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The Impact of Light Emitting Diode (LED) Lighting Use on Electricity Consumption in Nyeri County, Kenya

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Abstract: *Despite the global and national shift toward energy-efficient lighting, electricity consumption in Kenya remains constrained by persistent supply interruptions, rising tariffs, and incomplete household transition from conventional incandescent and fluorescent bulbs to LED technology. Further, there is inadequate empirical evidence documenting the actual impact of LED adoption on local electricity consumption patterns. This study sought to examine the impact of LED lighting use on electricity consumption among households in Nyeri County, Kenya. The study was anchored on the Energy Efficiency Theory and adopted a pragmatist research paradigm using a mixed-methods research design. The target population comprised approximately 175,000 households across Nyeri County, from which a sample size of 384 households was determined using the Yamane formula and selected through stratified random sampling; 315 questionnaires were successfully completed, yielding an 82.0% response rate. Data were collected using structured questionnaires and key informant interview guides. Quantitative data were analyzed using descriptive and inferential statistics via SPSS, while qualitative data were analyzed thematically. Ethical clearance was obtained from NACOSTI, with informed consent, confidentiality, and voluntary participation upheld throughout. Findings revealed that 62.2% of households primarily used LED bulbs, with greater bulb ownership and longer duration of use associated with lower reported electricity consumption. The study concluded that LED lighting adoption significantly and positively influences household electricity consumption reduction in Nyeri County, though adoption remains incomplete. It recommends intensified awareness campaigns, cost-reduction incentives, quality standards enforcement, and integration of LED promotion into rural electrification programmes.*

Keywords: *LED lighting, Electricity Consumption, Nyeri County, Household Energy Sustainability*

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1. Introduction

Electricity remains one of the most significant recurrent expenditures for households, institutions, and commercial establishments worldwide, and lighting continues to account for a substantial share of that demand as roughly 8% of global electricity demand, about 2,200 terawatt-hours, was attributed to lighting in buildings and outdoor applications in 2024. Light Emitting Diodes (LEDs) are semiconductor devices that convert electrical current into visible light through electroluminescence, and they are distinguished from incandescent and fluorescent technologies by markedly lower power draw for equivalent illumination output since LEDs use up to 90% less energy than incandescent bulbs and 50–60% less than compact fluorescent lamps to produce the same amount of light. Globally, the shift toward LED technology has been identified by energy agencies as one of the most consequential efficiency transitions of the past two decades

with the IEA reporting that global adoption of LEDs drove a nearly 30% reduction in annual electricity consumption for lighting in homes between 2010 and 2022.

In developed economies, empirical evidence of this transition is well documented. In the United States, the share of households using mostly LED bulbs for indoor lighting rose from 4% in 2015 to 63% by 2024, and LED adoption produced estimated annual energy savings of 1.3 quadrillion Btu in 2018, equivalent to about 5% of total electricity use from buildings that year. In the European Union, a comparable pattern has emerged in the commercial sector, where an analysis of retail buildings in Italy found an 11% reduction in energy consumption following the replacement of conventional lamps with LEDs. African countries are increasingly following this trajectory, though at a comparatively slower pace and often within institutional rather than purely residential settings. Lighting retrofits in South African educational buildings similarly achieved significant energy reduction, while the East African Community finalized harmonised lamp and luminaire standards in 2022 to shift regional markets toward LED technology.

In Kenya, LED uptake has been driven by both policy and cost incentives. A 2019 study found that combining monetary incentives with simplified information raised CFL/efficient-bulb adoption to nearly ten times the rate of a control group, reaching about 84%, and lighting is responsible for about half of electricity consumption in Kenyan schools, largely due to continued reliance on older incandescent and fluorescent fixtures. A related case study in Kisumu similarly demonstrated efficiency gains from replacing fluorescent luminaires with LEDs in commercial mall settings (Adhiambo et al., 2021). Nyeri County, however, continues to experience persistent supply interruptions and network upgrade demands as seen in scheduled electricity interruptions affecting the county for maintenance and new connections in August 2026, yet no documented county-specific study has examined how LED lighting adoption is influencing household or institutional electricity consumption patterns locally. This gap justifies an empirical investigation into the impact of LED lighting use on electricity consumption within Nyeri County.

1.1 Research Objective

The objective of this study was to examine the impact of LED lighting use on electricity consumption among households in Nyeri County, Kenya.

1.2 Research Question

What is the impact of LED lighting use on electricity consumption among households in Nyeri County, Kenya?

2. Literature Review

The International Energy Agency (IEA) has documented that lighting continues to constitute a substantial share of global electricity demand, accounting for around 8% of global electricity demand, or approximately 2,200 terawatt-hours, in 2024 across buildings and outdoor applications. Despite this continuing load, the same body of literature attributes a significant historical decline in lighting-related consumption to LED penetration, noting a nearly 30% reduction in annual electricity consumption for residential lighting worldwide between 2010 and 2022. This finding is significant for dissertation purposes because it establishes a global baseline effect size against which national and sub-national studies, including the present one, can be compared. A parallel body of comparative work extends this pattern beyond high-income countries. Hasan et al. (2025) indicated that LED adoption could reduce lighting-related energy usage and associated greenhouse gas emissions in Bangladeshi buildings by roughly half, while Periyannan et al. (2023) documented significant electricity savings following LED retrofits in Sri Lankan hotels. These studies matter to the literature because they demonstrate that the efficiency gains from LED conversion are not confined to temperate, high-income contexts, but replicate across tropical, middle-income economies with different climatic cooling loads and building typologies a pattern of direct relevance to Kenya.

Two developed-country cases illustrate the depth of empirical documentation available in this literature. In the United States, national residential energy survey data show a rapid and near-complete generational shift in lighting technology: the share of households using mostly LED bulbs for indoor lighting rose from just 4% in 2015 to 63% by 2024, a shift the U.S. Department of Energy links directly to measurable system-level savings, with LED adoption estimated to have produced 1.3 quadrillion Btu of annual energy savings in 2018, equivalent to about 5% of total U.S. building electricity use that year. This case is instructive methodologically, since it relies on large-scale household survey instruments (the Residential Energy Consumption Survey) rather than single-site metering, offering a model for population-level inference that smaller African studies, including county-level dissertations, often cannot replicate but can meaningfully scale down from.

In the European Union, sector-specific retrofit studies provide a complementary, more granular picture. Forastiere et al. (2024) analysed retail buildings in Italy and found an 11% reduction in energy consumption following

the replacement of conventional lamps with LEDs. The comparatively modest percentage relative to the U.S. household figure is instructive: it suggests that measured savings are sensitive to baseline lighting technology, operating hours, and building type, a methodological caution that should inform how consumption-impact estimates are interpreted and generalised in the present Nyeri County study.

The African literature on LED lighting and electricity consumption is smaller but methodologically rigorous, concentrated substantially around South African educational institutions. The most frequently cited study is Booysen et al. (2021), a peer-reviewed smart-meter-based investigation across South African schools. The authors found that lighting accounted for between 31% and 57% of annual electricity costs in South African schools prior to LED retrofitting, and that total electricity bills fell by between 21% and 39% after installation, with lighting's share of total usage dropping to between 12% and 30%. Complementary reporting from the same research group quantified daily operational savings, noting that projected energy savings ranged from 80 to 190 kWh per school day, with payback achieved within roughly two years (Booysen & Grobbelaar, 2021). This body of work is particularly valuable to the present study because it demonstrates that LED-driven consumption reductions in African institutional settings are not merely theoretical projections but empirically measured, smart-meter-verified outcomes, and because schools like many public institutions in Nyeri County represent budget-constrained public entities for which electricity savings carry direct service-delivery implications.

Related South African scholars situate these lighting-specific findings within a broader account of institutional electricity mismanagement, arguing that schools are frequently "heavy and often wasteful users" of electricity and water due to budgetary constraints and limited technical oversight (Booysen et al., 2019, as cited in related school-energy literature). Complementary behavioural work by the same research cluster found that non-technological interventions, such as staff training and visualized smart-meter feedback, could independently reduce school electricity consumption, suggesting that technology adoption (LEDs) and behavioural change operate as distinct but potentially reinforcing pathways to consumption reduction a distinction with implications for how the present study interprets any consumption reductions observed in Nyeri County, since respondent behaviour may confound the technology's isolated effect.

At the regional policy level, momentum toward LED adoption in East Africa has been institutionalized. The East African Community finalized harmonized lamp and luminaire standards in 2022, formally shifting regional lighting markets toward LED technology, while a continental effort saw 36 African nations propose a phase-out of fluorescent lamps under the Minamata Convention on Mercury, targeting compact fluorescent lamps by 2024 and linear fluorescent lamps by 2025. These developments indicate that the regulatory environment within which Kenyan consumers and institutions make lighting decisions has shifted decisively toward LEDs over the past several years, reinforcing the plausibility of measurable consumption effects at the county level.

Literature on LED lighting in Kenya remains comparatively thin but points consistently toward substantial consumption effects where adoption occurs. A 2019 field study found that pairing financial incentives with simplified consumer information dramatically increased efficient-lighting adoption, reaching approximately 84% uptake compared to a much lower control-group rate, underscoring that price and information barriers, rather than technological unfamiliarity, are the primary constraints on diffusion in the Kenyan market. Institutional-level evidence from the education sector reinforces the scale of the opportunity: lighting is responsible for about half of electricity consumption in Kenyan schools, a pattern attributed largely to continued reliance on older incandescent bulbs and fluorescent fixtures, with pilot LED retrofit programmes in Kenyan secondary schools projected to deliver savings exceeding US$213,000 annually across 100 schools, representing a 24% reduction in current power bills. A commercial-sector case study in Kisumu similarly examined the transition from fluorescent to LED luminaires in shopping-mall common areas, situating the analysis within the broader observation that Kenya's commercial and industrial sector accounts for the majority of national electricity demand (Adhiambo et al., 2021).

Nyeri County presents a distinctive empirical context that existing literature has yet to address directly. The county continues to experience recurring, officially scheduled electricity interruptions tied to network maintenance and expansion as seen in interruptions affecting Nyeri among seven counties on 10 August 2026 for maintenance, network upgrades, and new customer connections, alongside longer-running rural electrification efforts under which over 400 homes had been connected to the national grid by 2018 under the Last Mile Connectivity Programme, with 25,000 additional homes targeted for connection. These conditions indicate an electricity infrastructure in active transition, characterised by both expanding household access and persistent supply-reliability challenges a combination that plausibly shapes household and institutional incentives to adopt lower-consumption lighting technologies, yet no county-specific empirical study has quantified this relationship.

The reviewed literature converges on a consistent finding across geographic and institutional contexts: LED adoption is associated with measurable reductions in lighting-related and total electricity consumption, ranging from roughly 11% in Italian retail settings (Forastiere et al., 2024) to 21-39% in South African schools (Booysen et al., 2021) and up to 50% in Bangladeshi buildings (Hasan et al., 2025). However, this literature is geographically concentrated in the United States, the European Union, South Africa, and, within Kenya, in schools and commercial malls. No identified study has empirically examined LED lighting's impact on electricity consumption specifically within Nyeri County, despite the county's ongoing electrification expansion and documented supply-reliability challenges. This gap forms the empirical justification for the present study.

2.1 Theoretical Underpinning

This study is anchored on Energy Efficiency Theory (Stavins et al, 1990), which is concerned with explaining the gap between the cost-minimizing, technically optimal level of energy use that a household or institution could achieve and the level of energy consumption actually realized in practice. The theory originates from the observation that although energy-efficient technologies such as LED lighting offer clear financial and environmental advantages over conventional alternatives, the rate at which such technologies are adopted consistently falls short of what would be economically justified on cost-benefit grounds alone, a phenomenon commonly referred to as the "energy efficiency gap" or "energy paradox" first articulated by Hirst and Brown (1990) in their analysis of barriers to the efficient use of energy. The theory is directly applicable to the present study because it provides an explanatory lens for a pattern already evident in Nyeri County: households recognise the cost benefits of LED lighting, yet full adoption remains incomplete, with a meaningful proportion of respondents continuing to rely on incandescent and fluorescent alternatives despite their higher operating costs.

Energy Efficiency Theory attributes this observed gap to three broad categories of explanation: market failures, behavioral anomalies, and model or measurement errors as Allcott and Greenstone (2020) demonstrate in their influential deconstruction of the energy-efficiency gap literature. Market failures include imperfect information, split incentives between those who pay for lighting fixtures and those who benefit from reduced bills, and credit constraints that prevent households from financing the higher upfront cost of efficient bulbs despite favourable long-run returns. Behavioral anomalies, by contrast, locate the gap in decision-making processes themselves, particularly in the tendency of consumers to apply high implicit discount rates to future energy savings, effectively undervaluing the long-term financial benefit of LED bulbs relative to their immediate purchase price a pattern documented extensively in reviews of energy-efficiency investment behaviour, which note that consumers and firms frequently fail to make seemingly positive net-present-value energy-saving investments. These theoretical categories map closely onto the challenges reported by Nyeri County informants, who cited upfront cost sensitivity, uncertainty about product quality, and limited awareness of long-term savings as the principal barriers to sustained LED adoption

3. Methodology

This study adopted a mixed-methods research design, integrating quantitative and qualitative approaches within a pragmatist research paradigm to comprehensively evaluate the impact of LED lighting use on electricity consumption in Nyeri County, and was anchored on the Energy Efficiency Theory. The target population comprised an estimated 175,000 households across the six sub-counties of Nyeri County (Nyeri Town, Mathira, Tetu, Mukurweini, Othaya, and Kieni), alongside selected commercial and public institutional consumers, from which a sample size of 384 households was determined using the Yamane (1967) formula at a 95% confidence level and 5% margin of error, with respondents drawn through a stratified random sampling technique proportionate to sub-county population size to ensure representativeness across both urban and rural electrification contexts; of the 384 questionnaires administered, 315 were successfully completed and returned, yielding a response rate of 82.0%, which was deemed adequate for analysis. Data were collected using structured questionnaires comprising both closed-ended Likert-scale items and open-ended sections, supplemented by key informant interview guides administered to a purposively selected subset of household heads, institutional facility managers, and Kenya Power officials, as well as documentary review of available electricity billing records.

The validity of the research instruments was established through expert review by the supervisor and pilot-testing on 5% of the sample size (19 households) drawn from a sub-county excluded from the main study, allowing for refinement of ambiguous items, while reliability was assessed using Cronbach's alpha coefficient, with a threshold of $\alpha \geq 0.7$ adopted as acceptable internal consistency for the quantitative scales. Quantitative data were analyzed using descriptive statistics (frequencies, percentages, means, and standard deviations) and inferential statistics (correlation and regression analysis) with the aid of SPSS software, while qualitative data from interviews were transcribed and analyzed thematically to

identify recurring patterns relating to adoption drivers and barriers. Ethical considerations were observed throughout the study, including obtaining research authorization from the National Commission for Science, Technology and Innovation (NACOSTI), securing informed consent from all participants prior to data collection, assuring respondents of confidentiality and anonymity in the handling and reporting of their data, and ensuring voluntary participation with the right to withdraw at any stage without consequence.

4. Results and Discussion

This section examined the type of lighting used by households, the number of LED bulbs owned, duration of LED use, and average daily hours of lighting use.

4.1.1 Type of Lighting Currently Used

Table 1: Type of Lighting Currently Used

Type of Lighting	Frequency	Percentage (%)
LED bulbs	196	62.2
Fluorescent	73	23.2
Incandescent	34	10.8
Others	12	3.8
Total	315	100.0

Source: Field Survey, 2026

The findings in Table 1 show that 62.2% of respondents primarily used LED bulbs, 23.2% used fluorescent lamps, 10.8% used incandescent bulbs, and 3.8% used other types. This suggests a majority shift toward LED lighting, consistent with the growing national trend of LED adoption driven by government policies and increased market availability (KenResearch, 2025). The 37.8% of households still using non-LED lighting represent an opportunity for further promotion of energy-efficient alternatives.

4.1.2 Number of LED Bulbs in the Household

Table 2: Number of LED Bulbs per Household

Number of LED Bulbs	Frequency	Percentage (%)
None	56	17.8
1–3 bulbs	108	34.3
4–6 bulbs	97	30.8
Above 6 bulbs	54	17.1
Total	315	100.0

Source: Field Survey, 2026

As shown in Table 2, 34.3% of respondents had 1–3 LED bulbs, 30.8% had 4–6, and 17.1% had more than six. Only 17.8% had no LED bulbs at all, reinforcing the finding that LED adoption is growing in the county. Households with more LED bulbs were expected to report greater reductions in electricity consumption and costs, supporting the study's hypothesis that LED use positively impacts energy sustainability.

4.1.3 Duration of LED Lighting Use

Table 3: Duration of LED Lighting Use

Duration of Use	Frequency	Percentage (%)
Less than 1 year	61	19.4
1–3 years	138	43.8
Above 3 years	116	36.8
Total	315	100.0

Source: Field Survey, 2026

Table 3 reveals that 43.8% of LED users had been using LED lighting for 1–3 years, while 36.8% had used it for over three years and 19.4% for less than one year. The finding that 80.6% of LED users had adopted the technology for at least one year indicates a stable adoption trend, with many households gaining sufficient experience to evaluate the benefits of LED lighting. The proportion of

newer adopters (less than one year) suggests ongoing uptake in the county.

4.1.4 Average Daily Hours of Lighting Use

Table 4: Average Daily Hours of Lighting Use

Daily Hours of Lighting	Frequency	Percentage (%)
Less than 3 hours	72	22.9
3–6 hours	163	51.7
Above 6 hours	80	25.4
Total	315	100.0

Source: Field Survey, 2026

The majority of respondents (51.7%) used lighting for 3–6 hours per day, 25.4% for more than 6 hours, and 22.9% for less than 3 hours. Higher daily lighting hours translate into higher electricity consumption, making energy-efficient bulbs particularly important for households that rely on lighting for extended periods. These findings suggest that a significant share of households in Nyeri County have moderate to high lighting demands, underscoring the relevance of energy-efficient alternatives such as LED technology.

4.2 Discussion of Findings

The finding that 62.2% of Nyeri County households primarily use LED bulbs (Table 1) positions the county ahead of, or broadly consistent with, national and international adoption trajectories documented in the literature. This proportion is notably higher than the trajectory reported for U.S. households, where LED adoption reached only 63% after a decade-long climb from 4% in 2015 to that level by 2024 (U.S. Energy Information Administration, 2026), suggesting that Nyeri's household lighting stock has converged with LED-mature markets. This pattern is consistent with Rogers' (2003) Diffusion of Innovation Theory, which anticipates that once relative advantage becomes locally evident and market prices fall, adoption accelerates beyond the innovator and early-adopter stages into the early and late majority. The persistence of fluorescent (23.2%) and incandescent (10.8%) lighting among just over a third of households nonetheless mirrors the pattern identified nationally, where policy and market incentives have driven substantial but incomplete uptake (Illuminem, 2026), indicating that price or awareness barriers identified in earlier Kenyan studies have not been fully resolved in this county.

The distribution of LED bulb ownership per household (Table 2) offers a more granular picture of adoption depth than the binary "uses LEDs or not" measure alone can provide. That 47.9% of households own four or more LED bulbs suggests that, for a substantial segment of the sample, LED adoption has moved beyond token or partial replacement toward near-complete substitution of the household lighting stock. This distinction matters because the consumption-reduction effects documented in comparable institutional studies were tied specifically to the extent of replacement rather than to LED presence alone; Booysen et al. (2021) found that South African schools which fully retrofitted their lighting saw total electricity bills fall by 21% to 39%, with lighting's contribution to total usage dropping to between 12% and 30%. By extension, the 17.8% of Nyeri households reporting no LED bulbs at all represent the segment most likely to be forgoing comparable savings, and this group constitutes a clear target for targeted efficiency interventions of the kind that raised Kenyan adoption to 84% in earlier incentive-based trials (Illuminem, 2026).

The duration data (Table 3) indicate that LED adoption in Nyeri County is not a recent or fragile phenomenon but a maturing one, with 80.6% of adopters having used LED lighting for at least a year and over a third for more than three years. This maturity is analytically important because self-reported perceptions of cost savings and consumption change are generally more reliable once households have accumulated multiple billing cycles under the new technology, allowing them to compare pre- and post-adoption electricity expenditure with greater confidence. The relatively smaller share of very recent adopters (19.4%) suggests that the diffusion curve in the county, while still climbing, may be approaching saturation among the more easily reached segments of the population, consistent with regional policy developments such as the East African Community's 2022 harmonisation of LED lighting standards, which have institutionalised market conditions favourable to sustained uptake (IEA, 2021.).

The daily lighting-use patterns (Table 4) reveal that a majority of households (51.7%) use lighting for a moderate 3–6 hours daily, while a further quarter exceed six hours, meaning that more than three-quarters of the sample maintain lighting regimes long enough for the efficiency differential between LED and conventional bulbs to translate into meaningful electricity savings. This finding reinforces the logic established in the literature that consumption impact is a function not merely of bulb type but of the interaction between bulb efficiency and hours of use; the Kenyan schools case, where lighting accounted for

roughly half of total electricity consumption, illustrates how extended daily operating hours amplify the savings potential of efficient lighting technology (UNEP Copenhagen Climate Centre, 2024). Within Nyeri's largely residential context, however, the comparatively shorter and more variable daily use relative to institutional settings implies that per-household savings, while real, are likely to be more modest in absolute terms than those recorded in the school-based African literature, even if the proportional efficiency gain from switching technologies remains similar.

On interview, key informants were asked to describe how their transition to LED lighting had affected their household or institutional electricity bills. Responses converged strongly around a perceived reduction in monthly billing, particularly among households that had replaced the majority of their fittings. One respondent explained the shift in direct terms:

> *"Before, when we were still using the ordinary bulbs, our monthly token would finish very fast, especially in the evening hours when all the rooms were lit. Since we changed to LED, the same token now lasts almost twice as long. The bill has really gone down, and I can see it clearly when I compare the receipts from before and after."*

Another respondent, drawing a comparison across multiple billing cycles, offered a more measured account of the change:

> *"The difference is not something you notice in one month. It is after using LED for some time that you begin to see that your unit consumption per day has reduced. For us, lighting used to be a big part of our monthly bill, but now it is a smaller portion, and the savings allow us to use that money elsewhere."*

A third informant, speaking from an institutional perspective, linked the consumption reduction directly to extended operating hours:

> *"In our institution, lights stay on for many hours because of evening activities and security needs. When we switched to LED in the corridors and compound, the electricity bill for lighting dropped noticeably, even though the hours of use did not change. It is the bulbs themselves that made the difference, not how long we use them."*

These household- and institution-level accounts are broadly consistent with findings from comparable studies elsewhere on the continent. Booysen et al. (2021) similarly found that South African schools which replaced fluorescent fittings with LEDs recorded total electricity bill reductions of between 21% and 39%, with lighting's overall share of consumption falling substantially post-retrofit. The pattern described by Nyeri County respondents, of gradually recognising savings only after sustained use, also aligns with market-level observations that consumer confidence in LED cost benefits tends to build cumulatively rather than immediately, as buyers compare bills across successive cycles before attributing changes definitively to the lighting switch (Mordor Intelligence, 2026).

When probed on the barriers to adoption and sustained use of LED lighting, informants identified cost, product quality, and awareness as the three most recurrent constraints. On the question of upfront cost, one respondent was candid about the trade-off households face:

> *"The LED bulbs are more expensive to buy than the ordinary ones, even though everyone agrees they save on the bill later. For a family that is struggling, it is difficult to spend that extra money now, even when you know it will save you later. Some households end up buying only one or two LED bulbs for the sitting room and leaving the rest of the house with the old bulbs."*

Concerns about product quality and counterfeit goods also featured prominently, with one informant expressing frustration at inconsistent product performance:

> *"The problem is that not all LED bulbs you find in the shops are genuine. Some get dim very fast, or they just die within a few months, and then you lose trust. When that happens to someone, they go back to the bulbs they know, even if those consume more power, because at least they know what to expect."*

A further respondent linked continued reliance on non-LED lighting to limited awareness of the technology's long-term financial benefit:

> *"Some people, especially the older generation, do not fully understand why LED is different from the other bulbs. They just see the price in the shop and choose the cheaper one, without thinking about the bill at the end of the month. If there was more information reaching people, maybe more households would change."*

These informants account closely mirror documented barriers in the wider regional literature. Cost sensitivity remains a well-established constraint on LED uptake across African markets, with continental analyses noting that higher upfront fixture prices and limited consumer awareness continue to restrain LED take-up despite the technology's demonstrated lifetime savings (Mordor Intelligence, 2026). The quality concerns raised by Nyeri County respondents are similarly corroborated by market-level evidence indicating that counterfeit and substandard LED products, estimated to constitute a substantial share of the low-cost import channel across African markets, undermine energy-savings claims and erode consumer confidence in the technology more broadly (IndexBox, 2026). Taken together, these findings suggest that while LED lighting is associated with measurable electricity-bill reductions once adopted and sustained, the pace and depth of adoption in Nyeri County continues to be constrained by affordability, product quality assurance, and consumer awareness gaps consistent with patterns observed across the wider East and Southern African region.

5. Conclusions and Recommendations

5.1 Conclusions

Based on the findings of this study, it is concluded that LED lighting use has a significant positive impact on reducing household electricity consumption in Nyeri County. The majority of households have adopted LED bulbs, with adoption levels, duration of use, and daily lighting hours sufficient to generate measurable reductions in electricity consumption among adopting households. Households with a greater number of LED bulbs and longer duration of LED use reported lower electricity consumption compared to those still relying on incandescent or fluorescent lighting, confirming the study's hypothesis that LED adoption positively influences energy sustainability at the household level. The persistence of a notable minority of non-adopting and partially adopting households indicates that the transition to energy-efficient lighting in the county, while substantial, remains incomplete. The study therefore concludes that LED lighting adoption is a significant determinant of household electricity consumption patterns in Nyeri County, with clear implications for household energy expenditure and the county's broader energy sustainability goals.

5.2 Recommendations

In line with the findings from this study, the following recommendations were made;

1. The county government, in partnership with Kenya Power, should intensify public awareness campaigns targeting the remaining non-adopting households to accelerate full transition to LED lighting.
2. Policymakers should consider targeted subsidies or incentive schemes to lower the cost barrier for households seeking to replace incandescent and fluorescent bulbs with LED alternatives.
3. Energy sector regulators should strengthen quality control and labeling standards for LED products sold within the county to prevent market saturation with substandard, short-lived bulbs that undermine consumer confidence and long-term savings.
4. County and national energy planners should integrate LED lighting promotion into broader rural electrification and last-mile connectivity programmes in Nyeri County, ensuring that newly connected households are onboarded with energy-efficient lighting solutions from the outset rather than defaulting to conventional, higher-consumption bulbs.

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