Africa (NDEA). Likewise, increasing energy access is a cornerstone of Kenya’s development strategy to transform its economy into that of a middle-income industrialized country.

The project maximized the use of existing electricity infrastructure by connecting households and businesses located within a 600-meter radius of suitable distribution transformers operating below full capacity. Specifically, the project extended the low-voltage network throughout Kenya, with counties that have low electrification rates prioritized. Broadly, the evaluated project, Phase 1 of the LMCP, planned to connect 284,200 households, 30,000 commercial customers, and public facilities (health centres and schools) around project transformers across all 47 counties in Kenya.

Altogether, this translated to providing electricity access to 1,571,000 people. The project prioritized customers in counties with low electricity penetration rates and the connection fee was subsidized.

The project had four components, namely: (i) construction of a low-voltage network (UA 96.25 million) comprising of 12,000 kilometres of low-voltage distribution lines (415V and 240V) to households and businesses, and the installation of energy meters for the connection of targeted beneficiaries; (ii) project supervision and management (UA 2.6 million); (iii) capacity building and re-establishment of the Kenya Power and Lighting Company (KPLC) tree seedlings nursery (UA 0.25 million); and (iv) project audit (UA 0.1 million).

What was Evaluated?

Independent Development Evaluation (IDEV) conducted an impact evaluation of LMCP Phase I in Kenya. The LMCP was implemented across 45 counties in four phases, with the Bank financing Phases I and II. The evaluation estimated the causal impact of the intervention by comparing households within the 600 meters eligibility border (treatment group) with households outside the 600 meters eligibility border (control group). The report
presents the average effect of the project on eligible households in targeted communities (treatment group) that connected to electricity through the project relative to ineligible households (control group) that were not connected through the project.

**Purpose and Objectives of the Evaluation**

This evaluation aims to inform the mid-term review of the Bank Group’s Strategy for the NDEA (2016-2025) by identifying lessons and potential areas for improvement. It intends to provide credible evidence-based findings on the impact of the LMCP and recommendations for future energy operations. It also examines project design and implementation issues that may hinder households from deriving the benefits from access and use of on-grid energy, namely: affordability, reliability, and adequacy of electricity. Overall, the evaluation will provide evidence on the first years of implementing the NDEA in the context of Kenya and show how similar innovative programmes can be scaled to increase energy access in other RMCs. The evaluation’s objectives are: (i) to estimate the impact of LMCP Phase I on pre-specified direct, intermediate, and final outcomes; (ii) to identify factors that affect the performance and development outcomes of the project; (iii) to generate lessons and provide recommendations for increasing the impact of ongoing and future electricity access projects financed by the Bank. The overarching evaluation question was: “What are the causal impacts of the Bank-supported LMCP Phase I in Kenya?”

**Methodology Used**

A mixed-methods approach, comprising of quantitative and qualitative methods, was used to address the evaluation questions. In the quantitative studies, an attempt was made to estimate the impacts of the project on key variables of interest (electricity access, jobs creation, earnings from self-employment, education, health, firm productivity, productive use of electricity, income and consumption, subjective well-being, migration, awareness of current events, investments, and savings) using household surveys. Quantitative data was collected through household surveys in 5,290 households (2,721 treatment households and 2,569 control households) in 157 transformer communities across six counties in Kenya. This was complemented with Geographic Information System data, 155 Key Informant Interviews, six Focus Group Discussions, 55 business surveys and semi-structured interviews with key energy stakeholders in Kenya. To establish evidence of the project’s impact without bias, the evaluation compares the impact on the project beneficiary households and businesses with a counterfactual, defined as what would have happened to the same households and businesses at a similar time had the project not been implemented.

In the absence of baseline data for the LMCP Phase I, a quasi-experimental impact evaluation method was used to estimate the causal impact of the project by controlling for confounding factors such as the non-random placement of LMCP transformers, take-up by beneficiaries, and geographical spillovers. The evaluation exploits the design of the LMCP Phase I to find a counterfactual. To be eligible for the program, households need to be located within 600 meters in cable distance of an LMCP Phase I transformer. The evaluation compares households within the 600 meters with a control group outside the border using a regression discontinuity design. Furthermore, a qualitative analysis was conducted to provide further insights on contextual issues that are relevant to the design of the impact evaluation as well as the effectiveness and sustainability of the project.

The evaluation experienced the following limitations: (i) lack of baseline data to capture changes over time; (ii) potential recall bias and measurement error; (iii) imperfect compliance with the project design by contractors; (iv) lack of data on some components of the LMCP, in particular, tree planting and distribution of energy-saving lightbulbs to households; (v) results only show the average effect of all components of
the project, requiring caution in interpreting income outcomes; (vi) differences in the timing of electricity connections and issues with customer connections that may reduce the extent of development impact for beneficiaries in some counties; and (vii) the COVID-19 lockdown in Kenya beginning from March 2021 delayed field data collection. The impact evaluation mitigated these challenges where possible. For instance, the first three limitations were addressed by the evaluation’s identification strategy of a fuzzy regression discontinuity (RD) design instead of the sharp RD envisioned at the evaluation’s inception. The assumption is that households on either side of the boundary are similar in every aspect, except their eligibility for the program. In addition, a balance test on a set of covariates was conducted and the variables were included as control variables. The fourth limitation could not be addressed since the data required was not available, while the remaining limitations were addressed by qualitative analysis.

**Findings**

The evaluation examined key variables of interest based on the Project Theory of Change (ToC, Annex 1). The estimated impact of the project on these outcomes are the following.

**Finding 1:** What difference did the LMCP make to connected households and businesses?

The evaluation finds positive results of the impact of the project on increasing access to and use of a reliable source of electricity for households.

The evaluation found that the project significantly increased beneficiaries’ electricity connection to the national grid compared to the non-beneficiaries in the transformer communities surveyed. The project increased the rate of electrification by 85% as compared to the control group. Also, it increased the use of electricity from the grid for lighting by 83% and reduced the use of lighting from other sources by 17%.

The evaluation also found that the project had a statistically significant effect on reducing the ownership of other sources of electricity such as solar devices and rechargeable batteries by 51% and 12%, as compared to the control group. The effect on generator ownership was close to zero. Despite the reduction of the ownership of other sources of electricity, the evaluation did not find a significant difference in total energy spending between connected and non-connected households. Nevertheless, the qualitative evidence suggests that the reliability and quality of electricity vary substantially across locations.

The evaluation also found that the project somewhat increased the use of electricity by connected businesses and households, as compared to the control group. However, electricity was predominantly used for lighting and entertainment. The relatively high cost of electricity hampered a greater use of electricity for productive purposes and thus constrained potential for higher income earnings from self-employment.

Evidence from the evaluation shows that the intervention increased the connection of household-owned businesses to the national grid by 7%. Notably, the project increased the use of electricity for agricultural activities such as irrigation by 17%. The ownership of electrical appliances such as hairdryers, sewing machines, and security lights also increased by an additional type of appliance. Overall, the qualitative evidence showed that the most important benefits for small businesses are increased security due to lighting and longer opening hours. Others include an increased use of electrical appliances for their business. However, the evaluation finds no evidence of impacts on labour market outcomes such as business ownership and job creation. It also found no effect on the proportion of households owning a business and the proportion of households employed (excluding agriculture) as compared to the control group.

**The impact of the project on some educational outcomes for children was found significant and**
The project was found to have a significant positive impact on household consumption, while the reported impact on household income was positive but not statistically significant. The project increased the monthly average consumption expenditure of treated households by 1,704 Kenyan Shillings (KES). The size of this effect was positive and statistically significant. The increase in consumption was led by an increase in the consumption of non-durable goods. This household consumption dynamic is expected in resource-constrained settings where durable items such as refrigerators and electric stoves require large capital outlays. In contrast, households in these settings can easily purchase non-durable items such as clothes, airtime, recreation, religious expenses, and other personal items. The evaluation finds that the reported impact of the project on households’ average monthly income was positive (913 KES), but not statistically significant. The lack of statistical significance is likely due to the inherent difficulties in measuring income using survey data due to response errors (i.e., under-reporting of earnings) and the need for a large enough sample size to detect impact.

Moreover, the evaluation found no statistically significant effect of the project on asset ownership, household characteristics and wealth (fertility choices and housing quality for instance). Similarly, while households’ savings decreased by 6% and borrowing increased by 7%, the estimated impacts are not statistically significant. These results are partly explained by the finding that the intervention did not increase wealth creation (i.e., new job and business opportunities in communities), and therefore, did not significantly increase the reported household income. While the evaluation finds that businesses operate for longer hours, this is yet to translate to higher income earnings, at least in the short-term. A possible explanation for this finding is that in small village economies with small-scale businesses, longer opening hours may not necessarily translate into more consumers due to constrained consumer demand.

An additional factor is the finding of electricity-sharing by eligible (treatment) households with neighbouring non-eligible (control) households (see below under “unintended impacts”). This reveals the presence of spillovers in the benefits of the project to non-beneficiaries, which can explain some of the lack of difference between the two groups. If the control group’s access to electricity de facto increased, leading them to report benefits (electricity use, well-being etc.), the difference between the two groups grows smaller.
Finding 2: What are the impacts of the project on women and girls?

The project was found to have a positive impact on the time women spent on leisure activities but no impact on women’s empowerment. Women in treated households spent one hour per day more on leisure activities than their counterparts in non-beneficiary households. Conversely, they decreased the time spent on sleeping/resting and working (outside the farm) by one hour, respectively. The evaluation did not find any significant impact of the project on women’s likelihood to work, to have their own savings in a financial institution, to make financial decisions or on the proportion of girls enrolled in school. Similarly, the intervention did not affect the time women and girls spent on household chores, childcare, cooking, and fetching firewood and water. However, the qualitative evidence shows that the project improved women’s safety, as they can walk outside at night without fear for their physical safety.

Finding 3: What were the unintended impacts?

The project increased the social capital of project beneficiaries in communities and increased awareness about current events. Qualitative interviews and quantitative analysis showed that the project generated a substantial amount of electricity sharing among neighbours. While this practice varied across communities, it was common for households connected to electricity to allow their neighbours to charge their mobile phones, watch television, and use electric appliances. During lifecycle events like funerals, for instance, it was usual for neighbours to share electricity with the bereaved family. This practice promoted beneficial social cohesion and increased social capital. Nevertheless, electricity sharing reveals the presence of spillovers in the benefits of the project to non-beneficiaries. Furthermore, the project led to a significant increase in the level of awareness and knowledge related to local politics, education, and health. This was driven by the increase in the ownership of electrical appliances such as televisions and radios among project beneficiaries.

Finding 4: Are development benefits from the project sustainable?

Despite good technical quality and strong partnerships with the Government and other development agencies, the sustainability of the development outcomes of the project was found to be highly unlikely in the near term. Timely and regular maintenance of the electricity transmission and distribution network is critical for the provision of affordable, reliable, and quality electricity for beneficiary households after completion. Currently, the evidence shows that the electricity supply is unreliable in some communities while the quality is inconsistent. This situation has been worsened by emerging challenges such as the decline in electricity sales and delays in revenue collection due to the COVID-19 pandemic. Moreover, the imbalance created by the high cost of maintaining and operating the extensive electricity network relative to the low revenue generated from last-mile connections is highly likely to affect the financial sustainability of KPLC.

The evaluation finds that 2 to 3 years after connecting households to the grid through the project, electricity consumption by beneficiaries has remained low. Beneficiaries feel insufficiently informed and involved in the project, creating mistrust. They mainly use the electricity for lighting and charging phones. A lack of resources may be the primary reason why beneficiaries do not use much electricity, since the qualitative study revealed that electricity is still costly. To a large extent, this is expected and unsurprising since the project targeted low-income households and businesses in peri-urban and rural areas. Consequently, the rising cost of electricity network maintenance and operation and the technical losses from extending low-voltage lines have grown faster than the revenues generated from last-mile connections. The unreliability of electricity supply in some transformer communities also discouraged beneficiaries from purchasing electrical appliances.
These factors played a key role in the deterioration of KPLC’s finances, with net profits plummeting by 97% between 2016 and 2020. Thus, the worsening financial situation of KPLC is highly likely to affect the sustainability of the project and its development outcomes since the power utility may not have the resources required to maintain the electricity network in the near term. This would compromise the reliability and quality of electricity received by households and businesses.

The evaluation also finds that KPLC has limited capacity in financial recovery, debt restructuring, corporate governance and organizational efficiency. With limited manpower resources relative to the large number of project sites it supervises, it requires both financial support and technical assistance to adequately supervise project sites and contractors, to maintain the electricity network, and to stimulate the demand for electricity.

**Recommendations**

IDEV makes the following recommendations:

**Recommendation 1:** Ensure the sustainability of project benefits. Priority areas of action to consider include:
- Strengthening the organizational and operational capacity of KPLC through non-lending instruments such as technical assistance from trust funds, special funds, and grants.
- Enhancing meaningful participation and engagement of community leaders and beneficiaries throughout the project cycle.

**Recommendation 2:** Stimulate and manage households’ and businesses’ demand for the productive use of electricity. Priority areas of action to consider include:
- Integrating complementary interventions into Bank electricity access programs to link electricity with income-generating activities such as irrigation services and the promotion of small businesses (MSMEs).

**Recommendation 3:** Improve future electrification projects’ design and implementation. Priority areas of action to consider include:
- Ensuring that project design is based on actual engineering assessments and field data, and that the optimal transformer protection distance is applied.
- Improving analytical work, including detailed electricity demand studies based on willingness to pay and affordability analysis for electricity and alternate energy sources, to better inform the preparation and formulation of energy access projects and programs.

**Lessons**

The following are the main lessons from the impact evaluation of the LMCP Phase I in Kenya.

**Lesson 1:** A high cost of electricity relative to the household income of beneficiaries undermines access and the productive use of electricity.

**Lesson 2:** The financial sustainability of the electric utility company is a critical success factor for the quality and reliability of electricity provided to eligible households.

**Lesson 3:** An effective project communication strategy is key to increasing households’ participation in electrification projects.

**Lesson 4:** Lack of baseline data hampers the assessments of project outcomes and impacts after completion.
About this evaluation

This report summarizes the findings of an impact evaluation of the AfDB’s phase 1 of the Last Mile Connectivity Project in Kenya. The project sought to increase access to electricity, particularly for low-income groups in peri-urban and rural areas, by maximizing the use of existing transformers of the Kenya Power and Lighting Company (KPLC). Approved by the Bank in 2014, at a value of about USD 131 million, the project was envisaged to extend the low-voltage electricity network to reach around 1.2 million people.

The evaluation aimed to inform the mid-term review of the AfDB’s Strategy for the New Deal on Energy for Africa (NDEA) by estimating the causal impact of the project so as to generate lessons and provide recommendations to enhance the impacts of ongoing and future electricity access projects.

Overall, the project was found to be effective in increasing access to electricity for the beneficiaries. However, the reliability and quality of electricity varied substantially across locations, and there was a limited increase in the productive use of electricity. The evaluation also observed that the development outcomes for the project were unlikely to be sustainable in the near term. Some of the lessons that the evaluation draws are on: the productive use of electricity, the success factor for the quality and reliability of electricity, and increasing the participation of beneficiaries in electrification projects. The Bank was advised to ensure the sustainability of project benefits, stimulate, and manage households’ and businesses’ demand for the productive use of electricity, and improve the design and implementation of its future electrification projects.