Contribution of UNU/GTP training to geothermal development in Asian countries

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Abstract

The United Nations University Geothermal Training Programme (UNU/GTP) can be considered synonymous with the training of geothermists in Asia. The first 2 UNU/GTP Fellows in 1979 came from the Philippines, and in 1980-1981 9 Fellows came from the Philippines and China. As of 2003, Asia constituted 26% of the countries that have availed of the UNU/GTP, and 43% of the total number of Fellows who have attended the courses under the UNU/GTP.

Asia also accounts for 39% of the world's total geothermal generating capacity and 21% in terms of direct use of geothermal resources. Economic growth rates for 1997-2010 in Asia are projected at 2.9-6.9%. Given the close relationship of economic growth and energy consumption, providing power through geothermal energy to fuel these economies offers vast potential opportunities in geothermal investments. With the increasing global awareness on sustainable development and the significant fuel savings derived from utilizing geothermal resources, developing geothermal expertise then becomes even more imperative for Asian economies. The UNU/GTP is, therefore, a very relevant factor not only in the professional career growth of ex-Fellows but also in the rapid development of geothermal resources in Asia.

Keywords: *Asia, United Nations University Geothermal Training Programme.*

1 Introduction

The concept of creating the United Nations University (UNU) was the brainchild of Mr. U Thant, the Secretary General of the United Nations in 1969 (Fridleifsson, 1998). The UNU has its base in Tokyo, and the proposal for it to focus on geothermal and solar energy and the practical applications of these energy resources was imbibed by the UNU in 1975. In 1978, considering the expanse of expertise and facilities available at the National Energy Authority (Orkustofnun), it was concluded that a UNU Geothermal Training Programme (UNU/GTP) should commence in 1979 with preference for candidate trainees from developing countries, which were then undertaking geothermal exploration and development, in a bid to help these countries develop their own pool of geothermal experts.

This paper, therefore, discusses the relevance and contribution of the UNU/GTP in the exploration and development of geothermal resources in developing countries in Asia, excluding China.

2 Asian UNU/GTP Fellows

It is indeed worthwhile to note that the first participants to the UNU/GTP in geothermal development came from Asia, specifically the Philippines. To date

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(2003), Fellows have come from a total of 39 countries of which 10 or 26% are from Asia (Figure 1). Of the total of 300 Fellows of the UNU/GTP, 129 or 43% came from Asia (Figure 2).

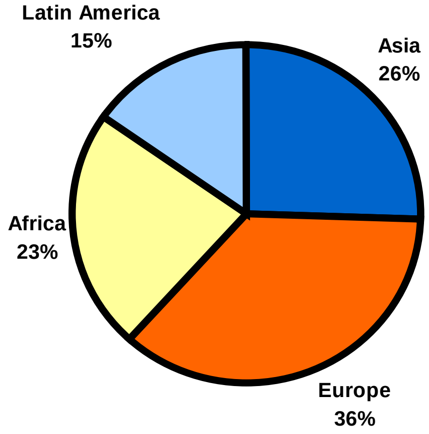

Figure 1: Participating countries.

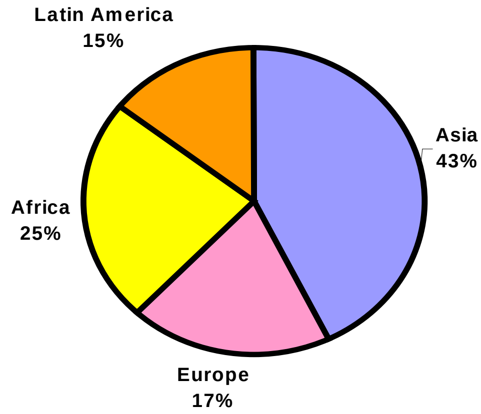

Figure 2: Participating Fellows.

(Source: www.os.is/unugtp/)

Statistics show that China leads the UNU/GTP participating countries, having produced 54 Fellows (Figure 3). The Philippines comes in at third with 29 Fellows, after Kenya with 33. El Salvador and Ethiopia follow at 20 Fellows each. Indonesia comes sixth with 12 Fellows after Poland with 14. As such, Asians dominate the GTP over their Latin American, East European and African counterparts in terms of number of Fellows.

It is worthwhile to note that the number of UNU/GTP Fellows is greater in countries with considerable geothermal resources, and which have significant geothermal generating capacity such as the Philippines and Indonesia. However, Figure 4 also shows that even in countries with no geothermal utilization, a considerable number of trainees were invited. This can be explained by the stated objective of the UNU/GTP, i.e., to prepare countries with potential geothermal resources for future geothermal development activities.

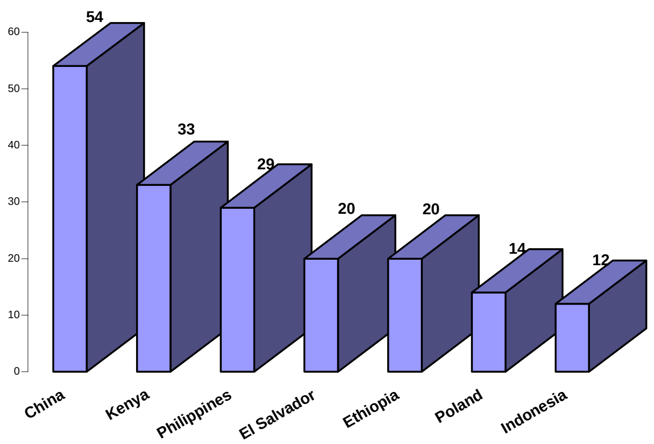

Figure 3: Ranking of countries per UNU/GTP Fellows (Source: www.os.is/unugtp/).

Based on the Table of Installed Geothermal Generating Capacities in 2000 by C.W. Huttrer, Asia accounts for 39% of the world's total installed geothermal generating capacity of 7,974 MWe. Figure 5 shows that three Asian countries are among the top six countries in geothermal power generation. In terms of direct use, figures from Lund et al. (2000) show Asian utilization of thermal energy from geothermal resources constitutes 21% of the world's 16,211 MWt total (Figure 6).

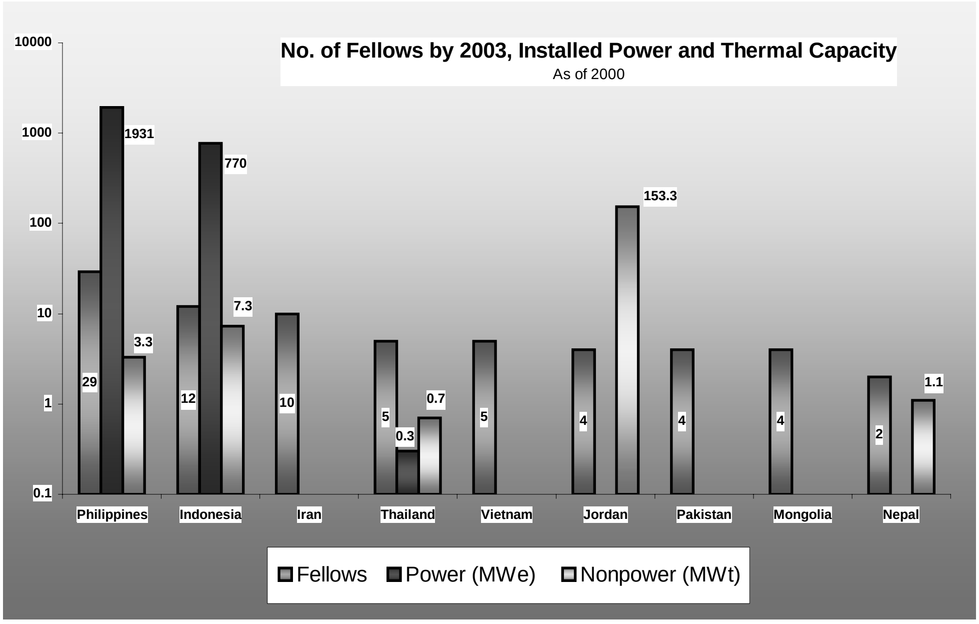

Figure 4: Number of fellows and installed geothermal capacity in Asia. (Source: www.os.is/unugtp/; Huttrer, 2000; Lund et al., 2000).

The economic growth forecast for 1997-2010 ranges from 5.3% to 5.7% in developing Asia, with China expected to post 6.1-7.4% growth per year (IEO, 2001). Economic growth in industrialized countries, on the other hand, is expected between 2.7 and 3.6% per annum. The energy consumption growth rate for Asia is projected at 3.2-4.1% per year, while that in industrialized countries is at 1.2%. Power plants from geothermal energy can provide the fuel needed to run the economies of Asia. These statistics justify the cause of the UNU/GTP for Asia in capacity building of human resources on geothermal energy development.

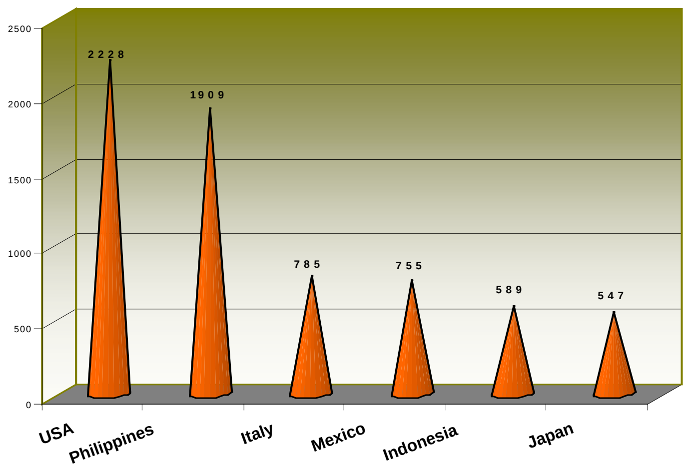

Figure 5: World ranking in geothermal installed capacity. (Huttrer, 2000)

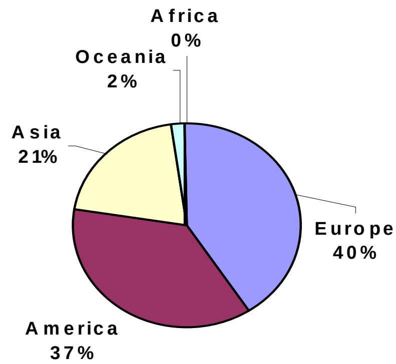

Figure 6: Direct use of geothermal Resources (Lund et al., 2000).

Records of the UNU revealed that the most attended specialized course by Asian Fellows, except those from China, was Reservoir Engineering with 16 participants (Figure 7). Borehole Geology, Geothermal Utilization, Exploration Geophysics, Borehole Geophysics and Geochemistry are well attended courses at 10-12 participants each. The Geological Exploration course had been completed by three trainees, and there was one trainee each for Environmental Studies and Drilling Technology. A look at the geothermal development plans of these countries would show that the types of specialization of participants each year are more or less reflections of the stage of geothermal energy development in their respective countries. Again, this only shows that the UNU/GTP is designed or tailor-made to the training needs as well as responsive to the geothermal development needs of these countries.

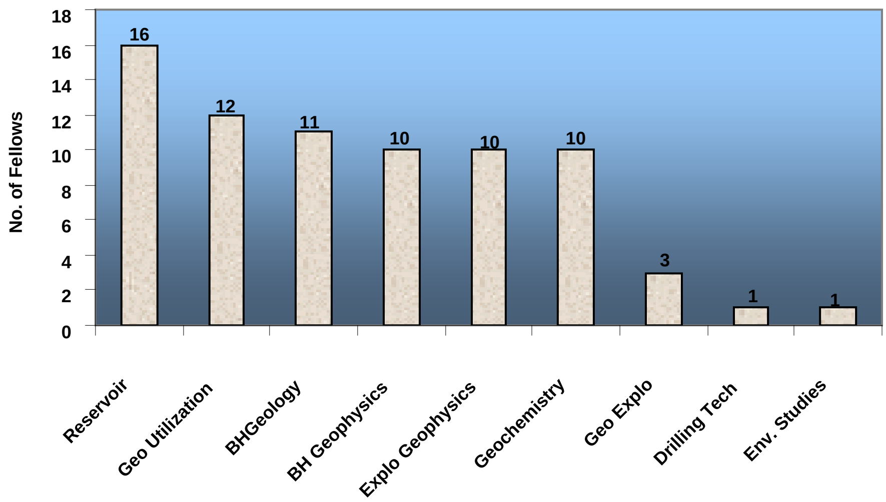

Figure 7: Number of Fellows from Asia per course (www.os.is/unugtp/, 2003).

3 The UNU/GTP and geothermal development in Asia

3.1 The Philippines

The Philippines started regional survey and assessment of its hot springs as early as in 1953. The first pilot power plant (3 MW) to demonstrate and harness geothermal energy for power generation was, however, commissioned only 24 years later in 1977. As previously mentioned, two Fellows from the country were the first trainees under the UNU/GTP, and were chosen in consonance with the UNU's objective of developing and/or strengthening capabilities in developing countries with geothermal potential and development activities. The Philippines is considered the pioneer in geothermal development in Asia. By 1979, when the first batch of UNU/GTP trainees was invited, the country already had 223 MWe of installed geothermal generating capacity.

Given the ambitious plan to tap geothermal resources for its power requirements and the already on-going drilling activities in the country when the UNU/GTP started, the fields of specialization of Fellows from the Philippines were focused on borehole studies with emphasis on alteration mineralogy. These specializations later shifted to geophysical exploration and reservoir management. Most recent focus is on database management considering the wealth of data accumulated in 26 years of geothermal activities, in a bid to explore the non-power application of geothermal resources in the country. The constant shift in the fields of specialization among the Filipino participants is consistent with the geothermal priorities of the country.

To date, there are a total of 29 UNU/GTP Fellows from the Philippines of which 7 or 23% are women. Seventeen (17) Fellows or 59% of the total remain employed in the geothermal industry or associated fields. Unfortunately, only two of the 7 women Fellows remain working in this field.

Indeed, the UNU/GTP has made great impact to the Philippine geothermal industry since the expertise gained by Fellows has been used and applied in the different stages of geothermal exploration, development and utilization not only in the country, but in other Asian countries as well. Philippine geothermists now render their geothermal services locally and also abroad, keeping with the vision of the Philippines becoming a center of excellence in geothermal technology and services. Most of the Fellows have advanced in their professional career, having been promoted to higher ranks i.e. supervisors, operations/exploration managers and policy makers (Table 1). Others have made it to the international scene as renowned experts in their own rights. Fellows remaining in the country since completing their UNU/GTP training gained better understanding of their jobs, thereby delivering better services and opening opportunities for research. Contributions of Fellows range from pure geothermal research to feasibility study preparations, development works, facilitation, monitoring, policy formulation and sharing of expertise through paper presentations, as resource persons and as media/publication contributors.

Table 1: Positions/Whereabouts of Philippine UNU/GTP Fellows.

Position	Geology	Geochemistry	Geophysics	Reservoir
Policy maker			○	
Research	x			◊
Manager				□ □
Supervisor		○ □	□ □	□
Senior Staff	○			
Junior staff		□ □	□	x ○ □
Migrated	○	○		○ □ □
Retired				□ □
No information			□	□ □ □ □

○ DOE Personnel □ PNOC-EDC
◊ Working abroad x PGI

In an effort to increase the direct use of geothermal energy, the Department of Energy has started collaboration with the Tourism Department in identifying thermal areas with potential for spa resort development on the basis of surface temperature, accessibility and proximity to other tourist destinations. The Philippines is also extending its services with its neighbors such as Indonesia and Iran for the exploration and development of geothermal resources in these countries.

The Philippine Energy Plan (PEP) which is now being developed for 2004-2013, has set an ambitious renewable energy program called “100 in 10” which aims to double the current installed geothermal generating capacity of 1,930 MWe by at least another 1,900 MWe by year 2013. These additional capacities would come from new areas as well as from the optimization of resources in existing geothermal fields. With the bigger areas already under exploitation, the new geothermal areas targeted under the PEP are of lesser potential, i.e., < 100 MW, more difficult to explore and more expensive to develop. Thus, it would require the best geothermists to bring these new geothermal areas from exploration to the development stage. Sustainability of geothermal operations as well as optimizing resources within producing fields is, likewise, an ongoing challenge to those who manage these resources. It would not be surprising therefore if specialization of future Philippine participants to the UNU/GTP would again be focused on exploration and utilization.

3.2 Indonesia

Geothermal exploration surveys conducted in Indonesia since 1974 have identified 217 prospects. Thirty-two percent of these prospects were classified as high enthalpy fields. Geothermal exploration activities were being undertaken in Indonesia when the UNU/GTP started, which is in contrast to the Philippines where geothermal development and production had already begun even before the start of the UNU/GTP. Indonesia started geothermal electricity production in 1983 in the 30-MWe Kamojang Field in West Java (Radja, 1995), a year after two Indonesian geothermists participated in the UNU/GTP in 1982. The field of specialization of the first two Fellows, were on exploration, i.e., geophysics and borehole geology, which expertise they were able to apply immediately in the North Sulawesi and West Jawa geothermal prospects. It is important to note that next to the Philippines, Indonesia has the largest installed geothermal capacity in Asia (Figure 5), and a few megawatts greater than Japan.

Specialization of Indonesian Fellows follows a similar trend as the Philippines. This can be explained by the thrust of the Indonesian Government to improve geothermal energy share in the country’s power mix in the near term from 3.4% to 7% by 2007, not to mention the vast geothermal potential awaiting utilization in the long term. Government priority for geothermal development can be seen in the country’s effort to improve its policies to make geothermal competitive and to broaden opportunities for geothermal utilization in their thrust to put up mini-geothermal installations for rural electrification. The country may yet become the world’s biggest geothermal energy producer with its estimated geothermal energy potential of about 20,000 MW.

3.3 Thailand

Mapping of Thai hot springs started as early as 1946, and a local research group consisting of the Electricity Generating Authority of Thailand (EGAT), the Department of Mineral Resources (DMR) and Chiang Mai University pursued exploration to rank the prospects. From 90 hot springs, the prospects were narrowed to two (2), which were then evaluated as potential for binary power generation and cascade direct use (Ramingwong. et al., 2000).

Sending of Thai geothermists to the UNU/GTP began in 1984 and thus continued yearly until 1987, resuming for a year in 1991. The Fellows’ training at the UNU was very timely as there is an ongoing geological and geochemical assessment of the country’s geothermal resources. Their expertise may have been put to practice with the exploration drilling in the San Kampeang, and the development of the Fang geothermal field. Fields of specialization of Thai Fellows ranged from borehole studies to geochemistry. Two deep exploratory wells were drilled in San Kampeang in 1989 and further drilling in Fang was conducted in 1992-1993. Fifty shallow gradient wells were also completed in Pai geothermal prospect in 1994. Fang geothermal prospect started production in December 1989 with an installed capacity of 300 kW. The development was undertaken in cooperation with the French Environment and Energy Management Agency (ADEME). UNU/GTP studies must have been put to good use in these drilling programs and also when Thailand participated in a regional collaborative project on isotope geochemistry in 1997.

3.4 India

India only availed of the UNU/GTP in 1980 and in 1984, by sending two visitors to the programme for a few weeks. India has an inventory of their thermal resources. Pilot plants have also been installed to prove technical viability of geothermal development for binary power generation (Sarolkar, 2000) and the investment scenario seem to favor development of non-conventional energy sources in view of environmental concerns.

3.5 Iran

Iran has prioritized its geothermal prospects for detailed exploration including drilling. It is through the United Nations' recommendations in 1975 that interest in geothermal exploration began in Iran. In the 1990s, renewable energy sources including geothermal have been given increased importance, concentrating especially on the geothermal systems associated with the large Sabalan volcanic cone in NW-Iran. After extensive geophysical work, a prospective production area was outlined in the Meshkin Shahr area (Fotouhi et al. 2000, Bogie et al, 2000). Exploration drilling started there in late 2002. The country started participating only in 1996 and has since sent ten Fellows to the UNU/GTP. The first Iranian Fellows took exploration methods, borehole studies, geothermal utilization and environmental studies in anticipation of developing its own geothermal resources. The bulk of the Fellows' contribution to geothermal research in the country is in the area of exploration, but they have also played an important part in the development of the Meshkin Shahr area. As in other Asian countries, the main impediment for geothermal utilization in Iran is the availability of vast, indigenous and cheaper fossil fuels.

3.6 Vietnam

Vietnam prides itself with having explored at least 300 hot spring sites since 1945 (Hoang, 2000). In 1990, Vietnam's geothermal potential was assessed by UNESCO, New Zealand, Italy and other international institutions. In 1998, ORMAT obtained license to build geothermal power plants in Vietnam. Five (5) participants from Vietnam completed the UNU/GTP from 1996-2001, with Fellows taking mostly geothermal exploration courses that would enable them to assess and characterize the country's identified geothermal prospect sites.

3.7 Nepal

Nepal's initial assessment of its hot springs showed low reservoir temperatures. However, a national inventory of its geothermal resources is still ongoing (Ranjit, 2000). Present utilization is confined to balneology, tourism and therapeutic uses of hot spring waters. Two Nepalese Fellows completed the UNU/GTP in 1994 and 1995, taking the Geochemistry and Geothermal Utilization courses, respectively. This is in line with the recent focus of geothermal research in the country, which is on the geochemistry of Nepal hot spring waters and their potential uses.

3.8 Jordan

Jordan's geothermal resources are of the low-temperature type and their future exploitation is seen in the area of greenhouse heating, aquaculture and refrigeration by absorption (Swarieh, 2000). Four (4) Jordan geothermists availed of the UNU/GTP in the fields of borehole geophysics, reservoir engineering, geothermal utilization and geochemistry. These areas of study are very relevant for the country inasmuch as the characteristics of thermal resources at the border of Jordan with Syria, Israel and Iraq are for direct applications.

3.9 Mongolia

Mongolia's geothermal prospects are mostly located in the north and central parts of the country (Tseesuren, 2001). Comprehensive investigation of the prospects has not been conducted, but this is now on the agenda of the government. The geothermal activity is expected to be limited to low-enthalpy resources. Utilization to date has been limited mainly to balneological/bathing purposes, but heating must be an interesting alternative. The country has availed of four (4) slots on geothermal utilization in the GTP in 2001 and 2003. According to a study by one of the Mongolian Fellows as part of the research requirement of the GTP, calculation of the thermal potential of the hot springs in Mongolia, resulted in the identification of at least 18.4MWt of geothermal resources. This can be considered as a big step towards further developing the geothermal potential of the country considering that hot springs are mainly eyed for direct use such as bathing, balneology, and greenhouse applications, but more significantly for therapeutic and heating purposes.

3.10 Pakistan

Pakistan has yet to undertake in-depth assessment of its geothermal resources. The studies done so far have been geological and geochemical surveys (Bakht, 2000). Utilization potentials are in the area of binary power production and direct use applications such as greenhouse and space heating as well as fish farming (Mughal, 1998). Four (4) Fellows availed of courses on geology, geochemistry, borehole logging and reservoir engineering, but the follow-up has been limited.

4 Training needs assessment

The worldwide trend of liberalization and deregulation of industries and global competition are posing a very great challenge to geothermal development. This challenge is especially true in developing countries where the resource is facing stiff price competition from traditional fossil-based fuel sources. The long gestation period, exploration risk, and taxes imposed on the use of the resource are discouraging private investment in geothermal projects (Benito, 1998). While it is desirable to train more technical personnel, the UNU/GTP should also consider training even for a short period (one month), policy and decision makers on the benefits and advantages of geothermal energy development as well as on financial and economic viability of geothermal projects. These decision-makers play crucial roles in planning and in deciding on what type of power plants or fuels or energy mix a country would eventually use or adopt as a national policy. Also from the foregoing discussions, the following observations are drawn:

1. The majority of the training courses availed of by Asian countries are in reservoir, borehole and geochemical studies. This may be a reflection of the expertise already gained by these countries in exploration geology, geophysics and geochemistry. It may also indicate that such expertise is gained from other training institutions.
2. Most of the Asian countries that utilize or plan to utilize their geothermal resources for direct use do not avail of reservoir studies, but concentrate on drilling and geochemistry. Thus, with the discovery of new fields and completion of wells, an increase in training on reservoir management can be expected.
3. Drilling technology is rarely taken as a specialization, which may indicate their good experiences in oil and gas, or mining ventures in these countries. UNU/GTP, however, should look into the possibility that these countries do not have the drilling technology and expertise, and may be continuously relying upon foreign drilling contractors for their needs.
4. Environmental studies are commonly taken by participants from countries with geothermal power plants. With the increasing awareness on sustainable development, attendance in the course on environmental studies may increase even in the early stages of geothermal development.
5. Philippine and Indonesian experiences show that there is a need for continued specialization even after successful geothermal projects are undertaken, for sustained expertise in the local geothermal industry, especially in Government.

5 Conclusions

Asia plays a significant role in the world geothermal scene both in terms of power generation and direct utilization. The contribution of the UNU/GTP in the geothermal development of Asian countries is undeniably enormous in terms of efficiency of operations of geothermal fields, lessening exploration risks, as well as in the professional growth of ex-Fellows. Inasmuch as the courses are tailor-made for each Fellow, the UNU/GTP continues to be relevant and in a way “personal” or sensitive to the immediate training needs of the country. Lastly, the UNU/GTP is contributing towards enhancing human resource development in the participating countries, and is helping them to be eventually self-reliant in terms of technical expertise in the different phases of geothermal development.

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