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An Update on International Capacity Building at the University of Auckland's Geothermal Institute

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ABSTRACT

The University of Auckland's Geothermal Institute has been a leading centre for geothermal education and training since 1978. Over the past four decades, it has played a significant role in building geothermal capacity across the Asia-Pacific and East Africa. Over this time, collaboration with industry for access to applied experience has been a cornerstone of making our teaching relevant, applicable, and current. This paper presents an update on the recent training delivered by the Geothermal Institute in these regions, working closely with Jacobs as an industry partner. This paper reviews two major programmes delivered in collaboration with Jacobs New Zealand: the East Africa Geothermal Facility Webinar Series, offered through the New Zealand–Africa Geothermal Facility (AGF) in partnership with the Africa Geothermal Centre for Excellence (AGCE), and the Geothermal Energy Project Management (GEPM) Short Course Series, delivered through the Manaaki New Zealand Short-Term Training Scholarship Programme. We outline and compare the design and delivery modalities of these programmes and examine their contributions to regional capacity development. A core element of these programmes has been cross-disciplinary learning and collaborative teamwork towards improved resource evaluation and consideration of decision-making throughout the phases of a typical development project. We reflect on the role of capacity-building in advancing the United Nations Sustainable Development Goals, the lessons learned from these programmes, and opportunities for improving training in the future.

1 INTRODUCTION

The United Nations Sustainable Development Goals (SDGs) are a set of 17 global objectives that aspire to end poverty, protect the planet, and promote peace, prosperity, and well-being for all by 2030 (United Nations, 2015). Geothermal energy has a role to play in achieving many of the SDGs, notably:

- Goal 7 (Affordable and Clean Energy): Geothermal provides consistent, baseload renewable energy, improving energy access and reliability.
- Goal 8 (Decent Work and Economic Growth): Geothermal development creates jobs in exploration, drilling, construction, operation, maintenance, and consulting.
- Goal 9 (Industry, Innovation, and Infrastructure): Investment in geothermal supports resilient energy infrastructure and technological innovation.
- Goal 13 (Climate Action): By replacing fossil fuels, geothermal energy reduces greenhouse gas emissions and supports climate change mitigation.

However, geothermal energy developments face several key challenges, including resource uncertainty during the early stages of development, high upfront costs during exploration drilling, the technical complexity of managing resources sustainably, site-specific characteristics of geothermal resources requiring bespoke design and analysis, and potential environmental and social impacts. These factors can contribute to high capital costs, long payback periods, and perceived risks, all of which can limit access to finance and prevent geothermal projects from reaching the development stage. This is especially true in developing countries.

Capacity building is essential for addressing these challenges, as it strengthens the skills, knowledge, and networks of individuals in the short term and builds the capacity of industries and institutions over the long term.

By enhancing both professional and organizational capabilities, capacity building enables geothermal resources to be developed as reliable, low-carbon energy sources, while also contributing to the achievement of the UN Sustainable Development Goals.

New Zealand has a long history of supporting international geothermal energy development, dating back to the 1970s, when it, alongside other countries, provided funding and technical assistance for resource exploration and development in Indonesia and the Philippines (Hochstein and Sudarman, 2008; Sussman et al., 1993). These early efforts fostered enduring bilateral relationships and ongoing collaboration in the geothermal sector. New Zealand's geothermal capacity-building initiatives continue today through technical support, tertiary education, and vocational training delivered by the country's geothermal industry (Zarrouk, 2017; Tetra Tech, 2024).

The Geothermal Institute (GI), based at the University of Auckland, has contributed to New Zealand's capacity-building efforts throughout the years. This paper reviews two major programmes delivered in collaboration with Jacobs New Zealand as part of New Zealand's international capacity-building programmes. Section 2 discusses the Geothermal Energy Project Management (GEPM) Short Course Series, delivered through the Manaaki New Zealand Short-Term Training Scholarship Programme, and Section 3 discusses the East Africa Geothermal Facility Webinar Series, offered through the New Zealand–Africa Geothermal Facility (AGF) in partnership with the Africa Geothermal Centre for Excellence (AGCE).

2 GEOTHERMAL ENERGY PROJECT MANAGEMENT PROGRAMME

The first Geothermal Energy Project Management (GEPM) course was delivered in 2017. Since then, the GEPM programme has delivered ten courses. The first three were held annually from 2017 to 2019 for participants from Indonesia and the Philippines. No courses were held in 2020 and 2022 due to COVID-19 restrictions, while the 2021 course was delivered online over 10 weeks. Between 2023 and 2025, six courses were completed, four for Indonesian and Filipino cohorts and two for East African participants.

GEPM participants are funded through the Thematic Short Term Training Scholarships, a stream of the Manaaki New Zealand Scholarships Programme. Administered by the Ministry of Foreign Affairs and Trade (MFAT) and Education New Zealand (ENZ), Manaaki scholarships provide fully funded opportunities for citizens of developing countries to study in New Zealand, with the aim of building knowledge and skills that support sustainable development in their home countries (Education New Zealand, 2025).

A similar programme, the Renewable Energy Project Management (REPM) course, was run alongside the GEPM programme. The REPM courses taught project management skills in the context of a broad range of renewable energy technologies (including geothermal). However, the focus of this paper is the GEPM programme, and statistics from REPM courses have not been included.

Section 2.1 below outlines the GEPM course content, Section 2.2 presents the programme reach, and Section 2.3 discusses the successes, challenges, and lessons learned from its delivery.

2.1 Course Overview

The GEPM programme is designed to equip participants with the skills necessary to improve resource evaluation and strengthen decision-making across all stages of the development of a geothermal project. While the content has undergone refinement over the years, its core objectives have remained consistent. The course is structured around the following guiding principles:

- Cross-disciplinary learning – integrating perspectives from geoscience, engineering, finance, policy, and management to support the development of geothermal projects.
- Collaborative teamwork – emphasizing group work and problem-solving in mixed teams to reflect real-world project environments.
- Contextual relevance – tailoring content to the participants' local geothermal industry and their professional backgrounds.
- Building connections – fostering both domestic networks among participants and international connections with the New Zealand geothermal industry.
- Manaaki experience – embedding the values of manaakitanga (hospitality, care, and respect), offering participants a meaningful cultural and professional experience whilst in New Zealand.

Table 1 presents a high-level summary of the content currently covered in the course. Each course is structured around a set of bespoke project scenarios that are tailored to the specific group of participants. These scenarios are designed to reflect realistic geothermal projects and encompass the full spectrum of project stages, from initial exploration through to make-up drilling. Importantly, they incorporate the technical, financial, and regulatory challenges commonly encountered when developing a geothermal resource. Table 2 provides a typical project description, taken from the 2025 GEPM-Africa course. Note that the projects described in Table 2 are hypothetical and do not necessarily reflect the status of actual geothermal systems or projects under development.

Table 1: Overview of GEPM course content

Module	Content
Introduction to the fundamentals of Geothermal Energy	Introduction to geothermal systems, geothermal geosciences, thermodynamics, reservoir engineering, conceptual modelling, and energy extraction.
Geothermal Resources and their Development	Exploration and development process strategy. Resource capacity estimation and protocols. Environmental, community, and social considerations and impact assessment. Introduction to process and resource optimisation and resource management.
Project Management Fundamentals	Project concepts, methodologies, and approaches, including project establishment (justification, business case, governance, scope, and success measures), project planning (requirements, design, staging, scheduling, budgeting, and quality planning), and project controls (tracking, reporting, and earned value analysis). Scope and change management, quality assurance, issues and risk management, as well as project direction, with a focus on team development, communication, leadership, and stakeholder engagement, are also covered.
Applied Project Management	Application of project management to geothermal resources, including commercialization (ownership, regulation, and environmental safeguards), financing (equity, debt, grants, risk mitigation, and tariffs), and contractual frameworks (procurement, consulting, EPC contracts, and performance requirements). It also emphasizes risk management, decision-making, and the preparation of a comprehensive business plan.
Business Cases Development and Presentation	Apply course learning to develop Business Cases tailored to realistic geothermal development scenarios. These scenarios were tweaked for each course. They were designed to reflect realistic geothermal development projects and encompass the full spectrum of project stages, from initial exploration through to make-up drilling. Each team prepared a Business Plan for a Decision Gate for their allocated project. Decision points were chosen at different stages along a project's development pathway. This lets participants, particularly geoscientists and drilling engineers who are involved in the early stages of a project, appreciate the importance of their place in the life (or bigger picture) of a geothermal project. Each team presented its Business Plan to a panel of Decision Makers on the last day of the course.
Field Trip	Visit to geothermal sites around the Taupō volcanic zone, including significant geothermal surface features, geothermal power stations, direct-use applications, networking opportunities, pōwhiri (welcome), and cultural experience.

Table 2: Example project descriptions for the 2025 GEPM-Africa course. These projects are hypothetical and do not necessarily reflect the status of actual geothermal systems or projects under development.

Project Description	Decision Point / Question
Comoros. "Karthala Geothermal Power Project". Assume this is the year 2029. Exploration drilling of 3 deep wells occurred from 2025 to 2029. Two wells were successful. An exploitable geothermal resource has been discovered, and 8 MWe has been tested at the wellhead. A PPP has been created, and a Detailed Feasibility Study has been completed, with positive results.	Financial Investment Decision (FID). Does the project meet the funder's requirements for FID, meaning an EPC contract can be signed to build a 15 MWe power plant to be operated by the PPP? Developer under a 30-year PPA?
Djibouti. "NE Assal Exploration". Geochemical analysis and preliminary MT provide strong evidence for the existence of a geothermal energy source in NE Assal, but prior drilling in the region indicates caution before deep exploration drilling. Some shallower or TG wells are proposed as an interim step to inform a possible exploration drilling program to support a 35 MWe project. Some additional MT may also be valuable to locate the shallow wells.	Contract Award TG Wells and MT Survey. Does the project meet GRMF's requirements to award contracts to: drill shallow/TG wells; to do additional MT surveys and; to analyse the results to justify the higher cost of a full exploration drilling program?
Ethiopia." Tendaho 1 Geothermal Power Plant (60 MWe)". Slimhole exploration and delineation drilling has been undertaken, but further drilling is required to confirm that sufficient geothermal energy resources exist for Tendaho 1. It is planned to appoint a Project Management and Engineering Services company with geothermal experience to select well targets, prepare well design, prepare civil works design, prepare bid packages for civil works, drilling, well testing and feasibility study, and manage bidding process up to contract award.	Contract Award Project Management Services. Does the project meet WB's requirements to award a Project Management and Engineering Services contract, the scope of which is to prepare contracts for civil works, delineation drilling, well testing, and Feasibility Study?
Kenya. "Mau Escarpment Geothermal Power Plant". Assume that GDC has drilled, tested, and independently proven 40 MWe of steam at the wellhead and plans to sell steam to KenGen for a 70 MWe power plant development. KenGen has a Bankable FS and EPC tenders in hand. GDC and KenGen have agreed on a 30-year steam supply agreement where the steam price is expressed in USc/kWh.	Financial Investment Decision (FID). Does the project meet the funder's requirements for FID, allowing contracts to be signed to design and build a 70 MWe power plant and steamfield and to drill the remaining production and injection wells?
Tanzania. "Ngozi Geothermal Power Project". Assume that a 3 well slimhole exploration programme has been completed in 2026. Two wells flowed, and enough flow for 500 kWe was tested at the wellhead. Sufficient estimated geothermal energy resources have been identified to support a 30 MWe project for 20 years. Pre FS completed. Confirmation/appraisal drilling (2 full-size wells) is required by the funder. If this is successful, drilling will continue until sufficient well capacity (production and injection) is achieved. Well pads, roads, and water supply have been prepared.	Contract Award Full Size Drilling. Does the project meet the funder's requirements for drilling, allowing a contract to be signed to drill two full-size appraisal wells, with options to continue drilling?

Table 2 (cont.): Example project descriptions for the 2025 GEPM-Africa course. These projects are hypothetical and do not necessarily reflect the status of actual geothermal systems or projects under development.

Project Description	Decision Point / Question
Rwanda. "Bugarama Hot Springs Multi Use Project". Assume several slim holes drilled to 500m have found a 120˚C aquifer. Testing indicates a high Probability of Success (POS) that a deeper 150˚C reservoir may exist (this temperature is needed for feasible power generation). Deeper drilling of 3 full-sized wells is planned to prove sufficient resources and provide flow capacity. Concept / Pre-FS study has been done for: (1) a 40-room hotel and hot spring spa, (2) a pilot-scale community crop drying facility, and (3) a 2 MWe binary power plant to supply the local grid and support the development of local tourist lodges and other enterprises supporting Cyamudongo Tourism. These 3 wells are expected to supply this development.	Contract Award Development Drilling. Does the project meet the funder's requirements for drilling, allowing a contract to be signed to drill 3 full-size wells?

2.2 Programme Reach

Figure 1 summarises the GEPM programme reach. In total, 292 participants have completed the GEPM programme. Of the participants, 216 were male, 75 were female, and one identified their gender as other. Approximately 80% of course participants were from the Asia region, with 234 participants from Indonesia (191 participants) and the Philippines (43 participants). From 2024 onwards, the GEPM progamme was also offered to countries in the African region. A total of 58 participants from ten African countries participated, including Djibouti, Kenya, Ethiopia, Tanzania, Egypt, Rwanda, Zambia, South Africa, Algeria, and the Comoros.

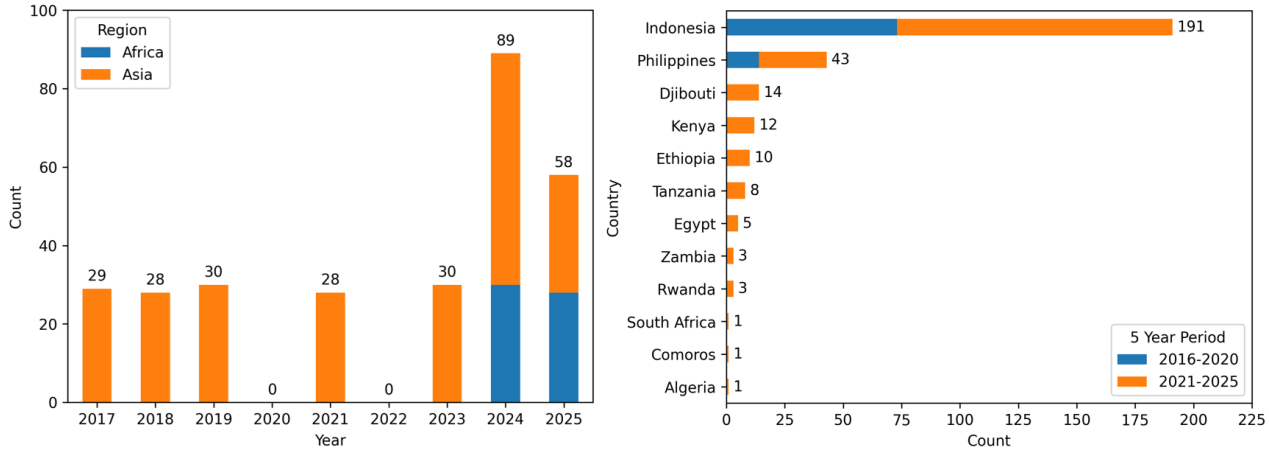


Figure 1: Number of GEPM participants per year with regional breakdown in colour (left) and number of participants per country where colours indicate the time period (right).

2.3 Successes, Challenges, and Lessons Learned

One of the keys to the success of the GEPM programme has been its co-design and delivery with partners from the New Zealand geothermal industry. This collaboration ensures that the course content reflects industry practice and is directly applicable to real-world projects. Jacobs New Zealand, in particular, has played a central role, contributing technical expertise, case studies, and experienced practitioners who bring first-hand knowledge of geothermal project development. This integration of academic and industry perspectives provides a comprehensive programme that is aligned with the needs of the Asia-Pacific and East African geothermal industries.

One of the strengths of the GEPM programme is that it brings together participants with a wide range of professional backgrounds, encompassing geosciences, engineering, finance, management, marketing, environmental disciplines, project management, education, and drilling, among others. This diversity promotes

knowledge exchange and robust discussion between stakeholders who would not ordinarily engage in open dialogue. Participants have frequently remarked on the unique value of having a forum in which regulators, off-takers, and power producers can engage in candid conversations that might be difficult in their typical industry settings. These discussions are facilitated by the following:

- An emphasis on group work, in which participants are deliberately placed into mixed teams with diverse professional backgrounds and experience levels.
- An immersive course structure in which participants live, learn, and travel together.
- Diverse content that encourages participants to contribute and share their ideas.

Similarly, another contributing factor to the course's success has been the careful selection of participants. The courses are specifically targeted at mid-career practitioners who are still involved with the implementation of geothermal projects but have the potential to progress to management positions. This demographic is well-positioned to translate learning into practice across current and future geothermal projects and to disseminate knowledge throughout their organizations.

The GEPM programme faces several challenges. The course is intensive, requiring full-time participation over four to five weeks, which can place significant demands on both participants and instructors. Its reach is limited by small cohort sizes of 30 participants, relying heavily on each individual's capacity to implement change within their organizations and to disseminate knowledge from the course. One key learning made during the GEPM programme was to provide more interaction time (group exercises and discussions) and less lecturing. For the GEPM courses, these exercises were designed to progressively build the skills needed to prepare the key elements of participants' Business Cases, ensuring exercises were relevant and meaningful to the course objectives. Finally, careful management of the scope of the GEPM course was required to ensure that the content remains focused and achievable within the five-week timeframe.

Remote delivery in 2021 proved challenging with difficulties maintaining engagement, accommodating participants' ongoing work commitments, and managing time zone differences over the 10-week course. A key shortcoming of delivering long-duration courses online is the reduced opportunity for interactive discussion, which has become a defining feature of the GEPM courses. In the in-person format, meaningful discussions, in which many participants contribute their own professional experience, develop organically as attendees and presenters build trust. Group work is also significantly more effective in person, where facilitators can move between tables, provide guidance, support discussions, and prompt spontaneous discussion if groups become stuck. Similarly, informal interactions over lunch and during off-time play an important role in strengthening networks. These unstructured opportunities help participants build long-term connections. Nevertheless, participant feedback indicated that 2021's online delivery was still very well received, and the overall learning experience remained successful despite these challenges.

3 EAST-AFRICAN GEOTHERMAL ENERGY WEBINARS

The East African Geothermal Webinar Series ran annually from 2021 to 2023. It formed part of a broader capability development programme jointly facilitated by the University of Auckland and Jacobs New Zealand. The programme was planned for in-person delivery, but COVID-19 travel restrictions required it to move online.

The Geothermal Energy Webinar series was delivered through the Africa Geothermal Facility (AGF) in partnership with the African Geothermal Centre of Excellence (AGCE). AGF 1.0 was established in 2017 through a partnership between the African Union Commission (AUC) and the New Zealand Ministry of Foreign Affairs and Trade (MFAT) to address gaps in access to reliable energy by supporting advancements within the East African geothermal sector (Tetra Tech, 2024). Over its implementation period, New Zealand based suppliers, including Jacobs New Zealand, JRG Energy, and the University of Auckland, provided a range of technical support and capacity-building programmes. AGF 1.0 employed a 'demand-driven' modality in which flexible and responsive technical assistance and capacity building were provided based on the needs of implementation partners in Africa. The programme concluded in December 2024.

Below, we summarise the Webinar series programme in Section 3.1 and discuss its reach in Section 3.2. Successes, challenges, and lessons learnt are discussed in Section 3.3.

3.1 Programme Overview

Table 3 summarises the three series of webinars delivered between 2021 and 2023. A total of 33 pre-recorded online seminars, ranging from 45 minutes to 1.5 hours in length, were delivered across the three series. Supporting material was prepared and delivered to the participants. Live Q&A sessions were run to facilitate discussions between participants and experts about the webinar content. For Series 1 and 2, a 1.5-hour Q&A session was run for each webinar. For Series 3, a 2-hour Q&A session was hosted per week, covering content from three pre-recorded webinars. Combining the Q&A sessions resulted in a "panel-style" format that provided an opportunity for multiple geothermal specialists to provide input on questions.

In the 2023 webinar series, transcripts and subtitles in both English and French were provided in response to participant feedback from previous sessions.

Table 3: Summary of the three series of webinars delivered through the African Geothermal Facility.

Series	Dates	Sessions	Themes
1	11/05/2021 - 23/06/2021	9	Resource assessment, Well testing, Surface engineering design and management, Project feasibility and finance
2	10/05/2022 - 16/06/2022	12	Geothermal systems, Modelling, Successes and failures in power plants developments, Funding opportunities
3	25/05/2023 - 15/06/2023	12	Geothermal resources and Exploration methods, Feasibility studies, Utilisation, Regulatory framework, and resource classifications

3.2 Programme Reach

Figure 2 shows the number of webinar registrations for each series by country. Note that for Series 1 and 2, participants were required to register for each webinar. This was changed for Series 3, in which participants registered for each week (three webinars and a Q&A session). Table 4 provides additional summary statistics.

In total, there were 2,555 registrations across the three series, the majority of which were from Kenya and Ethiopia. For Series 1 and 2, approximately 270 individuals registered for at least one webinar, while Session 3 saw an increase to 346 individual registrations. Although these figures provide an indication of reach, the actual audience was likely to be broader. Survey responses from Series 3 revealed that 240 participants shared the webinar content with colleagues, suggesting significant secondary dissemination beyond the initial registrants. Although the webinars were primarily designed for African geothermal professionals, registration was available to participants from outside the region. Individuals from Indonesia, the Philippines, Japan, the United States, New Zealand, and several European countries also engaged with the programme. These non-African participants have been excluded from the statistics presented in this paper.

The gender distribution across the three webinar series indicates that female participation remained relatively low, ranging from 19% to 25%. These figures suggest modest progress toward gender balance over time, although males consistently represented the majority of participants. The data highlights the need for continued efforts to promote inclusivity and address barriers limiting female engagement in capacity-building.

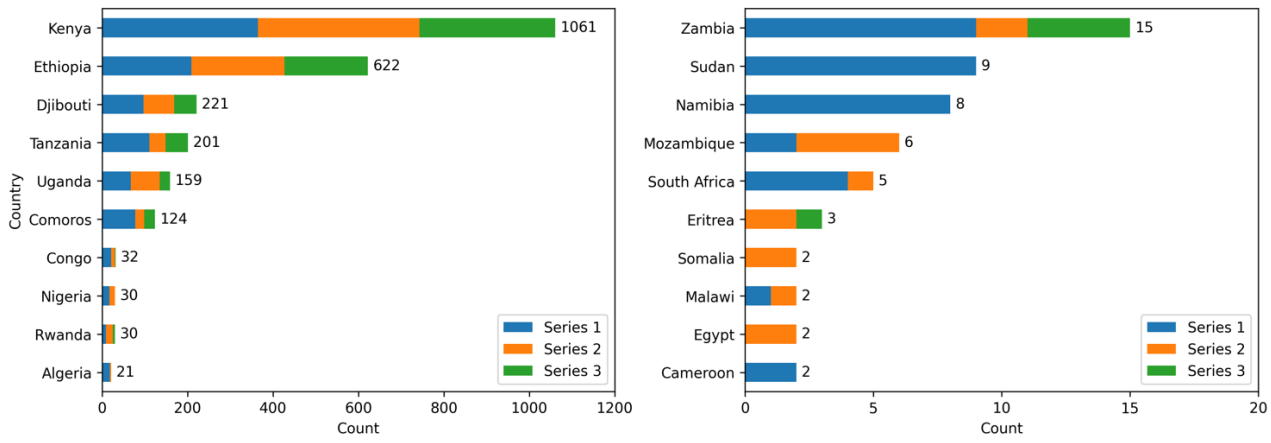


Figure 2: Registrations for African countries with series registrations shown in colour (left and right).

Table 4: Summary of webinar registration and attendance at the live Q&A events.

	Webinar Registrations				Live Q&A	
Series	Total	Individuals	Female*	Male*	Attendance+	Questions
1	1027	270	19%	81%	288	128
2	850	271	26%	74%	121	112
3	678+	346	25%	75%	237	77
Total	2555	-	-	-	646	317

* Gender percentage calculated from total registrations

\+ Series 3 registration and Q&A attendance was per week (3 webinars and one Q&A)

3.3 Successes, Challenges, and Lessons Learned

The East African Geothermal Webinar Programme successfully delivered three annual webinar series, reaching participants from 20 African countries with diverse professional backgrounds, including geoscientists, engineers, project managers, researchers, students, and managers. Below, we discuss some of the successes, challenges, and lessons learned throughout the programme delivery.

The use of pre-recorded, downloadable content combined with live Q&A sessions proved to be an effective format for webinar delivery in East Africa. Pre-recorded content allowed participants to access material at their own pace and improved accessibility by reducing challenges with unstable internet connections and bandwidth limitations. It also broadened the reach of the programme by allowing participants to share material within their organisations. As the courses were managed and delivered from New Zealand, pre-recording sessions also reduced time-zone challenges.

The live Q&A sessions provided an opportunity for in-person engagement with the presenters. We found it valuable to allow participants to submit questions prior to and during the live sessions. Collecting questions made sessions easier to moderate and allowed more reserved participants to ask questions. As shown in Table 4 above, live attendance at the Q&A sessions was lower than the number of registrations. Feedback indicated this was primarily due to work conflicts, time constraints, and poor internet connectivity. Recordings of the Q&A sessions were provided to improve access equity.

Feedback surveys indicated that language presented a barrier for some participants in the 2021 and 2022 webinar series, particularly in French-speaking nations. In response, captions and transcripts in both English and French were added to all recorded content. Feedback indicated the transcripts and translations were valued highly by participants.

Similar to the GEPM programme discussed in Section 2, industry collaboration was a critical factor in the success of the East African Webinar Series. The webinars were co-delivered by Jacobs, Earth Sciences New Zealand (formerly GNS), and the University of Auckland, ensuring both a broad scope of technical content and the inclusion of practical examples drawn from geothermal projects in East Africa.

Feedback from participants and post-course reviews highlighted several areas for improving webinar delivery. Areas for improvement could include co-delivering webinars with African partners, creating a centralized repository for course materials, developing more robust metrics to monitor content access, and improving methods for collecting participant feedback, as the survey response rate was often low.

4 CONCLUSIONS

International capacity building plays an important role in advancing geothermal energy development and achieving global sustainability goals. The Geothermal Institute at the University of Auckland has demonstrated the value of combining technical expertise, industry collaboration, and cultural exchange to strengthen skills and networks across diverse regions through programmes such as the Geothermal Energy Project Management (GEPM) short courses and the East Africa Geothermal Facility Webinar Series. These initiatives have improved decision-making capabilities, fostered cross-disciplinary learning, and supported the growth of the geothermal sectors in Asia-Pacific and East Africa.

Future capacity-building efforts should continue to be delivered with strong industry-academic collaboration. Webinars and in-person training serve complementary roles: webinars provide scalable, accessible knowledge dissemination, while in-person programmes provide targeted, in-depth learning of content and an opportunity

for practical application to case studies from the geothermal region. Both modalities are required to maximize the impact of capacity-building activities.

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