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Performance Indicators for Power Projects in Kenya

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ABSTRACT

Renewable energy development has been underexploited in Kenya due to investor's negative perception of the projects' high investment risk. The purpose of the study was to establish the extent to which performance indicators of hydroelectric energy projects are achieved in Kenya. The study adopted pragmatism paradigm, mixed method approach and descriptive survey design. Structured questionnaires and interview guide were used to collect quantitative and qualitative data from a census of 94 participants. Validity test of 0.775 and a reliability coefficient of 0.781 were obtained after pretesting of the instruments amongst 10% of the participants. Descriptive statistic of means and standard deviation was applied and thematic content analysis of qualitative data done for triangulation. The composite mean and composite deviation for the performance indicators results were 4.23 and 0.281 respectively; implying that participants agreed that Performance indicators of Hydroelectric Energy projects were achieved. The findings of this study thus provide insight on how the different indicators under consideration contributed to performance of hydroelectric energy projects. The study thus concludes that the hydroelectric power projects performed since there was efficiency and increased capacity in power production, power supply was of quality, clients were satisfied, the project had positive environmental impact and revenue generation was adequate to sustain the projects while project implementation cost and time, access to power supply, power affordability were just slightly above average. Further research should be done on the factors influencing performance of hydroelectric energy projects to ensure optimal performance.

Keywords: Performance Indicators, hydroelectric energy projects

INTRODUCTION

Hydroelectric energy is a vital economic development tool due to its negligible greenhouse gas emission, low cost of production, adjustability to meet consumer demands, economic performance in terms of revenue flow, low maintenance cost, and positive environmental impact (Luis *et. al.*, 2013). Hydroelectric power constitutes 17.5% of global electricity, with Norway having 99%, Canada 57%, Switzerland 55%, Sweden 40% and USA 7% (Luis, Sidek, Desaand, and Julien, 2013). In 1990, European governments had set an objective of an 80% greenhouse gas emissions reduction levels by 2050 (Rezec and Scholtens, 2017) and this is demonstrated by the increased consumption proportion of renewable energy at 15% in 2013 from 8% in 2005, and is further expected to rise to 20% in 2020, while by end of 21st century the European Union members expect full dependence on renewable energy (European Environment Agency, 2016). China being the world's largest energy consumer, accounting for 20% with an expected increase of 60% by 2030 has

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embarked on policies regarding energy conservation, utilization efficiency and reduction in emission (Akan *et al.*, 2015); and this has enabled it to be a global lead frontier in renewable energy capacity installation accounting for more than the rest of the Asia Pacific region and all of Europe in 2013 alone (Masato, Candice and Jaewon, 2016). In contrary, India has shown laxity in harnessing renewable energy despite its high potential of 249,188 MW, as figures show that as of 2014 a paltry 12.95% of the renewable energy potential had been harnessed (Akan *et al.*, 2015).

In spite of Africa's endowment with substantial renewable energy resources, most of it is under-exploited, for instance, only approximately 7% of the massive hydro potential has been harnessed (Frisari, Hervè-Mignucci, Micale, and Mazza, 2013). Expanding economic demand has necessitated investment in power infrastructure in Sub-Saharan Africa and this if well implemented, can increase the estimated average regional GDP from the current 4% to more than 10% (Rosnes and Vennemo, 2009). In Kenya, Hydroelectric energy constitutes 45% of total power production (Ministry of Energy, 2015c). Even though the peak load projection is about 15,000 MW by 2030 and the energy sector is expected to gradually increase their installation capacity to 19,200 MW by 2030 to cater for the increased energy demand, the actual implementation of the plan is slow as a paltry 2,150MW of energy had been installed by 2014 (Ministry of Energy, 2015). Specifically, the inability of the government to exploit the 9 mapped potential hydropower projects and the estimated more than 7,000MW of geothermal is an indication of the challenge the sector is facing as only less than 1000MW has been fed on grid (Gitone, 2014). Further, this capacity growth projection has been hindered by the existing barriers to renewable energy development in Kenya including: huge sunk capital cost, insufficient data on renewable energy reservoirs, long connection distances from existing grids, constraints in financial closure and credit mechanism, technical challenges and high resource risk (Gitone, 2014). However, the government has proposed several mitigates including provision of incentives to spur private sector investments, installation of wind masts and data loggers, FiT Policy guarantees priority purchase, collaborations with multilateral partners for provision of guarantees and human resource development (Ministry of Energy, 2015a).

The purpose of the study was to establish the extent to which performance indicators of hydroelectric energy projects are achieved in Kenya. This study defines performance of hydroelectric energy projects as the success in meeting predefined measurable standard objective indicators of quality electricity supply, project cost reduction, increased generation capacity, affordable electricity supply, adherence to implementation time schedule, operational efficiency, customer satisfaction, positive environmental effect and increased profitability. The study aimed at contributing valuable knowledge on the achievement of performance indicators of hydroelectric energy projects and to suggest appropriate policies for strengthening their implementation to boost investors' confidence. The study also provides a reference to other researchers and policy developers on information concerning optimal performance of hydroelectric energy projects. The study was organized into introduction, literature review, findings and discussion, and conclusion.

LITERATURE REVIEW

Performance of Hydro-Power Projects

An assumption that a successful project is only architect on achieving time schedule, cost budget and quality production "iron triangle", is far from the truth as there are other significant measures such as user satisfaction, safety conditions and efficiency factors that needs further scrutiny (Sibiya, Aigbavboa and Thwala, 2015). The precision of performance indicators of a project is necessary to limit chances of ambiguity while achieving the project objectives (Ofori-Kuragu, Baiden and Badu, 2016). A study by Pramangioulis *et al.,* (2019) in Europe through desk review identified performance indicators for hydroelectric plant as technical performance, friendly environmental effect, economic performance, cost-effectiveness, efficient operation and electricity supply, quality of supply, social performance, user-friendly

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and legislative performance while Elbatran *et al.*, (2015) in their desk review study of hydropower technologies and turbines found that performance of hydro power systems are measured in terms of increased electricity generation capacity, efficiency of hydroelectric facilities, environmental safety, reduced cost of capital, increased households connection, reduced failure rates and low operation and maintenance cost.

An empirical study in the construction Industry by Sibiya, Aigbavboa and Thwala (2015) explored the significant KPI in South Africa's construction projects through quantitative survey design and data collected using Likert scale questionnaire while analysis was descriptive involving measures of standard-deviation and mean to rank the KPIs. Findings revealed that construction time, profitability, competitive procurement, risk management, quality assurance, safety, client satisfaction, productivity, project management and time predictability are the most significant KPIs in a construction project.

Another study by Ofori-Kuragu, Baiden and Badu (2016) to establish the common KPIs for Ghanaian contractors adopted pragmatism philosophy to conduct a mixed method survey and collecting data through questionnaire and expert interview from a census of 139 contractors while analysis was done through descriptive technique of percentage ranking. The study observed that a set of nine (9) KPIs are being applied by Ghanaian contractors including cost, quality, time, client satisfaction, safety, profitability, productivity, social friendliness, which were not only precise but equally measurable for successful project implementation.

In Machakos County, Kenya, Waweru and Rambo (2017) investigated determinants of effective hydroelectric power production in Kindaruma Power Station project through descriptive survey design with questionnaire and interview schedule to collect data from a census of 36 respondents while analysis involved descriptive and inferential statistics. Findings revealed that performance of hydroelectric projects was achieved in terms of profitability, increased power supply, improved customer satisfaction and increased household connectivity. Thus, the study provides an impetus to the current study. However, the sample size was small but current study intends to use 94 respondents to improve results generalizability.

Despite previous studies precision and convergence in the measurement of performance in hydroelectric power projects in terms of quality electricity supply, project cost reduction, increased generation capacity, adherence to implementation time schedule, operational efficiency, customer satisfaction, environmental safety and increased profitability (Pramangioulis et al., 2019; Waweru and Rambo, 2017; and Elbatran et al., 2015), none of the studies involved a census of both the public and Independent hydroelectric Power producer projects, a gap to be filled by the current study through descriptive survey design and descriptive statistical analysis.

METHODOLOGY

The study adopted pragmatism paradigm, descriptive survey design and mixed method approach for collection of both qualitative and quantitative data for results triangulation (Wambugu, Kyalo, Mbii, and Nyonje, 2015). A census of 94 participants consisting of 84 respondents and 10 Key Informants were involved in the study while data was collected using Questionnaire and interview guide. The data collection instruments were pre-tested amongst 10% of unselected participants and a validity coefficient of 0.775 and reliability coefficient of 0.781 obtained. Descriptive statistics of mean and standard deviation was done while thematic content analysis was used for qualitative data.

FINDINGS AND DISCUSSION

The study realized a 100% questionnaire return rate. The study sought to establish the performance

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indicators of hydroelectric energy projects in Kenya. Data was collected to measure ten indicators of Performance of Hydroelectric Energy Projects. To measure Performance of Hydroelectric Energy Projects ten statements were developed in the self-administered questionnaires. The views of the 84 research participants on Performance of Hydroelectric Energy Projects are presented in statements in the subsequent section. The respondents were asked to state their level of agreements or disagreements to the Items in the Likert scale of 1-5 where Strongly Agree(SA)=5, Agree(A)=4, Neutral(N)=3, Disagree(D)=2 and Strongly Disagree (SD)=1. The results are shown in Table 4.6

Table 4.6: Performance of Hydroelectric Energy Projects

STATEMENTS	**SA**	**A**	**N**	**D**	**SD**	**Mean**	**Std. dev**
1. The Project implementation is within scheduled time	4(4.8%)	52(61.9%)	23(27.3%)	5(6.0%)	0(0.0%)	3.65	0.668
2. The Project cost of capital is reduced	14(16.7%)	50(59.5%)	19(22.6%)	1(1.2%)	0(0.0%)	3.92	0.662
3. The Project meets required quality standards in supply of electricity	64(76.2%)	19(22.6%)	1(1.2%)	0(0.0%)	0(0.0%)	4.75	0.462
4. The Project clients are satisfied with the project outcomes	26(31%)	58(69%)	0(0.0%)	0(0.0%)	0(0.0%)	4.31	0.465
5. The Project operates efficiently as required	42(50%)	39(46.4%)	3(3.6%)	0(0.0%)	0(0.0%)	4.46	0.569
6. The access to power supply is easy	5(6%)	31(36.9%)	48(57.1%)	0(0.0%)	0(0.0%)	3.49	0.611
7. The project has positive environmental impact	77(91.7%)	7(8.3%)	0(0.0%)	0(0.0%)	0(0.0%)	4.92	0.278
8. The energy production capacity has increased	27(32.1%)	57(67.9%)	0(0.0%)	0(0.0%)	0(0.0%)	4.32	0.470
9. The produced electricity is affordable	8(9.5%)	40(47.6%)	35(41.7%)	1(1.2%)	0(0.0%)	3.65	0.668
10. The project generates adequate revenue	69(82.1%)	13(15.5%)	2(2.4%)	0(0.0%)	0(0.0%)	4.80	0.460
Composite mean and Composite standard deviation						**4.23**	**0.281**

Ten statements were developed to measure the extent of performance of hydroelectric energy projects. Statement (1) that 'the project implementation was within time schedule' had a mean of 3.65 and 0.668 standard deviation. This result indicate that from 84 respondents, 52(61.9%) agreed that project implementation was within time schedule, 4(4.8%) strongly agreed that project implementation was within time schedule, 23(27.3%) were neutral that project implementation was within time schedule, and 5(6%) disagreed that project implementation was within time schedule. This results indicate that the line statement mean score of 3.65 which was below composite mean score of 4.23; the results implies that project implementation was not within time schedule and hence may negatively affect the performance of hydroelectric energy projects. The higher line item standard deviation of 0.668 than composite standard deviation of 0.281 indicates divergence of opinions. The study results supports findings by Pramangioulis *et al.*, (2019) who observed that delays in the implementation and operations and maintenance of power

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projects has a negative influence on their performance.

Statement (2) that 'the project cost of capital is reduced' had a mean of 3.92 and 0.662 standard deviation. This finding indicate that from 84 respondents, 50(59.5%) agreed that project cost of capital was reduced, 14(16.7%) strongly agreed that project cost of capital was reduced, 19(22.6%) were neutral that project cost of capital was reduced, and 1(1.2%) disagreed that project cost of capital is reduced. This result indicates that the line statement mean score of 3.92 was below composite mean score of 4.23; this result implies that the project cost of capital was not reduced and hence may negatively affect the performance of hydroelectric energy projects. The higher line item standard deviation of 0.662 than composite standard deviation of 0.281 indicates divergence of opinions. The study results supports findings by Ofori-Kuragu, Baiden and Badu (2016) who observed that cost-overruns in the implementation and operations of power projects have a negative influence on their performance.

Statement (3) that 'the project meets required quality standards in supply of electricity' had a mean of 4.75 and 0.462 standard deviation. This finding indicate that from 84 respondents, 64(76.2%) strongly agreed that projects' electricity supply met quality standards, 19(22.6%) agreed that projects' electricity supply met quality standards and 1(1.2%) were neutral that the projects' electricity supply met quality standards. This result indicate that the line item mean score of 4.75 was above composite mean score of 4.23; this results implies that the projects met required quality standards in supply of electricity which would positively influence performance of hydroelectric energy projects. The higher line item standard deviation of 0.462 than composite standard deviation of 0.281 indicates divergence of opinions. The study results supports findings by Waweru and Rambo (2017) who observed that quality achievement in the implementation of power projects has a positive effect on their performance.

Statement (4) that 'project outcomes satisfied clients' had a mean of 4.31 and 0.465 standard deviation. This results indicate that from 84 respondents 58(69%) agreed that project clients were satisfied with the project outcome, 26(31%) strongly agreed that project clients are satisfied with the project outcome. This result indicates that the line statement mean score of 4.31 was above composite mean score of 4.23; this result implies that the project outcomes satisfied clients and hence positively affect the performance of hydroelectric energy projects. However, higher line item standard deviation of 0.465 than composite standard deviation of 0.281 indicates divergence of opinions. The study results supports findings by Sibiya, Aigbavboa and Thwala (2015) who observed that client satisfaction is positively correlated to the performance of power projects.

Statement (5) that 'the project operates efficiently as required' had a mean of 4.46 and 0.569 standard deviation. This result show that from 84 respondents, 42(50%) strongly agreed that project operates efficiently as required, 39(46.4%) agreed that project operates efficiently as required and 3(3.6%) were neutral that project operates efficiently as required. This result indicate that the line statement mean score of 4.46 was above composite mean score of 4.23; this results implies that the projects operated efficiently as required and hence positively influence the performance of hydroelectric energy projects. The higher line item standard deviation of 0.569 than composite standard deviation of 0.281 indicates divergence of opinions. The study finding supports findings by Elbatran *et al.,* (2015) who observed that efficiency in power plants operation positively influences the performance of the power projects.

Statement (6) that 'the access to power supply is easy' had a mean of 3.49 and 0.611 standard deviation. This finding indicate that from 84 respondents, 48(57.1%) were neutral that the access to power supply was easy, 31(36.9%) agreed that the access to power supply was easy and 5(6%) strongly agreed that the access to power supply was easy. This results shows that the line item mean score of 3.49 was below composite mean score of 4.23; this results implies that the access to power supply is not easy and hence may negatively influence the performance of hydroelectric energy projects. The higher line item standard deviation of 0.611 than composite standard deviation of 0.281 indicates that there is a strong divergence of opinion by the

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respondents. The study finding supports findings by Hansen, Pedersen, and Nygaard (2015) who observed that difficulty in access to power supply by intended customers negatively influence performance of power projects.

Statement (7) that 'the project has a positive environmental impact' had a mean of 4.92 and a 0.278 standard deviation. This finding shows that from 84 respondents, 77(91.7%) strongly agreed that the project has a positive environmental impact, 7(8.3%) agreed that the project has a positive environmental impact. This result indicates that the line statement mean score of 4.92 was above composite mean score of 4.23; this result implies that the projects had a positive environmental impact and hence positively influencing performance of hydroelectric energy projects. The lower line item standard deviation of 0.278 than composite standard deviation of 0.281 indicates that there is convergence in opinion among the respondents. The study finding supports findings by Rezec and Scholtens (2017) who observed that renewable energy projects have a positive environmental effect hence better performance.

Statement (8) that 'the project energy production capacity has increased' had a mean of 4.32 and 0.470 standard deviation. This finding shows that from 84 respondents, 57(67.9%) agreed that project energy production capacity has increased, 27(32.1%) strongly agreed that the project energy production capacity has increased. This result indicates that the line item mean score of 4.32 was above composite mean score of 4.23; this result implies that the project energy production capacity has increased and hence positively influences performance of hydroelectric energy projects. The higher line item standard deviation of 0.470 than composite standard deviation of 0.281 indicates that there is a divergence of opinion by the respondents. The study finding supports findings by Gitone (2014) who observed that an increase in renewable energy capacity production significantly improves performance of power projects.

Statement (9) that 'the produced electricity is affordable' had a mean of 3.65 and 0.668 standard deviation. This finding show that from 84 respondents, 40(47.6%) agreed that the produced electricity was affordable, 35(41.7%) were neutral that the produced electricity was affordable, 8(9.5%) strongly agreed that the produced electricity is affordable and 1(1.2%) disagreed that the produced electricity was affordable. This results show that the line statement mean score of 3.65 was below composite means score of 4.23; this result implies that the produced electricity is not affordable and hence may negatively influence performance of hydroelectric energy projects. The higher line item standard deviation of 0.668 than composite standard deviation of 0.281 indicates that there is a strong divergence opinion among respondents. The study finding supports findings by Gitone (2014) who observed that the cost of electricity is still high for the customers and thus affects performance of renewable power projects.

Statement (10) that 'the project generates adequate revenue had a mean of 4.80 and 0.460 standard deviation. This finding indicate that from 84 respondents, 69(82.1%) strongly agreed that the project generates adequate revenue, 13(15.5%) agreed that the project generates adequate revenue and 2(2.4%) were neutral that the project generates adequate revenue. This results shows that the line item mean score of 4.80 was above composite mean score of 4.23; this results implies that the project generates adequate revenue and hence positively influnce performance of hydroelectric energy projects. The higher line item standard deviation of 0.460 than composite standard deviation of 0.281 indicates that there is a divergence opinion among respondents. The study finding supports findings by Frisari and Micale (2015) who observed that renewable energy projects have the ability to generate adequate revenue for their operations and profit hence positively affecting their performance. The overall composite score of all indicators of Performance of Hydroelectric Energy Projects had a mean of 4.23 and 0.281 standard deviation. This finding shows that out of 84 participants, 71(84.5%) of participants at least agreed that there is performance of hydroelectric energy projects; this findings are similar to findings by Pragmangiouis *et al.,* (2019) who observed that steady revenue inflows from electricity sales ensures performance of Hydroelectric Energy Projects.

These findings were further supported by qualitative data derived from Key informant interview regarding

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performance of Hydroelectric Energy Projects. This observation was explicitly captured by KenGen participant who, upon being asked about the performance of hydroelectric energy projects, responded:

"…our good performance can be shown by the confidence the public and investors have in us when we successfully issued the Largest Public Infrastructure Bond in Kenya of over Kshs.26 billion in 2016 through the NSE to fund mega energy projects. The good performance is attributed to a committed skilled workforce for delivery of cost effective operation and maintenance of existing and new power projects." As an intervention, *"…the 10 year Good-to-Great (G2G) transformative strategic plan launched in 2007 for capacity expansion and sustainable power supply has met 83% delivery success out of 721MW targeted by 2020 in conformity with Least Cost Power Development Plan (LCPDP) and Vision 2030 for access to affordable, quality, reliable, adequate, safe, and competitive electricity."* (KII No. 1, KenGen).

This was supported by Ministry of Energy (MoE) respondent who asserted that:

"…implementation of institutional reforms such as legal, regulatory and institutional framework in the energy sector on Least Cost Power Development Plan (LCPDP) for electricity generation, transmission and distribution to drive entire economic growth and Vision 2030 flagship projects is facilitated effectively by offering quality, cost effective, competitive and affordable energy services. In spite of these reforms, the energy sector still faces challenges including huge capital input and long leads times from feasibility to infrastructure implementation, constraint in mobilization of funds for mega-power development, high energy cost, low income per capita and under-industrialization." However as an intervention, *"…the 2004 Energy Policy Session Paper Number 4, the 2006 Energy Act, Number 12 and FiT Policy 2008 for renewable energy sub-sector seek to increase private sector investment and address these challenges to ensure affordable and reliable supply of energy."* (KII No. 2, MoE).

Further, the KenGen participant said that:

"…the earning of Certified Emission Reduction (CERs) or carbon asset funds under Clean Development Mechanism (CDM) portfolio projects like the 24 MW Kiambere Project from United Nations Framework Convention on Climate Change (UNFCCC) was a boost to renewable energy projects. The current portfolio of registered CDM projects by KenGen can contribute up to 1,500,000 tons of Carbon Dioxide (CO2) emission reduction every year. Equally, *"…to deliver on climate change and sustainability, KenGen is establishing a full-fledge CDM and finance center."* (KII No. 1, KenGen).

Certified Emission Reductions are carbon credits from developing nations to enable developed nations limit their emission targets in accordance with Kyoto Protocol for reduced global warming.

Concerning the efficiency of power production, the KenGen interviewee stated that:

"…there is enhanced generation capacity through increased power production, plant availability and reduced machine down time which has led to increased revenue generation and subsequent increase in shareholders' value." Specifically, *"…in 2019 performance monitoring and measurement of hydro's stations achieved high plant availability of 98% against a target of 82% due to proactive breakdown simulation maintenance philosophy which led to good financial returns."* Further, *"…to improve the availability of our power plants, we are upgrading the control and protection systems of the old power plants through implementation of SCADA Phase II to increase efficiency and reduce operational costs by enabling remote control and visibility of power plants at a central dispatch centre."* (KII No. 1, KenGen).

Though the production efficiency of the existing power projects was good, the capacity expansion of potential hydropower stations is wanting and this was supported by the Ministry of Energy Official who stated that:

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"…in spite Kenya having an estimated hydropower potential of about 6,000MW for large hydros (above 10MW) and over 3,000MW for small hydros, only 823.8 MW of large hydros and less than 25MW of small hydros has been exploited as at 2019." (KII No. 2, MoE).

To protect hydropower investments, the Ministry of Energy official said that:

"…to cushion generators, transmitters, distributors and consumers against the vulnerability of hydropower to variations in hydrology and climate, the National Government through Renewable Energy Resources Advisory Committee (RERAC) has developed strategies on Criteria for allocation and licensing of energy resource areas to investors, Management of water towers and catchment areas and development of multi-purpose dams for power generation." Further, *"…the National Government has integrated hydroelectric energy resources exploration under Rural Electrification and Renewable Energy Corporation."* Equally, *"…the Government explores local and international viable financing options, Public Private Partnerships and set up of Consolidated Energy Fund for infrastructure development."* (KII No. 2, MoE).

A General observation by the Ministry of Energy respondent was that:

"…the vulnerability of hydropower projects due to variations in hydrology and climate change results into high economic risk, specifically, small hydros subsector experience challenges including viability threat due to destruction of catchment areas, inadequate financial resources, insufficient hydrological data and inadequate technical personnel, lack of awareness on FiT among potential investors and unclear guidelines on PPA negotiations." (KII No. 2, MoE).

As an intervention and to attract investor, FiT tariffs have been reviewed downwards for the introduction of renewable energy auctions for competitive price bidding of power projects. This was reflected through a remark from the Ministry of Energy respondent that:

"…since the introduction of FiT policy a good number of investors have expressed interest in developing power projects including 104 small hydro's with a 579.71MW capacity." (KII No. 2, MoE).

To improve power transmission efficiency the respondent from KenGen said that:

"…we collaborate with KETRACO and other key stakeholders on the review of the National Land Act to provide a subsidiary legislation for partial and permanent way leave acquisition to facilitate the construction of transmission lines to ensure cost effective integration of new plants comprising of about 5,000km in the short term and 16,000km by 2031." (KII No. 1, KenGen).

Similarly, an interviewee from KETRACO observed that:

"…the Government has decommissioned the expensive Garissa and Lamu thermal power plants following successful completion of Kindaruma to Garissa and Mombasa to Lamu transmission lines which have reduced the cost of electricity production though challenges of unjustified land compensation for way leave delayed the project's completion schedule." (KII No. 3, KETRACO).

On profitability an interviewee from KenGen observed that:

"…due to improved revenues and optimization of expenses, the operating profit grew by 43% from Kshs.11.342 billion to Kshs.16.271 billion in the year 2018/2019." (KII No. 1, KenGen).

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On risk management KenGen Interviewee eluded that:

"…risk management practices are robust with a designated Audit and Risk Management Committee of the Board that develops a comprehensive Enterprise Risk Management (ERM) policy including a Strategic Corporate Risk Matrix to monitor effectiveness of internal control systems in assessing and mitigating risk exposures in line with ISO 31000 for effective internal financial management." (KII No. 1, KenGen).

For environmental safety and quality electricity supply KenGen respondent observed that:

"…there is a close collaboration between the company, neighboring communities and other stakeholders to achieve environmental sustainability consistent with National and International Standards in the generation of safe, quality and competitively priced electric energy and this has been demonstrated through operational certification to both ISO 9001:2008 for Quality Management and ISO 9001:14001 for Environment Management besides ISO 18001 for Occupational Health Safety Management System (OHSAS) from which policies and rules such as Quality Policy Statement; Occupational Safety and Health Policy Statement; Fire Safety and Emergency Policy Statement; General Safety Rules are derived." Further, *"…setting, monitoring and evaluation and capacity building on environmental objectives and targets is continuously done as per the environmental policy, laws, regulations and permit conditions for pollution prevention and environmental impacts mitigation."* (KII No. 1, KenGen).

The adherence to environmental safety was supported by observations from Energy Regulatory Commission (ERC) interviewee response that:

"…Environment, Health and Safety (EHS) follow up audits of Sondu and Sang'oro hydroelectric power plants were done in 2017 and Corrective Action Plans (CAPs) for the non-conformities prepared and submitted by KenGen." (KII No. 4, ERC).

On customer satisfaction, KenGen respondent observed that:

"…a certificate of customer service was awarded in 2019 after an independent consultancy report by Commission on Administrative Justice (CAJ) which demonstrated that KenGen power projects offer high quality customer service and satisfaction. This is achieved through conducting regular comprehensive Internal Customer Satisfaction Survey to improve the quality of service delivery and ensure prompt resolution of public complaints referred directly or channeled through Commission on Administrative Justice (CAJ)." (KII No. 1, KenGen).

However, a contrast picture was portrayed by KPLC respondent that:

"…in 2018-2019 expressions of dissatisfied customers due to challenges in service delivery and subsequent negative media coverage eroded the gains made in maintaining high stakeholder confidence besides facing an unprecedented event when the entire top management was arraigned in court and consequently suspended." However, as a mitigate, *"…the Board of Directors promptly appointed on an interim basis a competent senior management team to maintain our market presence, strong brand and heritage as an energy solution provider of choice to fulfill the Government's Big Four Agenda."* (KII No. 5, KPLC).

Concerning the accessibility of electricity, KPLC respondent said that:

"…based on 2018 report 73.5% of the population had access to electricity while in 2019 a total of 578, 808 new customers were connected to the grid, growing the overall customer base by 9.4% to 6,761,090 million through the subsidized government funded Last Mile Connectivity Project to enable customers access electricity cheaply on Feeder Based Business Units (FBBUs)."

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However, *"…the cost of extending the power supply network remains a major challenge especially in rural areas owing to land tenure system."* (KII No. 5, KPLC).

These resentments show an institution under depression to provide safe, secure and reliable electricity for economic development. The responses provided insight on how the different indicators under consideration contributed to performance of hydroelectric energy projects. The study findings on the measurement of performance were in tandem with findings of Pramangioulis *et al.,* (2019); Waweru and Rambo, (2017); Ofori-Kuragu, Baiden and Badu (2016), Sibiya, Aigbavboa and Thwala (2015), and Elbatran *et al.,* (2015) who held a convergence view that measurement of performance in hydroelectric power projects should be attached to quality electricity supply, project cost reduction, increased generation capacity, implementation within time, operational efficiency, customer satisfaction, environmental safety, increased profitability, competitive procurement and risk management.

CONCLUSIONS

The composite mean and composite deviation for the performance indicators results were 4.23 and 0.281 respectively; implying that participants agreed that Performance indicators of Hydroelectric Energy projects were achieved. The findings of this study thus provide insight on how the different indicators under consideration contributed to performance of hydroelectric energy projects. The study thus concludes that the hydroelectric power projects performed since there was efficiency and increased capacity in power production, power supply was of quality, clients were satisfied, the project had positive environmental impact and revenue generation was adequate to sustain the projects while project implementation cost and time, access to power supply, power affordability were just slightly above average. Thus, more should be done lower the cost of power production and adhere to the implementation schedule. Further research should be done on the factors influencing performance of hydroelectric energy projects to ensure optimal performance.

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