Republic of Kenya

FY2022 Ex-Post Evaluation Report of Technical Cooperation Project

"The Project for Capacity Strengthening for Geothermal Development in Kenya"

External Evaluator: Mayumi Hamada

Foundation for Advanced Studies on International Development

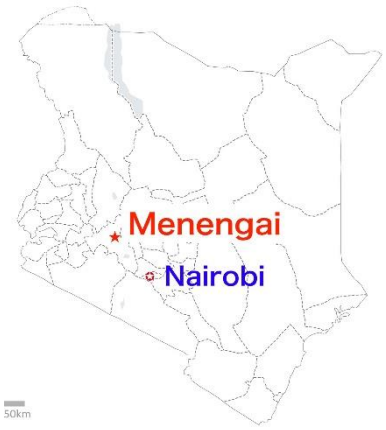
0. Summary

This project was implemented to mitigate technical risk in geothermal development by enhancing human resources of the Geothermal Development Company (hereinafter referred to as "the GDC") in Kenya, thereby contributing to the proper provision of steam to independent power producers (hereinafter referred to as "IPPs"). The project, which aimed to contribute to promotion of geothermal development, was consistent with the Kenya's development policy and development needs, as well as Japan's ODA policy. Although planned and coordinated linkage between this project and other projects supported by other donors was not observed, linkage with other JICA projects were planned to produce specific effects, such as improving the retention of skills by utilizing the skills acquired through this project at the onsite surveys of another technical cooperation project and so on. As a result of the implementation, expected effects on the technical enhancement were observed. Therefore, the project's relevance and coherence are high. The outputs were mostly achieved, and the project purpose was achieved by project completion. In addition, the overall goal was mostly achieved at the time of ex-post evaluation. The GDC's drilling capacity, which was enhanced significantly through this project, made sufficient utilization of the drilling equipment (rig) supported by African Development Bank (AfDB) possible, which brought significant mutual effects. The drilling team members, who significantly enhanced the capacities through this project, were dispatched to surrounding countries as trainers at the time of ex-post evaluation. Knowledge on the multi-purpose use of geothermal energy earned through this project was utilized for the implementation and management of demonstration sites[1] of the pilot project of multi-purpose use of geothermal energy supported by the United States Agency for International Development (USAID) and so on. These show the emergence of positive impacts. Therefore, the effectiveness and impacts of the project are high. Although outputs were mostly achieved, the project cost borne by the Japanese side slightly exceeded the plan, and the project duration significantly exceeded the plan. Therefore, efficiency of the project is moderately low. Slight issues have been observed in the technical and financial aspects. However, these are mostly improving and being resolved.

[1] To promote investors' understanding about the multi-purpose use of geothermal energy, a demonstration site was constructed for pilot projects, such as greenhouse cultivation and fish farming, using geothermal energy to control the temperature in the Menengai geothermal area with the USAID's support (2010–2014). This project was implemented as part of the "Power Africa Initiative," which was a U.S. government–led initiative launched in 2013 to improve energy access in sub-Saharan Africa. Participants included the private sector, donor countries, and international financial institutions (interview with the USAID).

Therefore, sustainability of the project effects is high. In light of the above, this project is evaluated to be highly satisfactory.

1. Project Description



Project location (source: prepared by the external evaluator with the map provided by JICA)

Steam gushing out at the Menengai geothermal site (source: photo taken by the external evaluator)

1.1 Background

At the time of planning, Kenya was facing many problems, such as power shortages, low electrification rates, high power prices, and frequent power outages, just like the power sector in many developing countries. Although solving these problems required a multifaceted approach, among others, securing a power source was the basis for everything, and a power supply development plan was considered to be the core of the plan. In addition, Kenya was dependent on hydroelectric power generation, which is susceptible to drought and other weather conditions, for more than 70% of its total power-generation capacity.

On the other hand, Kenya is located on the Great Rift Valley and is said to have one of the world's greatest geothermal resource potentials. Under these circumstances, the Kenyan government gave its attention to the abundant geothermal resources and considered that geothermal energy, which is low carbon and appropriate for base-load power supply,[2] should be the major power supply in the future. The government established the GDC in 2009 to further accelerate the development of geothermal resources nationwide, making the geothermal section of Kenya Electricity Generating Company (hereinafter referred to as "KenGen") independent. The GDC had been developing geothermal resources in the Menengai area, about 150 km northwest of Nairobi, being financed by AfDB and other funders. Although the GDC had

[2] A power source wherein the cost is low and stable generation is possible at any time, night or day.

sufficient funds and equipment for geothermal development (steam development) in the Menengai caldera with support from other donors, it lacked capacity for reservoir evaluation, exploration and target selection, and so on. Thus, the Kenyan government requested Japan for this project.

1.2 Project Outline

Overall Goal		GDC will be able to properly provide steam to power generation utilities.
Project Purpose		To enhance human resources of GDC which contribute to technical risk mitigation in geothermal development.
Outputs	Output 1	Training program for GDC staff will be established.
	Output 2	Capacity in developing conceptual models of reservoirs[3] and siting successful drilling targets will be improved.
	Output 3	Capacity to strike drilling targets will be improved.
	Output 4	Capacity in interpreting wellbore data, establishing calibrated reservoir models and evaluating geothermal resources will be improved.
	Output 5	Capacity to prepare economically and environmentally viable business plans as a steam provider will be enhanced.
	Output 6	Capacity in implementing projects of multi-purpose use of geothermal energy will be enhanced.
	Output 7	GDC's internal mechanism to improve and continue training program will be established.
Total cost (Japanese Side)		1,954 million yen
Period of Cooperation		September 2013–March 2020 (Extension period included: September 2017–March 2020)
Target Area		Nairobi (GDC Headquarters), Nakuru, Naivasha, Menengai (geothermal site), Silali, Paka, Arusu, Korossi, Chepchuk, and Suswa
Implementing Agency		GDC
Other Relevant Agencies/ Organizations		Ministry of Energy

[3] A model that estimates structures of underground heat and water flows based on the data collected by geophysical exploration and geochemical investigation.

Consultant in Japan	West Japan Engineering Consultants, Inc.
Related Projects	**Technical Cooperation (TC) Project** - The Project for Reviewing GDC's Geothermal Development Strategy (2014–2017) - The Project for Capacity Strengthening for Geothermal Steam Supply and Management (March 2022–February 2025) **Other International Organizations, Aid Donors** - Menengai Geothermal Development (AfDB, 2011–2019) - PRG for 3 Menengai IPP Geothermal companies (AfDB, 2014) - Quantum Power Menengai (IPP) (AfDB, 2017) - Power Africa (USAID, etc. 2013–)

1.3 Outline of the Terminal Evaluation

1.3.1 Achievement Status of Project Purpose at the Terminal Evaluation

The project purpose was assessed to be achieved. The major reason was that capacity development was successful not only in drilling techniques but also in a variety of fields. Therefore, the technical capacity level of the GDC was assessed to achieve the project purpose. On the other hand, it was expected that the GDC would accelerate the activities in the remaining period to enhance the achievement level because some of the activities for establishing an internal human resources development system had not yet been completed.[4]

1.3.2 Achievement Status of Overall Goal at the Terminal Evaluation

It was assessed as possible to achieve the overall goal within 3 to 5 years after project completion. As for the reason, it was pointed out that the preparation of starting steam supply was almost ready at the time of terminal evaluation, not only in terms of the contract with IPPs but also the construction of power-generation facilities.[5]

1.3.3 Recommendations from the Terminal Evaluation

The recommendations by the end of the project period were made for the GDC and JICA project team as follows: 1) implementation of the remaining activities (a. finalization of the handbooks, b. finalization of Steam Report 2, c. finalization of draft memos for upgrading human resources development system, d. training on internal control, procurement, and micro-seismic analysis, and e. presentation of the Project Completion Report); 2) consideration of the draft

[4] Terminal Evaluation Report p. 21.
[5] Terminal Evaluation Report p. 21.

career development program (Output 7); 3) continuous improvement of drilling management (reviewing inventory, maintenance, and logistics plans and reflection of the results into the Project Completion Report); 4) planning for equipment maintenance and software license renewal; and 5) storage, management, and updates of the eighteen handbooks developed.

Furthermore, recommendations were made for the GDC after project completion such as securing training budget, capacity development of geothermal human resources in East Africa, continual contribution to the academic community, securing a budget for the certification of Environment Management System and completion of the certification process.[6]

2. Outline of the Evaluation Study

2.1 External Evaluator

Mayumi Hamada, Foundation for Advanced Studies on International Development

2.2 Duration of Evaluation Study

This ex-post evaluation study was conducted with the following schedule.

Duration of the Study: November 2022–February 2024

Duration of the Field Study: March 14, 2023–March 21, 2023, July 2, 2023–July 8, 2023

3. Results of the Evaluation (Overall Rating: A[7])

3.1 Relevance/Coherence (Rating: ③[8])

3.1.1 Relevance (Rating: ③)

3.1.1.1 Consistency with the Development Plan of Kenya

At the time of planning, Kenya's national development plan *Vision 2030* (established in 2007) aimed to become a middle-income country by 2030, underlined the necessity of power source development for enhancing industrial competitiveness by lowering the electricity price, and indicated geothermal development as one of the priority projects.[9] Furthermore, the *Least Cost Power Development Plan* (hereinafter referred to as "the *LCPDP*") (2011), the country's electricity development plan, set the goal of raising the amount of power produced by geothermal energy to 5,530 MW by 2030.[10]

Also, at the time of project completion, *Vision 2030* was still effective. Moreover, the *National Energy Policy* (2014), which was formulated during the implementation period, emphasized the increase of the geothermal power-generation capacity as well as the importance of the GDC's role.[11] Furthermore, the *National Energy Policy* (2018) promoted increasing the amount of

[6] Terminal Evaluation Report pp. 29-31.
[7] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory.
[8] ④: Very High, ③: High, ②: Moderately Low, ①: Low.
[9] Ex-ante Evaluation Sheet p. 2.
[10] Ex-ante Evaluation Sheet p. 1.
[11] Terminal Evaluation Report pp. 22–23.

geothermal power generation, recommended investment in the geothermal field, and encouraged direct use.[12]

Therefore, this project was consistent with Kenya's development policy, which aimed to promote geothermal power from the time of planning to project completion.

3.1.1.2 Consistency with the Development Needs of Kenya

At the time of planning, Kenya's peak power demand was expected to drastically increase from 1,227 MW in 2010 to 12,738–22,985 MW within 20 years due to economic growth and population increase. In contrast with this, power-generation capacity was 1,593 MW in 2011; hence, the large-scale development of power sources was required in the future.[13] Furthermore, power supply was unstable, as it was susceptible to weather such as drought due to a dependence on hydroelectric power generation, which shares approximately half of the power-generation capacity. On the other hand, Kenya had abundant geothermal resources, and its potential was said to be 7,000 MW.[14] However, the GDC's technical issues were pointed out at the planning stage, which included being unable to site successful drilling targets, strike drilling targets, conduct geothermal resources evaluation,[15] and so on.[16] Major donors such as AfDB supported the GDC with the procurement of rig but did not provide support for human resources development in the field of drilling, which requires immense time and efforts. The GDC owned some rigs before commencement of this project, with the support of AfDB, but did not have sufficient capacity to reach specific underground points where geothermal resources exist[17] reliably and economically through the utilization of the above equipment.

Kenya's peak power demand had been increasing from the time of project commencement (2013) to project completion (2020) (Figure 1).

[12] National Energy Policy 2018, p. 11.
[13] Ex-ante Evaluation Sheet p. 1.
[14] Ex-ante Evaluation Sheet p. 1.
[15] Survey and research to evaluate characteristics of geothermal energy system and capacity of energy production (https://geo-science.co.jp/resource-assessment/#:~:text=).
[16] Terminal Evaluation Report p. 23.
[17] Questionnaire to the JICA staff concerned.

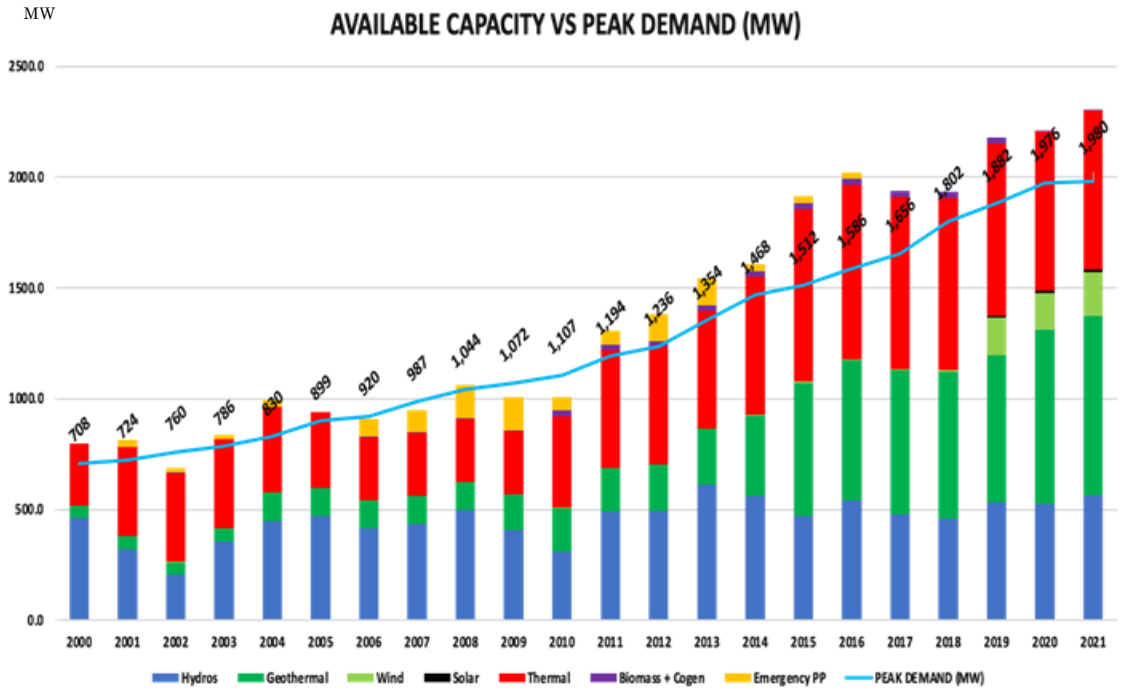


Figure 1 Electric Power Supply and Peak Power Demand

Source: Ministry of Energy, Kenya.

Note: The blue line shows the peak power demand. The dark-green colour in the bar graph shows geothermal energy, whereas red thermal, blue hydro, and yellow-green represent wind energy.

Based on the above, the promotion of geothermal power generation had been consistent with Kenya's development needs.

3.1.1.3 Appropriateness of the Project Plan and Approach

The project design matrix (PDM) of this project was revised only once. Namely, the PDM of the initial plan (June 2013) was revised in April 2018. No change was made to the overall goal, project purpose, and outputs, but the indicators of each objective were revised. Table 1 shows the major changes. "Indicator 2: actual power-generation capacity" of the overall goal was set at the appropriate level in the context of its objective. Many indicators of the project purpose and outputs were revised, or more indicators were added to be appropriate. Thus, the revision of the PDM was mostly appropriate. However, the project purpose actually includes two things ("mitigation of technical risk in geothermal development" and "human resources development at the GDC"). Although the sentence can be understood as the latter, "human resources development" is the project purpose, there is a logical problem for this understanding. This is because it can be understood as an expression that describes all of the outputs in a single phrase, and the indicators show the results to be achieved as a result of utilizing knowledge and skills.

Table 1: Revision of PDM and Major Points of Change

Objectives	Indicators of the Initial Plan's PDM	Indicators of Revised PDM
Overall Goal GDC will be able to properly provide steam to power generation utilities.	Number of steam purchase contract signed between power generation utilities and GDC	1. Available steam at surface 2. Actual generation capacity
Project Purpose To enhance human resources of GDC which contributes to technical risk mitigation in geothermal development.	1. Success rate of steam development 2. Reduction in work period required for steam development	1. Success rate of steam development (well targeting) (no. of wells discharging successfully improved by at least 10 points[18] (–2014 vs. 2015–)) (well targeting) 2. Success rate of steam development (well drilling) (no. of wells reaching target depth improved by at least 10 points (–2015 vs. 2018)) 3. Improvement in the speed of drilling rate (gross rate of penetration (ROP) improved at least by 15% (2015 vs. 2018)) 4. At least 50% reduction on the foreign drilling experts in the rig crew (–2015 vs. 2018)
Outputs 1. Training program for GDC staff will be established. 2. Capacity in developing conceptual models of reservoirs and siting successful drilling targets will be improved. 3. Capacity to strike drilling targets will be improved. 4. Capacity in interpreting wellbore data, establishing calibrated reservoir models, and evaluating geothermal resources will be improved. 5. Capacity to prepare economically and environmentally viable business plans as a steam provider will be enhanced. 6. Capacity in implementing projects of multi-purpose use of geothermal energy will be enhanced.	- Number of GDC's staff who accomplished the target level in the capacity checklist (Output 2, 3, 4, 5, 6)	- Target level in the capacity checklist realized - Addition of indicators (2-3, 3-2 – 3-5, 4-3 – 4-5, 7-2, 7-4, 7-5): not only capacity enhancement through training was evaluated based on the capacity checklist but also contents that show actual capacity enhancement were clarified, and the target levels of the indicators were set. Example of addition of the indicators: 2-3: Conceptual model developed/improved based on the training knowledge 3-2: Downtime reduction due to the equipment failure (At least 15% or more reduction on the wait on repair time over the total drilling time (2015 vs. 2018))

[18] "Point" is a unit to show differences between the before and after increase and decrease. When something increases from 50% to 60%, it becomes a 10-point increase because the difference of the value is 10. Regarding the percentage in the same example, it becomes 60% because it increased by 20% from 50% (0.50 + (0.50 x 0.20) = 0.6 = 60%) (https://enjoy.sso.biglobe.ne.jp/archives/percent_point/).

7. GDC's internal mechanism to improve and continue training program will be established.		

Source: Documented by the evaluator based on Project Completion Report, Detailed Planning Survey Report, and Terminal Evaluation Report.

Furthermore, the target area of this project included not only Menengai but also Silali, Paka, Arusu, Korossi, Chepchuk, and Suswa at the planning stage. After project commencement, the implementation of activities in these places became difficult because the security had worsened. Consequently, on-the-job training (OJT)[19] was not implemented in the six places except for Menengai. Thus, in terms of the target area, the project plan was partially unachieved. However, all of the planned technical training was implemented in the Menengai area, and technical enhancement was observed. In addition, the technical level's expected enhancement was considered to be achieved to some extent, even though the capacity to apply knowledge and skills in the sites outside Menengai was not developed.[20] Therefore, the influence was small as it did not seriously hinder the project purpose's achievement.

During the project's implementation, formulation of the "Steam Report" (a reservoir evaluation report at the Menengai geothermal site) was added as an activity for Output 4 (capacity enhancement in interpreting wellbore data, establishing calibrated reservoir models, and evaluating geothermal resources will be improved). This came to be one of the causes for the extension of the project period because the survey and report for the reservoir evaluation required much time. On the other hand, it led to the decision to invest in the power plant's construction as it dispelled concerns of the funders for IPPs on the stability of the steam supply output (see 3.2.2.1 Achievement of Overall Goal). In this sense, the addition of this activity was significantly meaningful.

As a lesson learned from a similar project in the past, it was planned in this project "to establish a system of quality management of steam data for decreasing the business risk of IPPs, which will be engaged in power generation and sales utilizing the steam provided by the GDC, and to provide opportunities for the exchange of opinions so that IPPs' needs will be understood." Regarding the former point, training was conducted on the establishment and operation of integrated databases during the project duration, although the utilization status could not be

[19] Educational method in which bosses and seniors give guidance to subordinates and juniors through actual work at working places so that knowledge and skills are acquired.

[20] At the time of planning, it was planned to implement basic technical training with the model of Menengai first and then to apply the knowledge and skills already acquired at the sites other than Menengai. However, this concept is partially applicable to this project's whole training, which covers broad areas, although it is applicable to 3G (geology, geochemistry, geophysical exploration), reservoir engineering, and the environment. In addition, the Menengai site was assessed to be utilized effectively as a training site because the Menengai site itself had the very complicated structural characteristics of a geothermal reservoir. Therefore, it is unlikely that the fact that the training was not conducted in the sites other than Menengai seriously affected this project's training effects (questionnaire to experts at the time of ex-post evaluation).

confirmed at the time of ex-post evaluation. As for the latter, the opportunities for opinion exchange were offered as needed from the time of project implementation to the ex-post evaluation, which contributed to the comprehension of their needs.

3.1.2 Coherence (Rating: ③)

3.1.2.1 Consistency with Japan's ODA Policy

At the time of planning, Japan's Country Assistance Policy for Kenya (2012) mentioned "Improvement of Electricity Access" as one of the development issues in the "Economic Infrastructure Development" among the five priority areas. This project was positioned in the "Power Generation, Transmission and Distribution Capacity Improvement Program." [21]

Therefore, this project was consistent with Japan's ODA policy at the time of planning.

3.1.2.2 Internal Coherence

At the time of planning, mutual effects of the establishment and enhancement of the GDC's technical capacity were expected by simultaneously implementing this project and the technical cooperation project "The Project for Reviewing GDC's Geothermal Development Strategy" (2014–2017) in order to ensure the GDC staff's skills earned through this project were utilized in the actual potential assessment of geothermal sites, as part of the latter project's activities.[22] However, the specific target level and so on were not set.[23] Furthermore, the emergence of mutual effects was planned through a combination of trainings in Japan such as "Knowledge Co-Creation Program for Group and Region Focus Program" and "The Kizuna Program."[24]

At the time of implementation, these planned linkages brought about the emergence of mutual effects. Specifically, the training effect of this project was enhanced as the GDC staff, whose capacity was enhanced through this project, conducted reservoir evaluation at the pre-feasibility study[25] level and so on in "The Project for Reviewing the GDC's Geothermal Development Strategy" (TC project).[26] The mutual effects are regarded as high because drilling skills earned by this project were indispensable for the data collection (e.g., understanding specific characteristics of steam in the steam well) to formulate a strategy.[27] Furthermore, the following trainings in Japan programs were conducted: "The Kizuna Program" (2 persons for 3 years, 1 person for 4 years), "Intensive Training for Geothermal Resource Engineers" (approximately 6 months every year from 2016), "Geothermal Policy and Strategy Program for Executives" (approximately 10 days every year from 2016), and "Geothermal Drilling Management"

[21] Ex-ante Evaluation Sheet p. 2.
[22] Project Completion Report of the technical cooperation project "The Project for Reviewing the GDC's Geothermal Development Strategy" p. 1.
[23] Questionnaire to the JICA staff concerned.
[24] Questionnaire to the JICA staff concerned.
[25] A study conducted at a stage prior to the feasibility study.
[26] Terminal Evaluation Report p. 24.
[27] Questionnaire to the JICA staff concerned.

(approximately 1 month every year from 2016). The above trainings contributed to the utilization of acquired skills after returning to the country, as well as to the assurance of smooth dialogue at a strategic level with the management staff.[28]

3.1.2.3 External Coherence

At the time of planning, many major donors provided financial support to the GDC for exploratory drilling. The GDC utilized the equipment, such as a rig, which was procured with a part of the loan financed by AfDB for exploratory drilling, in order to OJT drilling.[29] However, it cannot be said that there was linkage with these donors because special coordination was not made at the time of planning and implementation.

Regarding relevance, the promotion of geothermal development was consistent with the development policy and the development needs. Although the target area became smaller than planned due to security reasons, there was no significant problem in terms of the appropriateness of planning and approach because it did not inhibit the emergence of training effects and achievement of the project purpose. With regard to coherence, the project was consistent with Japan's ODA policy at the time of planning and linked with some other JICA projects, which led to the actual emergence of effects. As for external coherence, neither coordination nor linkage was made at the time of planning, which did not lead to a result. Therefore, its relevance and coherence are high.

3.2 Effectiveness and Impacts[30] (Rating: ③)

3.2.1 Effectiveness

3.2.1.1 Project Output

Table 2 shows the project outputs and the achievement status. Each output was mostly achieved by project completion, except for the establishment of the GDC's internal system, in order to implement and continue training continuously (Output 7). The cause of delay in achieving Output 7 was delay at the start of its activities.

[28] Questionnaire to the JICA staff concerned and Interview with the GDC.
[29] Ex-ante Evaluation Sheet p. 4.
[30] When providing the sub-rating, effectiveness and impacts are to be considered together.

Table 2: Achievement of the Outputs (By Project Completion)

Outputs	Indicators	Achievement
1. Training program for GDC staff will be established.[31] [Achieved]	1-1 Development of checklists and assessment sheet for GDC's staff capacity	Achieved
	2-2 Development of training materials and programs	Achieved
2. Capacity in developing conceptual models of reservoirs and siting successful drilling targets will be improved. [Mostly achieved]	2-1 Target level in the capacity checklist for necessary knowledge and skills realized in constructing geoscience elements to integrated conceptual models	Mostly achieved
	2-2 Target level in the capacity checklist for necessary knowledge and skills realized in the capacity to site wells	Mostly achieved
	2-3 Conceptual model developed / improved by GDC staff based on this training knowledge	Achieved
3. Capacity to strike drilling targets will be improved. [Mostly achieved]	3-1 Number of GDC's training staff who accomplished the target level (80% of trainees receive certificate)	Achieved
	3-2 Downtime due to the equipment failure (15% reduction)	Unachieved
	3-3 The number of major accident (15% reduction)	Achieved
	3-4 The total waiting time related to logistics (15% reduction)	Unachieved
	3-5 The total waiting time related to equipment delivery (15% reduction)	Achieved
4. Capacity in interpreting wellbore data, establishing calibrated reservoir models, and evaluating geothermal resources[32] will be improved. [Mostly achieved]	4-1 Target level in the capacity checklist for necessary knowledge and skills realized in the capacity to analyze wellbore data	Mostly achieved
	4-2 Target level in the capacity checklist for necessary knowledge and skills realized in the capacity for reservoir evaluation	Mostly achieved
	4-3 Reservoir evaluation report consulted by the Project	Achieved
	4-4 Carried out reservoir assessment and update reservoir model	Achieved
	4-5 Developed Numerical model for Menengai field	Achieved

[31] There is no PDM in Japanese language. In PCR in the Japanese language, it is described as "Training program necessary for the GDC staff's capacity development will be established."
[32] In PCR in Japanese, the expression is "reservoir evaluation" instead of "evaluating geothermal resources."

5. Capacity to prepare economically and environmentally viable business plans as a steam provider will be enhanced. [Achieved]	5-1 Target level in the capacity checklist for necessary knowledge and skills realized in the environmental and social safeguard	Achieved
	5-2 Environmental and social safeguard handbooks are developed	Medium level
	5-3 Target level in the capacity checklist for necessary knowledge and skills realized in the plant engineering	Achieved
	5-4 Target level in the capacity checklist for necessary knowledge and skills realized in the public/private scheme	Mostly achieved
	5-5 Target level in the capacity checklist for necessary knowledge and skills realized in the Economic Analysis	Mostly achieved
	5-6 Target level in the capacity checklist for necessary knowledge and skills realized in the Public Corporate Business Administration/ Finance	Achieved
6. Capacity in implementing projects of multi-purpose use of geothermal energy will be enhanced. [Achieved]	6-1 Target level in the capacity checklist for necessary knowledge and skills realized in the planning and implementation of multi-purpose use of geothermal energy	Mostly achieved
	6-2 Produced business plan for multi-purpose use of geothermal energy	Achieved
7 . GDC's internal mechanism to improve and continue training program will be established. [Partially unachieved]	7-1 Number of training sessions/programs conducted by GDC staff	Achieved
	7-2 GDC's internal trainer's development program established	Unachieved
	7-3 Number of training materials revised by GDC staff	Mostly achieved
	7-4 Established guideline for the training certificate in GDC	Mostly achieved
	7-5 Established system to link and reflect training development to the career development program	Unachieved

Source: Terminal Evaluation Report, Project Completion Report, Questionnaire to and Interview with the GDC
Note: As the PDM was not developed in Japanese, the expression of outputs followed the description in the Project Completion Report. Regarding the indicators, the evaluator summarized the indicators in PDM in English because the sentences of each indicator are long and there are many indicators.

3.2.1.2 Achievement of Project Purpose

As stated in the Relevance section, the project purpose ("To enhance human resources of the GDC that contribute to technical risk mitigation in geothermal development") actually involves two things ("mitigation of technical risk in geothermal development" and "the GDC's human resources development"); that is, there is a logical issue. Therefore, the project purpose is understood as "The technical risk is mitigated in geothermal development (through the GDC's human resources development)." This evaluation study was conducted based on this understanding.

Table 3 shows the indicators of the project purpose in the latest PDM and achievement status at project completion. In the Terminal Evaluation the project purpose was assessed to be

achieved.[33] All four indicators were completed or mostly completed.

Table 3: Achievement of the Project Purpose (By Project Completion)

Indicators	Achievement
1. Success rate of steam development (Well targeting) (No. of wells discharging successfully improved by at least 10 points (–2014 vs. 2015–))	Mostly Achieved The number of wells successfully discharged was 11 against 29 wells until 2014 (38% success ratio), whereas it was 10 against 22 (45% success ratio) since 2015 by the time of terminal evaluation. Thus, the success ratio improved by 7 points (45 – 38 = 7). The data for 2019 are included in the data above, as shown in the terminal evaluation report.
2. Success rate of steam development (Well drilling) (No. of wells reaching target depth improved by at least 10 points (–2015 vs. 2018))	Mostly achieved The number of wells reaching target depth until 2015 was 31 against 36 wells (86%), and increased to 14 against 15 (93%) from 2016 to 2018. The success ratio increased by 7 points (93 – 86 = 7). In 2018, all the wells (4 in total) reached the target depth (100%). In 2019, 4 wells out of 5 reached the target depth (80%).
3. Improvement in the speed of drilling rate (Gross ROP improved at least by 15% (2015 vs. 2018))	Achieved The speed of drilling in 2018 was 18.3 m /day, while 10.8 m /day in 2015. It improved by 69%. In 2019, the speed of drilling was 9.42 m/day.
4. At least 50% reduction on the foreign drilling experts in the Rig Crew (–2015 vs. 2018)	Achieved In 2015, one or two foreign drilling experts (the Philippines and Indonesians) were assigned at each working shift for each rig. Directional drilling works were also handled by external professional companies. However, in 2018, none of the rig crews had foreign drilling experts and directional drilling works were handled by the GDC national staff. This was achieved because the GDC's Kenyan staff became capable of drilling, not due to an increase in the number of staff but an enhancement in existing human resources' capacity.

Source: Terminal Evaluation Report pp. 19-20, Questionnaire to the GDC.

Based on the above, the project achieved its purpose.

3.2.2 Impacts

3.2.2.1 Achievement of Overall Goal

Table 4 shows the indicators and the achievement status at the time of ex-post evaluation of the overall goal ("the GDC will be able to properly provide steam to power generation utilities").

[33] Terminal Evaluation Report p. 21.

Available steam at the surface (Indicator 1) was achieved. However, this indicator shows one of the necessary processes for achieving the overall goal and does not necessarily mean that the overall goal was achieved, even if this indicator was. In other words, this is a necessary but insufficient condition. On the other hand, regarding the actual generation capacity (Indicator 2), one of the IPPs (Sosian Energy Limited) has almost completed construction work of the power plant (35 MW). Furthermore, steam has already been provided by the GDC to the power plant of Sosian Energy Limited for commissioning purpose, which validated the power supply to general households, although actual commercial operation has not yet started. Therefore, Indicator 2 was assessed as mostly achieved.

Table 4: Achievement of the Overall Goal (At the Time of Ex-post Evaluation)

Indicator	Achievement
1. Available steam at surface (MW worth)	Achieved However, this indicator is a process indicator and does not show the status of appropriate steam provision, stated as the overall goal. At the time of terminal evaluation, the steam test showed the amount of steam was 151.6 MW. According to "Steam Report 1," the amount of steam was confirmed to be sufficient for the supply to the three IPPs during the project life (25 years).
2. Actual generation capacity) (MW)	Mostly achieved At the time of ex-post evaluation, none of the three power plants expected to be constructed by IPPs in Menengai (35 MW each, 105 MW in total) completed its construction. However, one of the three IPPs (Sosian Energy Limited) was about to complete the construction work (35 MW) in early July 2023. Furthermore, its power plant started its commissioning from June 2023, and even though the formal operation (on a commercial basis) had not yet commenced, the GDC supplied the necessary steam to Sosian Energy Limited for commissioning. In this commissioning, electricity was actually delivered through the transmission and distribution network of KETRACO and Kenya Power and Lightning Company and supplied to general households. Thus, 35 MW have almost been secured already, and no problem was observed with the steam provided by the GDC in terms of both quality and quantity. As for the remaining two power plants, the next one (Globeleq Africa Limited) already commenced construction. It is expected to start operation in 2025, whereas the last one (OrPower 22) will begin in 2028.

Source: Project Completion Report, Terminal Evaluation Report p. 21, Questionnaire to and Interview with the GDC, Interview with Sosian Energy Limited.

Although three IPPs had already concluded a steam supply agreement with the GDC between 2013 and 2015, the construction of power plants by IPPs delayed significantly. The major causes were that scientific data that can dispel the concern of IPPs' funders about the stability of steam supply output and so on, could not be available until the Steam Report was developed in 2018 through this project, and the acquisition of government guarantee (Letter of Support and Partial

Risk Guarantee), which funders of IPPs require, faced challenge. These letters must be applied to multiple ministries, procedures differ depending on each ministry, and the acquisition process requires a lot of time.[34] In addition, the new contract with IPPs came to be suspended from around September 2021 to October 2022 due to the release of a report by the Presidential Task Force on the Review of Power Purchase Agreements (PPAs), which was brought about by public pressure to cut expensive electricity costs. In response to the recommendation from the task force (2021), the existing contract came to be negotiated/reviewed. This may also affect the delay in the contract.[35] Furthermore, some people pointed out that the performance of conducting business differs depending on each IPP.[36]

Among these causes of delay for the construction of power plants by IPPs, in order to dispel "funders' concerns about the stability of steam supply output for IPPs," it was necessary for the GDC to show with reliable data that 105 MW of steam were expected to be actually produced in the Menengai geothermal site with the power plant's construction. However, the IPPs' decision was delayed as the GDC's data were not recognized as sufficiently scientific authorization by IPPs and so on. This was changed by the development of the Steam Report (produced under the initiative of JICA experts as a part of technical transfer), which was added as an activity of this project. The submission of the Steam Report in 2018 by the GDC to the IPPs showing the steam amount supported by highly reliable data led to the decision made by the IPPs to commence the business projects.[37] The construction might have been further delayed if the Steam Report had not been developed.

On the other hand, Table 5 shows the continuation status of the project purpose and outputs from the time of project completion to ex-post evaluation. Both the project purpose and outputs have been mostly maintained. Regarding the project purpose, decrease has been observed in 2020 and 2021 in terms of the "success rate of steam development (well targeting)" (Indicator 1) and "success rate of steam development (well drilling)." However, improvement was observed in 2022. It has been shown that the commencement of drilling exploration wells at some new sites after 2020 led to a decrease in the success ratio compared to the production wells at Menengai. At the output level, some issues were observed for Outputs 2 and 7, but other outputs were sustained to some extent at the time of ex-post evaluation. Regarding Output 7, the existence of the program for fostering internal trainers could not be confirmed at the time of ex-post evaluation. However, 39 out of 40 trainers fostered continued working, and OJT, the major part of the project's training, still continued. In addition, the positions and the training were scheduled to be linked based on the idea of the GDC. It has many points substantially common with what the project aimed for, although it does not look the same. In this way, the favourable continuation

[34] Interview with IPPs.
[35] Interview with JICA Kenya Office and IPPs.
[36] Interview with the GDC.
[37] Interview with AfDB and IPPs.

status of the project purpose and outputs was considered to have contributed to the overall goal, improvement, and maintenance of the GDC's steam supply capacity.

Table 5: Continuation status of Project Purpose and Outputs (After Project Completion)

Indicators	2020 (Project Completion)	2021	2022	Difference (Compared to Project Completion)	Remarks
1 Success rate of steam development (Well targeting)	50%	0% (0 out of 4)	66% (4 out of 6)	16 points increase	The reason for the decrease in the success ratio in 2021 was that 3 out of 4 exploration wells were in Korossi, which was not too promising.
2 Success rate of steam development (Well drilling)	50%	80%	85%	35 points increase	The reason for the decrease in the success ratio in 2020 was the place was a new site and they were exploration well.
3 The speed of drilling rate (Gross ROP)	9.06 m/day	18.6 m/day	19.9 m/day	10.84 m/day increase	Steady increase was observed after project completion.
4 Ratio of the foreign drilling experts in the Rig Crew	0%	0%	0%	0%	Drilling continued without foreign experts after project completion.
Outputs					
Output 1	(Establishment of training program) At the time of ex-post evaluation, the checklists and handbooks developed through the project were still utilized.				
Output 2	(Capacity to develop conceptual models of reservoirs and to site successful drilling targets) Although conceptual models were improved, further Borehole Imaging[38] and Core Analysis[39] are required in Menengai. To cope with this, the GDC plans to request donors and so on to provide financial/technical support.				
Output 3	(Capacity to strike drilling targets) In the fiscal year 2021, seven wells were drilled in total in Baringo and Silali. The downtime due to the equipment failure was 3.6 days, which showed drastic improvement.				

[38] A type of physical logging. It is a method to measure information on the resistivity and acoustic impedance of the pit wall (geological formation) over the entire circumference and visualize it as an image of the pit wall (https://borehole-wireline.com.au/borehole-imaging/). As for physical logging, it is a technology that continuously measures geological information in the strata by lowering various measuring instruments (logging devices) into the drilled well.

[39] Various tests performed on cores (geological samples) taken from wells. The details are shown as follows: https://www.weblio.jp/content/Core+Analysis.

Output 4	(Capacity in interpreting wellbore data, establishing calibrated reservoir models and evaluating geothermal resources) The knowledge was maintained at the same level after project completion.
Output 5	(Capacity to prepare economically and environmentally viable business plans as a steam provider) The knowledge on planning a public private partnership (PPP) was incorporated into "The Project for Capacity Strengthening for Geothermal Steam Supply and Management" of JICA, which was ongoing at the time of ex-post evaluation.
Output 6	(Capacity in implementing projects of multi-purpose use) Although multi-purpose projects have not yet been implemented, discussions are underway with investors for implementation.
Output 7	(Mechanism to improve and continue training program) Although the same assessment as the one conducted during the project duration was not conducted, OJT was continued, and the teaching material developed was utilized at the time of ex-post evaluation. The existence of a program for fostering internal trainers could not be confirmed. Regarding the linkage and reflection of the training and career development programs, the GDC planned its original system at the time of ex-post evaluation to clarify essential skill/experience/capacity for every type of work/position, as well as to establish a link with the internal training, for which certificates (still in the planning process) would be given, even though it is not the exact system that this project intended to utilize. In addition, 39 out of 40 trainers fostered still continued to work and were dispatched to foreign organizations to conduct human resources development through the Centre of Excellence at the GDC.

Source: Questionnaire to and Interview with the GDC.

Based on the above, the project has mostly achieved its overall goal.

3.2.2.2 Other Positive and Negative Impacts

1) Impacts on the Environment

This project was classified as Category C because its undesirable effect on the environment was assessed as minimal since it did not correspond to the sector, characteristics, or area that are susceptible to the environment described in the "Japan International Cooperation Agency Guidelines for Environmental and Social Considerations" (promulgated in April 2010).[40] Furthermore, although cutting trees for civil works at the time of implementation resulted in a negative impact in the short/mid-term, trees were planted to mitigate the influence.

2) Resettlement and Land Acquisition

There was no resettlement or land acquisition because the target area was scarcely inhabited.

3) Gender Equality, Marginalized People, Social Systems and Norms, Human Well-being and Human Rights

During the implementation, this project respected the spot believed to be sacred in the target area, provided considerations to follow the community norms and traditions, and instructed its staff to give consideration in the same way.

[40] Ex-ante Evaluation Sheet p. 4.

4) Unintended Positive/Negative Impacts

As a result of capacity enhancement through this project, the GDC's drilling team staff came to be dispatched to surrounding countries as trainers.[41] In general, most of the drilling operations in geothermal development are conducted by private companies. Under these circumstances, it is worth mentioning that a public institution in a developing country has acquired the capacity of drilling and is now supporting human resources development in other countries such as Rwanda.[42]

In addition, the knowledge acquired through this project for planning and implementing multi-purpose use of geothermal energy from the business perspective was utilized in the implementation and management of the demonstration site of a pilot project supported by the USAID for multi-purpose use of geothermal energy, which brought mutual effects.[43] On the other hand, the implementation of multi-purpose use of geothermal energy had not yet started at the time of ex-post evaluation. Consequently, the project had not led to job creation and industry promotion in surrounding communities as expected at the time of planning. However, no protest movement broke out either.[44]

Furthermore, as stated in the Relevance section, the GDC's drilling skill, enhanced through this project, enabled sufficient utilization of the rig supported by AfDB, which resulted in significant mutual effects in promoting geothermal development in Kenya.[45]

Moreover, the construction of power plants by IPPs, which was promoted by this project, indirectly contributed to the conclusion of the EPC contract[46] between QPEA GT Menengai Limited, an affiliated firm of Globeleq Generation Limited, a British firm and one of the three IPPs, and Toyota Tsusho Corporation in Japan. It also contributed to the order received by Fuji Electric Co., Ltd., for a set of geothermal power-generation equipment.[47]

This project has achieved the technical risk mitigation in geothermal development through human resources development, which was set as the project purpose. In addition, it also mostly achieved the overall goal of appropriate steam supply to IPPs, and the effects emerged mostly as planned. Furthermore, the GDC's drilling team, whose capacity was enhanced through this project, was engaged in human resources development as trainers in surrounding countries, whereas mutual effects with the projects supported by other donors were observed. Therefore, the effectiveness and impacts of the project were high.

---

[41] They had no experience as trainers before implementation of this project. Interview with the GDC.
[42] Questionnaire to the JICA staff concerned.
[43] Questionnaire to the GDC.
[44] Questionnaire to and Interview with the GDC.
[45] Questionnaire to the JICA staff concerned.
[46] A construction work service contract for a construction project, which includes engineering, procurement, and construction.
[47] Questionnaire to the JICA staff concerned and information on a website. URL is as follows: https://www.fujielectric.co.jp/about/news/detail/2023/20230214140030031.html

3.3 Efficiency (Rating: ②)

3.3.1 Inputs

Table 6 shows the inputs of the project.

Table 6: The Inputs of the Project

Inputs	Plan	Actual
(1) Experts[48]	Approximately 400 P/M (No breakdown for Long and Short Term was shown) - Chief Advisor/Geothermal Development Planning [Exploration & Reservoir evaluation] Well Siting, Geology, Geochemistry, Geophysical Exploration, Data Integration, Reservoir Simulation, [Drilling] Drilling Operation Management, Drilling Super-advisor, Reservoir Evaluation, Wellbore Survey, Discharge Testing, Economic Evaluation [Management, etc.] Business Administration/Finance, Collaboration with IPPs, Socio-Environmental Considerations, Plant Engineering, Multi-purpose Use of Geothermal Energy, etc.	190.14 P/M in total - Chief Advisor/Drilling Planning [Exploration & Reservoir evaluation] Well Siting, Geology, Geochemistry, Data Integration/Reservoir Modelling, Geophysics [Drilling] Drilling Operation Management, Drilling Advisor, Reservoir Evaluation, Wellbore Survey, Discharge Testing, Economic Evaluation [Management, etc.] Business Administration/Finance, Collaboration with IPPs, Socio-Environmental Considerations, Plant Engineering, Multi-purpose Use of Geothermal Energy, Equipment Procurement, Training Coordinator, etc.
(2) Trainees received (Training in Japan)	- Drilling Technique: 1 month, approximately 24 persons/year - Reservoir Evaluation: 1 month, approximately 24 persons/year	76 persons in total - Drilling Technique: 1 month, 48 persons - Reservoir Evaluation: 1 month, 28 persons
(3) Equipment	(No description)	Equipment necessary for geothermal development and spare parts, software, etc.
(4) Local Cost	(No description)	77.8 million yen
Japanese Side Total Project Cost	1,876 million yen	1,954 million yen

[48] Regarding the dispatchment of experts, a gap is observed between the planned and actual values. There was a significant gap between the values shown on the Ex-ante Evaluation Sheet, which is defined as the basis of planned value, and that on the internal material prepared by JICA after the Ex-ante Evaluation Sheet was formulated. There is a possibility that JICA's detailed internal review corrected the planned value downwards after the Ex-ante Evaluation Sheet was developed. However, it could not be confirmed with the staff involved at that time. In addition, the planned value shown in the above internal material was 215.39 P/M. The contract between JICA and the implementing consultant was concluded based on the above internal material. Thus, the gap was not as significant compared with the planned P/M value at the time of the contract.

Kenyan Side Total Project Cost	1. Counterpart - Project Director - Project Manager - Departments: Geothermal Resource Assessment, Geothermal Resource Management, Drilling Operations, Infrastructure, Supply Chain, Human Resource, Environment, Direct Use of Geothermal Energy 2. Equipment Procurement 3. Office space and equipment for Experts and Staff 4. Salary and allowance of Counterparts	1. Counterpart - Project Director - Project Manager - Project Coordinator 2. Operation Cost 67,645 thousand Kenyan Shilling Major contents are as follows. - Project Office (electricity, internet access, telephone, security, cleaning) - Travel cost of Counterparts, cost of camp at Menengai, Meeting expense

Source: Ex-ante Evaluation Sheet, Terminal Evaluation Report, Project Completion Report, and Questionnaire to the GDC.

Note: The actual amount of local cost is the one at the time of terminal evaluation. P/M stands for person month.

3.3.1.1 Elements of Inputs

The implementing organization was asked to rate the quality, quantity, and timeliness of dispatch of experts, equipment procurement, and training in Japan shown above on 5-point scale (5 being the best). All of the responses were either 5 or 4 out of 5, which was high.[49] During the implementation period, experts in a variety of technical fields were dispatched, which promoted the activities due to flexible actions. On the other hand, the large number of experts sometimes brought about issues regarding the management and monitoring of the experts. It increased the workload of the JICA Expert Team, JICA Headquarters, and JICA Kenya Office with regard to the contract management. Because of this, sometimes the experts could not be dispatched in time for the schedule. In addition, the project could not provide the experts' schedule to the Kenyan side in advance in some cases. It has been reported that some counterparts could not participate in the training because the prior arrangement for training participation could not be made in time.[50] However, after being asked about the problems during the implementation period, the GDC and the experts at that time did not recognize there were specific issues, including those outlined above.[51] In addition, utilizing experts from the third country at the terminal evaluation was shown to be beneficial.[52]

3.3.1.2 Project Cost

The actual project cost borne by the Japanese side was 1,954 million yen, whereas the planned amount was 1,876 million yen. This slightly exceeded the plan (104% of the intended total).

[49] Questionnaire to the GDC.
[50] Terminal Evaluation Report p. 25, p. 33.
[51] Questionnaire to the GDC and Interview with the expert.
[52] Terminal Evaluation Report p. 25.

3.3.1.3 Project Period

Table 7 shows the planned and actual project duration.

Table 7: The Project Duration

Plan	Actual
September 2013–August 2017 (48 months)	September 2013–March 2020 (79 months)
	(Extension 1) April 2016 (6 months)
	(Extension 2) April 2017 (12 months)

Source: Ex-ante Evaluation Sheet, Terminal Evaluation Report, and Project Completion Report.

The actual project duration was 164% of the plan compared with the initial plan of 48 months. It significantly exceeded the plan. Although this project was extended twice, no activities or outputs were added for the first extension, whereas the activities to develop the Steam Report were added, as mentioned earlier for the second extension. Therefore, neither of the extensions was considered for addition to the project scope. Although the addition of the activities for the Steam Report resulted in the significant increase in project duration, it contributed to the achievement of the overall goal. Thus, the revision of the plan was appropriate.

Another reason for the increase in project duration included the suspension of dispatching experts for several months in 2017 due to security reasons caused by the presidential election, which led to suspension of the project activities (e.g., OJT drilling delayed by 1 year).[53] The delay in the budget disbursement of the GDC led to the suspension of sharing fuel required for drilling, which led to the delay in the OJT drilling. This also resulted in a delay in geothermal resources' data collection; thus, the Steam Report's development was delayed.[54]

Therefore, efficiency of the project is moderately low.

3.4 Sustainability (Rating: ③)

3.4.1 Policy and System

Regarding Kenya's national development plan *Vision 2030* and the *LCPDP* formulated in 2011, which were mentioned in the Relevance section, both were effective at the time of ex-post evaluation, as their target duration was until 2030. The *LCPDP* formulated in 2021 indicates that the Ministry of Energy plans to raise the geothermal power-generation capacity from 828 to 1,326 MW in 10 years from 2021 to 2030.[55] In addition, according to the Ministry of Energy, the

[53] Terminal Evaluation Report pp. 24–25
[54] Terminal Evaluation Report pp. 24–25
[55] Ex-ante Evaluation Sheet of "The Project for Capacity Strengthening for Geothermal Steam Supply and Management" p. 1.

government needs for promoting geothermal energy development are still high, and this direction will be maintained in the future as well.[56] This is because geothermal energy is Kenya's base-load power supply, and increasing the amount of power produced by geothermal power generation as the base-load power supply is required as it will increase renewable energy, even though the electricity supply amount has exceeded the electricity demand since 2011. Therefore, there is no problem with regard to the policy and system aspects.

3.4.2 Institutional/Organizational Aspect

At the time of ex-post evaluation, there was no change in the GDC's role to reduce the prior investment risk of geothermal energy development, encourage participation of IPPs, and conclude the Steam Supply Agreement.[57] In addition, the number of staff members was mostly maintained at a certain level after project completion, as shown in Table 8. According to the GDC, a sufficient number of staff members have been secured for geothermal energy development and the continuation of training. Thus, there is no problem in staff allocation.

Table 8: The Number of the GDC Staff

(Unit: persons)

Department	2019	2020	2021	2022
Total number of Staff	**1,054**	**1,033**	**994**	**1,052**
Human Resource Management	111	102	98	114
Drilling Operations and Infrastructure	422	419	397	421
Geothermal Resource Assessment and Geothermal Resource Management	171	166	172	177
Project Development	9	10	10	9
Commercial Affairs (Financial Affairs)	45	48	46	47
Others	296	288	271	284

Source: Questionnaire to the GDC.

At the time of terminal evaluation, it was pointed out that sustainability would be increased if a system to link the training and career development programs was established; in addition, an internal program for fostering trainers would be developed.[58] Regarding the linkage between the training and career development programs, the GDC is considering whether to establish a system similar to the one proposed by the project,[59] although they are not exactly the same.

[56] Questionnaire to the Ministry of Energy.
[57] Questionnaire to the GDC.
[58] Terminal Evaluation Report p. 27.
[59] The project proposed to the GDC the sustainable training program (VISION Program), which was linked with the

Namely, the GDC is in the process of establishing a system, for which it defined indispensable knowledge and skills for each job type and position with its own criteria, as well as a combined training necessary for career development for each job type and position at the time of ex-post evaluation. Furthermore, the GDC is working to register its training programs at the National Industrial Training Authority (NITA) and the Technical and Vocational Education and Training Authority (TVETA) so that it can conduct certification training courses internally.[60]

Therefore, there is no problem with regard to institutional/organizational aspects.

3.4.3 Technical Aspect

The project fostered 40 trainers in various fields such as geology, drilling, reservoir evaluation, multiple use of geothermal energy, environmental monitoring, plant engineering, and so on, and 39 of them were still working for the GDC at the time of ex-post evaluation. The project developed 18 handbooks,[61] which were still utilized at the time of ex-post evaluation. Although new teaching materials have not been developed by the GDC staff, they were in the process of being revised at the time of ex-post evaluation.[62] In this project, many GDC staff participated in a variety of training programs,[63] not only in Kenya but also in Japan. According to the GDC, the skills, especially in the fields of resource evaluation and drilling, significantly improved, and the knowledge and skills acquired were maintained at the time of ex-post evaluation.[64] Both in-country training and training in Japan were highly evaluated by the participants because of the meaningfulness and applicability to their works. Some participants of the training in Japan mentioned there was something to learn in not only knowledge and skills but also the Japanese culture, including the way of thinking, such as emphasizing accuracy and so on.[65] The GDC has been encouraging participants of the training in Japan to conduct technical transfer to others, and those participants actually explained what they learned to other staff after returning to the country. In addition, 98% of the participants of training in Japan were continuing to work for the GDC at the time of ex-post evaluation.[66]

The skills for underground resources evaluation based on the analysis of data obtained from geothermal wells, as well as the surface resource evaluation based on the analysis of data obtained from surface exploration conducted in the activities of the JICA technical cooperation project

career development program for drilling staff. This program's main pillar was OJT and included curriculum development to cope with multiple levels of drillers and training program development, which consider the average years required for promotion and those required for achieving the indispensable capacity for it.

60 Interview with the GDC.

61 Terminal Evaluation Report p. 27.

62 Questionnaire to the GDC.

63 Geology, geophysical exploration, geochemistry, drilling, data base, reservoir evaluation, well siting, wellbore survey, multi-purpose use of geothermal energy, environmental monitoring, plant engineering, public corporation management, economic analysis, socioenvironmental considerations, and so on.

64 Questionnaire to the GDC.

65 Interview with the training participants.

66 Interview with the Training-in-Japan participants, Questionnaire to the GDC.

"The Project for Capacity Strengthening for Geothermal Steam Supply and Management," are common with the skills acquired through this project. The GDC staff utilized the skills acquired through this project continuously and repeatedly,[67] and thus it is beneficial for the GDC to maintain and improve skills related to resource evaluation.

With regard to the smoothness of procuring spare parts at the time of ex-post evaluation, although the equipment procurement plan was prepared, there were some issues, such as budgetary problem, weak response from vendors to tenders, mismatch between the GDC's policy of paying on delivery, and the Chinese manufacturing company's policy of down payment when procuring spare parts made in China.[68] However, the former was not a serious problem, and the latter was solved by making procurement through third parties. However, the cost became more expensive.[69]

At the time of planning, one issue that become evident was that some of the equipment owned by the GDC did not meet international standards and thus was not compatible with equipment and spare parts produced by other manufacturers.[70] According to the Expert at the time, the equipment provided by JICA was procured with world standard specifications, and efforts were made to raise awareness of the differences from GDC's world standards and to improve skills in creating procurement specification. However, the GDC side did not seem to recognize that a part of their equipment did not meet the international standard. It has been recognized as a matter of fact that there is no compatibility or specifications differed depending on each manufacture.[71]

Based on the above, although minor issues were observed on the procurement of spare parts made in China, they were mostly improved or solved.

3.4.4 Financial Aspect

Table 9 shows the revenue and expenditure of the GDC since the project commencement year. The revenue was in decline since 2013, the project commencement year, but was moving toward recovery in 2022. Regarding its cause, the revenue amount included those loans from some donors such as AfDB, European Investment Bank, and so on, and the timeframe of the commencement and completion of each loan affected the fluctuation of the revenue. The difference in income and expenditure shows that the balance never fell into the red, even in a period of low revenue. In addition, the GDC explained that large-scale equipment, such as a rig, has already been procured and that the same level of cost compared with that before and during the project duration is not required.[72] Although the steam supply to IPPs, which was the overall

[67] Ex-ante Evaluation Sheet of "The Project for Capacity Strengthening for Geothermal Steam Supply and Management" and Interview with the project's Expert.
[68] Questionnaire to and Interview with the GDC.
[69] Interview with the GDC.
[70] Ex-ante Evaluation Sheet p. 8.
[71] Interview with the GDC.
[72] Interview with the GDC.

goal of the project, has been delayed, one of the three IPPs, Sosian Energy Limited, already started commissioning at the time of ex-post evaluation, and the revenue for the steam supply will increase. Furthermore, Table 10 shows GDC's expenditure for training. It is generally in decline. According to the GDC, as it was a relatively new organization, a large amount of training was required when the project started in 2013. However, as a result of capacity enhancement through a large number of training and OJT through the project, it is not necessary to conduct training as much as the initial project period at the time of ex-post evaluation. In addition, the GDC's participants are required to share the skills they acquired through the training with their juniors and successors. In this sense, it was explained that the same amount of training done during project implementation did not need to be conducted.[73]

Table 9: The Revenue and Expenditure of the GDC

(Unit: Million Kenyan Shilling)

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Revenue	14,398	12,658	14,884	10,350	8,674	6,038	5,340	6,522	6,238	9,015
Expenditure	13,362	10,091	13,813	9,605	8,049	5,603	5,228	5,458	6,040	6,260
Balance	1,036	2,567	1,071	745	624	434	112	1,064	198	2,755

Source: Questionnaire to the GDC.

Table 10: The Training Expenditure of the GDC

(Unit: Million Kenyan Shilling)

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Expenditure	117	88	55	51	71	25	6	21	52	29

Source: Questionnaire to the GDC.

Based on the above, although slight issues have been observed from a financial aspect, they are expected to improve in the future through the power plants' operation.

3.4.5 Environmental and Social Aspect

As stated in the Impact section, this project's undesirable impact on the environment was assessed as minimum and thus classified as Category C based on the JICA Guidelines for the Confirmation of Environmental and Social Consideration (April 2010). Although some plants were cut for civil works during the project, trees were planted to mitigate the impact; thus, there was not a serious problem. It is also unlikely that there will be a serious problem in the future.

Therefore, there is no problem in terms of environmental and social considerations.

[73] Questionnaire to and Interview with the GDC.

3.4.6 Preventative Measures to Risks

At the time of planning, it was recognized that two conditions (i.e., securing water necessary for drilling and the availability of geothermal resources that can be used for power generation at the expected project site) need to be met for achieving the project's outputs and project purpose.[74] At the time of ex-post evaluation, necessary water was secured, geothermal resources were sufficiently available, and uncertainty was not observed for the future.[75]

Therefore, there is no problem in terms of preventive measures to risks.

As stated above, slight issues have been observed in the technical and financial aspects. However, these are mostly improving and being resolved. Therefore, sustainability of the project effects is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project was implemented to mitigate technical risk in geothermal development by enhancing human resources of the GDC in Kenya, thereby contributing to the proper provision of steam to IPPs. The project, which aimed to contribute to promotion of geothermal development, was consistent with the Kenya's development policy and development needs, as well as Japan's ODA policy. Although planned and coordinated linkage between this project and other projects supported by other donors was not observed, linkage with other JICA projects were planned to produce specific effects, such as improving the retention of skills by utilizing the skills acquired through this project at the onsite surveys of another technical cooperation project and so on. As a result of the implementation, expected effects on the technical enhancement were observed. Therefore, the project's relevance and coherence are high. The outputs were mostly achieved, and the project purpose was achieved by project completion. In addition, the overall goal was mostly achieved at the time of ex-post evaluation. The GDC's drilling capacity, which was enhanced significantly through this project, made sufficient utilization of the rig supported by AfDB possible, which brought significant mutual effects. The drilling team members, who significantly enhanced the capacities through this project, were dispatched to surrounding countries as trainers at the time of ex-post evaluation. Knowledge on the multi-purpose use of geothermal energy earned through this project was utilized for the implementation and management of demonstration sites of the pilot project of multi-purpose use of geothermal energy supported by the USAID and so on. These show the emergence of positive impacts. Therefore, the effectiveness and impacts of the project are high. Although outputs were mostly achieved, the

[74] Ex-ante Evaluation Sheet pp. 7–8.
[75] Questionnaire to GDC.

project cost borne by the Japanese side slightly exceeded the plan, and the project duration significantly exceeded the plan. Therefore, efficiency of the project is moderately low. Slight issues have been observed in the technical and financial aspects. However, these are mostly improving and being resolved. Therefore, sustainability of the project effects is high.

In light of the above, this project is evaluated to be highly satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the Implementing Agency

It is regarded as meaningful for GDC to consider participation of a public institution as a power producer in the future because it takes a long time for private IPPs to commence power generation.

4.2.2 Recommendations to JICA

JICA Kenya Office should monitor the status of the construction of power plants by IPPs and the steam supply by the GDC as needed, as well as share information that can serve as a useful reference for future planning, such as contributing/hampering factors, if any, with the related divisions of JICA. In addition, providing advice by JICA Kenya Office to the ongoing technical cooperation project "The Project for Capacity Strengthening for Geothermal Steam Supply and Management" or related divisions of JICA as needed is expected based on the periodic monitoring reports of the above ongoing project.

4.3 Lessons Learned

<u>Analysis of external risks and clarification of implementing the organization's authority when setting the overall goal</u>

In this project, the construction of geothermal power plants by IPPs was indispensable for achieving the overall goal. However, the construction of power plants by IPPs in Kenya requires complicated application procedures, each of which takes a long time. This became one of the major causes of the delay in the power plant's construction. In case large scale of investment by private companies, in addition to the counterpart organization, is essential and complicated, and its implementation requires the long-term government's permitting process, it is crucial to conduct a thorough survey at the time of planning, make realistic estimates of how many years it will actually take, consider whether it is appropriate as the overall goal (approximately 3 years after project completion) prior to project implementation, and set the objective influenceable by the counterpart implementing agency.

<u>Implementing Organization's Understanding of Six Evaluation Criteria</u>

During this survey's field visit, there was a comment that the implementing organization did not

know the rating (of efficiency) would decrease in the evaluation if the project extended its duration. In order for the implementing organizations to make decisions on the project plan's revision, it is expected that the implementing organizations understand the basic ideas concerning the Six Evaluation Criteria. Furthermore, it is desirable that JICA secures thorough understanding of the basic concept of the Six Evaluation Criteria for its projects.

5. Non-Score Criteria

5.1 Performance

5.1.1 Objective Perspective

At the time of planning, major donors including World Bank and AfDB provided support to the GDC with the procurement of drilling rigs. However, they did not support human resources development in fostering drilling staff, which takes time and effort. Although the GDC already owned the rigs with AfDB's support, the accurate and economical capacity to strike drilling target points in the ground where geothermal resources exist was insufficient. As a result of JICA's support through this project for capacity enhancement, mainly in drilling technology, the rig supported by AfDB was sufficiently utilized, which resulted in significant mutual effects in promoting geothermal development in Kenya. In addition, JICA Kenya Office as well as JICA Headquarters provided appropriate support during the implementation by participating in all of the Joint Coordination Committee meetings, mid-term review, terminal evaluation, and so on, according to the GDC.

5.2 Additionality

None.

(End)