

UNU-GTP AND GEOTHERMAL TRAINING FOR AFRICA

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ABSTRACT

The United Nations University Geothermal Training Programme (UNU-GTP) has operated in Iceland since 1979 offering six month annual courses for professionals from developing countries. The aim is to assist developing countries with geothermal potential in capacity building in order to make the countries self sufficient in expertise for geothermal development. The training is tailor-made to suit the needs of the home country. Since 2000, the possibility has also opened for some UNU Fellows to extend their studies to MSc level with the six months training adopted as an integral part (30 out of 120 ECTS). In 2008, the possibilities were expanded further to include PhD studies.

As a contribution to the UN Millennium Development Goals, the UNU-GTP has expanded its activities with “annual” workshops/short courses in Africa (started in Kenya in 2005), Central America (started in El Salvador in 2006), and Asia. The events have been organized in cooperation with local energy agencies responsible for geothermal development. The aim is not only to increase capacity building, but also to further geothermal cooperation and to reach out to countries with interest in geothermal development which have not yet received quality training. Discussions are now underway with interested financial partners, looking at the feasibility of this developing into regional geothermal centres, under the UNU-GTP umbrella. An off-spring has also been the decision of UNU-GTP in offering short courses that can be tailor-made to the needs of a client from a developing country with local or external sponsors, with the first such events taking place in 2010.

Africa is a major cooperating partner of the UNU-GTP and a priority area within the UN system. Amongst the 452 UNU-GTP graduates (1979-2010), 129 or 29% have come from twelve African countries. Moreover, 12 of 25 UNU MSc-graduates are from 5 countries of Africa. The first two UNU PhD-Fellows are also Kenyans. Kenya is the leading country in geothermal development in East Africa, and many of their specialists have been trained in Iceland. The close cooperation between UNU-GTP, on one hand, and KenGen and more recently also GDC, on the other, has been the key to the successful annual Short courses given in Kenya from 2005, from which all countries in the region with geothermal potential have benefitted. The UNU-GTP expects to see other African countries succeed in geothermal development and is determined to continue to provide the training opportunities that the region needs.

Keywords: Geothermal Training, Short Courses, Africa

INTRODUCTION

The United Nations University (UNU) was founded in 1975 with an aim to build a global university, with special focus on assisting developing countries. Its headquarters are in Tokyo, but teaching is conducted in various centres around the world. The Geothermal Training Programme is operated within Orkustofnun - the National Energy Authority of Iceland. Orkustofnun became an Associated Institution of the UNU in 1978 and the UNU Geothermal Training Programme (UNU-GTP) has been in operation since 1979.

The aim of the UNU-GTP is to assist developing countries with significant geothermal potential to establish groups of specialists in geothermal exploration and development. This has been done by offering 6 months intensive training in the various fields that are needed in the exploration and development of geothermal resources. An MSc programme was initialized in 2000 in cooperation with the University of Iceland, and a PhD programme was opened in 2008, also in cooperation with the University of Iceland, providing more advanced academic opportunities in geothermal sciences or engineering. From 2005, core funding has also been secured for additional training efforts, taking the training to the developing countries, through regular workshops/short courses hosted in cooperative countries on different continents, as a part of efforts related to the UN Millennium Development goals. Finally, this has also opened up possibilities on offering short courses fulfilling special needs of a paying customer, with the first such courses held in 2010.

The paper describes the operations of the UNU-GTP with special reference to the activities and needs in Africa.

GEOTHERMAL TRAINING IN ICELAND

Since 1979, the UNU-GTP has held annual six month courses for professionals from developing countries. Nine specialized lines of training are offered: Geological Exploration, Borehole Geology, Geophysical Exploration,

Borehole Geophysics, Reservoir Engineering, Chemistry of Thermal Fluids, Environmental Studies, Geothermal Utilization and Drilling Technology (www.unugtp.is). Each trainee attends only one specialized line of study. The trademark of the training is to give university graduates engaged in geothermal work intensive on-the-job training in their chosen fields of specialization. The trainees work side by side with geothermal professionals in Iceland. The training is tailor-made for the individual and the needs of his institution/country. Table 1 shows the time schedule for the training.

A significant part of the practical training is conducted in connection with individual research projects. In most cases the participants bring with them data from geothermal projects in their home countries, but sometimes the research projects are integrated with geothermal exploration or utilization projects that are in progress in Iceland at the time of training. The project topic is always selected with respect to the status in the home country of the participant. All project reports have been published by the UNU-GTP, and since 1994, reports have been collected in the annually published book "Geothermal Training in Iceland", with the international publishing code (ISBN 978- 9979-68 / ISSN 1670-7400). Copies of the book can be obtained upon request. The reports are mailed regularly to former UNU Fellows and many of the leading geothermal institutions in developing countries. The complete reports can also be accessed from the home page (www.unugtp.is) in a pdf version.

Table 1: Time schedule for the six month specialized courses at UNU-GTP

Week	Geological Exploration	Borehole Geology	Geophysical Exploration	Borehole Geophysics	Reservoir Engineering	Environmental Studies	Chemistry of Thermal Fluids	Geothermal Utilization	Drilling Technology
1	Lecture course on all main aspects of geothermal energy exploration and utilization, practicals and short field excursions								
2									
3									
4									
5									
6	Field geology	Drilling	Resistivity methods	Course on well logging and reservoir engineering including: Logging and well testing practises Reservoir physics Reservoir simulation Tracer tests Computer programs	EIA Project planning Chemistry Physics Biology Monitoring Revegetation Health and safety	Sampling of fluids and gas		Drilling equipment Drilling procedures Well design Safety Management Rig operations	
7	Maps and photos	Petrological logging	Thermal methods			Analytical methods	Scaling and corrosion		Heat transfer and fluid flow Control systems
8	Structure analysis	Alteration	Magnetics			Thermodynamics			
9	Hydrogeology	Mineralogy	Gravity			Geothermometers			
10									
11	Excursion to the main geothermal fields of Iceland								
12									
13	Field work in deeply eroded strata	Aquifers Modelling	Data processing techniques	Logging methods Data evaluation	Responses to exploitation	Gas dispersion and abatement	Water rock interaction	Design of plants and systems	Cementing Completion
14									
15	Project and report	Project and report	Project and report	Project and report	Project and report	Project and report	Project and report	Project and report	Project and report
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									

Participants for the 6 months training are selected by private interviews during a site visit to the country in question, where a UNU-GTP representative assesses geothermal fields, research institutions and energy utilities. Candidates must have a university degree in science or engineering, a minimum of one year practical experience in geothermal work, speak English fluently, have a permanent position at a public energy company, utility, research institution or university, and be under 40 years of age. Participants from developing countries have received Fellowships financed by the Government of Iceland and the UNU that cover international travel, tuition fees, and per diem in Iceland. Other international agencies, such as The UNDP, the International Atomic Energy Agency (IAEA) and more recently a few other institutions have also financed fellowships for a few trainees through the years.

Since the foundation of the UNU-GTP in 1979, 452 scientists and engineers from 47 countries have completed the annual six month specialized courses offered (Figure 1). Of these, 42% have come from countries in Asia, 29% from Africa, 15% from Latin America, and 14% from Central and Eastern Europe. The largest groups have come from China (75), Kenya (53), Philippines (31), El Salvador (30), Ethiopia and Indonesia (27). In many countries, UNU-GTP graduates are among the leading specialists in geothermal research and development.

For the past few years, the regular funding of the UNU-GTP has allowed financing of six months training of about 18-20 UNU Fellows per year, with additional 1-3 UNU Fellows per year being financed through other sources, at least partially. However, our current set-up in Iceland, makes it possible to accept a few additional fellows if financed through external sources. This is reflected in the largest group to date in 2010, with 28 UNU Fellows, 8 of whom (6 Kenyans and 2 Nicaraguans) are mainly financed through other agencies. Figure 2 shows the UNU Fellows of 2010, 13 of whom come from Africa. The statistics show that the participation of African fellows has gradually grown and has reached 33% for the past 10 years (2001-2010), and half of those participating in the last 2 years have come from Africa (see Figure 1). This reflects the high current priority of Africa at UNU-GTP, as in the UN system in general.

The aim of establishing an MSc programme in cooperation with the University of Iceland (UI) was to go a step further in assisting selected countries in building up their specialist groups and to increase their geothermal research capacity. Since 2001, 25 former UNU Fellows (China 1, Djibouti 1, El Salvador 2, Eritrea 1, Ethiopia 2, Indonesia 3, Iran 3, Jordan

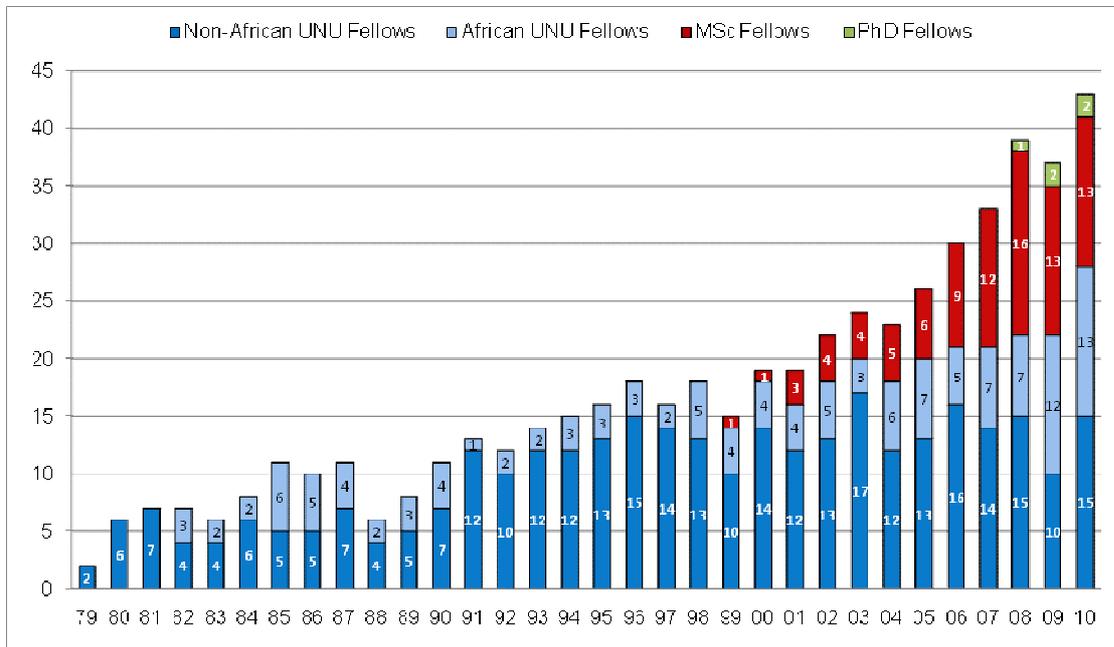


Figure 1: Number of UNU Fellows being trained and doing studies in Iceland 1979-2010 – the share of Africa for each year of the 6 months training is emphasized

1, Kenya 7, Mongolia 1, Philippines 2, and Uganda 1) have completed an MSc degree in geothermal science and engineering through the UNU-GTP MSc programme with 12 or 48% coming from Africa. In addition, eight are doing their MSc studies in Iceland in the autumn of 2010, 3 of whom come from Africa. The six months training at the UNU-GTP fulfils 25% of the MSc programme credit requirements (30 of 120 ECTS). The MSc theses have been published in the UNU-GTP publication series, and can also be obtained from the UNU-GTP webpage (www.unugtp.is). All of the MSc Fellows have been on UNU Fellowships funded by the Government of Iceland.



Figure 2: UNU Fellows in Iceland for 6 months training in 2010

Four former UNU Fellows, all of whom come from Africa, have now been admitted to PhD studies at the University of Iceland, with the first two admitted in the academic year 2008-2009. The two first ones are on UNU Fellowships (both from Kenya) while the other two (from Djibouti and Eritrea) are funded through other sources in Iceland.

For a more detailed description of the general operations of the UNU-GTP see Fridleifsson (2010) or the UNU-GTP webpage (www.unugtp.is).

SHORT COURSES IN AFRICA

Introduction

At the UN Summit Meeting on Sustainable Development in Johannesburg in 2002, the Icelandic Government announced that its contribution to the goals of the conference would be to finance increased operations of the UNU-GTP to enhance the use of geothermal resources for power production, thus, allowing the UNU-GTP to expand its capacity building activities, through workshops and short courses in geothermal exploration and development in selected developing countries. At the International Conference for Renewable Energies in Bonn in 2004, this contribution to the UN Millennium Development Goals was outlined further, and targeted to comprise annual workshops / short courses in East Africa to start in 2005, in Central America to start in 2006, and in Asia to start later (Fridleifsson, 2004). From the year 2005, the Government of Iceland has secured the necessary core funding for the UNU-GTP to carry out these plans.

The courses/workshops are set up in a selected country in the target region through cooperation with local energy agencies / utilities and/or earth science institutions, responsible for exploration, development and operation of geothermal facilities in the respective countries. In implementation, the first phase has been a week long workshop during which decision makers in energy and environmental matters in the target region have met with the leading local geothermal experts and specially invited international experts. The status of geothermal exploration and development has been introduced and the possible role of geothermal energy in the future energy mix of the region discussed. The purpose has, on one hand, been to educate key decision makers in the energy market of the respective region about the possibilities of geothermal energy and increase their awareness of the necessity for more effort in the education of geothermal scientists in the region, and, on the other hand, to further the cooperation between specialists and decision makers in the different countries. The workshop is followed by “annual” specialized short courses for earth scientists and engineers in surface exploration, deep exploration, production exploration, environmental studies and production monitoring etc., in line with the type of geothermal activity found in the respective region, and the needs of the region.

Presently, Workshops for Decision Makers have been held for East Africa (in Kenya 2005), for Central America (in El Salvador 2006) and for Asia (in China in 2008). Specialized Short Courses have since been held annually in Africa (Table 2) and almost annually in Central America, with the next courses scheduled to be held in Africa and Central America in late 2009 / early 2010. Material presented and written for these events has been published on CDs and is also available on the website of the UNU-GTP (www.unugtp.is). These series of Short Courses are expected to develop into sustainable regional geothermal training centres.

The African series of Short Courses

During the planning of the first Workshop, the priority region was East Africa with its huge and to a large extent unused potential for geothermal power development, and urgent need for development. Cooperation was sought with the Kenya Electricity Generating Company – KenGen. Kenya has been the leading African country in geothermal development, with 167 MWe on-line in 2009, expected to go beyond 200 MWe in 2010 (Simiyu, 2010), and KenGen has been the main authority in charge of that development. UNU-GTP had also had a long and fruitful cooperation with KenGen through its training activities. Hence, it was clear that KenGen had the knowledge and capability to act as a strong and active partner in this project. A cooperation contract was signed in early 2005. The Lake Naivasha area in the southern part of the Kenyan rift was chosen as the main site for the Short Courses, due to the vicinity of the active Olkaria high-temperature geothermal system and its geothermal power plants. In 2009, the newly formed Geothermal Development Company – GDC in Kenya, which has taken over many of the responsibilities of KenGen as well as staff members, came in as an additional cooperation partner. The cooperation has generally meant that the costs of all invited foreign participants (travels and accommodation) and non-local lecturers (salaries, travels and accommodation) are covered by the UNU-GTP and the Icelandic Government, while the costs of the local Kenyan participation and some of the local arrangements are born by KenGen, and from 2009 also GDC. KenGen and GDC have proven to be first-class hosts and have made excellent arrangements for the Workshop and Short Courses.

The first course in Africa (“*Workshop for Decision Makers on Geothermal Projects and their Management*”) was held in Kenya in November 2005 in cooperation not only with KenGen, but also ICEIDA (Icelandic International Development Agency) and UNEP (United Nations Environment Programme). The 5 day Workshop was held after six nations in East Africa with good geothermal potential had decided to join forces and increase their cooperation in geothermal research and development within the so-called African Rift Geothermal Facility (ARGeo). Here the UNU-GTP had accepted to play a leading role in guiding and implementing the capacity building component of ARGeo, and the Workshop was intended to be the first step in that process.

The aim of the Workshop was, as outlined above, to get together high-level decision makers from the energy companies / institutions in the region, to make them better informed about the main phases of geothermal development and what kind of manpower, equipment, and financing is needed for each phase, and analyse what was available in the region. Participation was by invitation only, as has been for all other events. High-level decision makers from five of the six ARGeo countries (Eritrea, Ethiopia, Kenya, Tanzania, and Uganda, but missing Djibouti) attended the Workshop, plus lecturers from Ethiopia, Iceland, Kenya and The Philippines. As listed in Table 2, 30 participants attended including the local lecturers that were active in all phases of the Workshop. In addition, 4 Icelandic lecturers attended the event and 1 from the Philippines (Table 3). Figure 3 shows the participants and lecturers.

From the good attention of the participants and their active participation in the discussion, it was clear that the Workshop achieved its aim, and that there was indeed need for increased capacity building in the region. Sixteen papers were written, presented and distributed as conference proceedings and on a CD-ROM (Fridleifsson et al., 2005).

Table 2: Participants in the Workshop and Short Courses in East Africa 2005-2009

Country	Kenya 2005*	Kenya 2006	Kenya 2007	Kenya 2008	Uganda 2008	Kenya 2009	Total
Algeria			1				1
Burundi				2	1	2	5
Congo				1	1		2
Djibouti		2	1	2	3	2	10
Egypt			1				1
Eritrea	2	3	2	2	1	2	12
Ethiopia	5+2	3	1	2	3	3	19
Kenya	6+9	10	13	18		21	77
Rwanda			2	2	1	3	8
Tanzania	2	2	2	2	4	3	15
The Comoros			2			2	4
Uganda	4	3	3	2	5	3	20
Zambia				2	2	2	6
Yemen			2	2	1	2	7
Others					2		2
Total	30	23	30	37	24	45	189

* The second number shows African lecturers, most of whom also

participated fully in other parts of the Workshop

One of the results of the Workshop was that the Short Courses in East Africa should focus on surface exploration which was the field acutely needed for most countries in the region. These Short Courses have been an annual event since 2006. Table 4 gives an overview of the events, while Table 2 shows the participation from various countries and Table 3 lists the lecturers. The first Short Course was the 10 day “*Short Course on Surface Exploration for Geothermal Resources*” held in November, 2006. The purpose was to give “a state of the art” overview of the methods used in surface geothermal exploration, and discuss the status and possibilities of geothermal development in East Africa. This was achieved through a first half with scientific lectures covering the three important fields of surface exploration of geothermal resources, i.e. geology, geophysics and chemistry of thermal fluids, including many case examples, while the second half included presentations and discussions on the status of the



Figure 3: Participants in the Workshop for Decision Makers on Geothermal Projects and their Management held at Naivasha, Kenya, November 14-18, 2005

Table 3: Lecturers in the UNU-GTP Workshops and Short Courses in East Africa 2005-2009

Short course / Workshop	Total	Home country	Neighbour. countries	Internat.	Iceland	UNU-Fellows
Kenya 2005	16	9	2	1	4	8
Kenya 2006	20	11	5	0	4	15
Kenya 2007	25	16	4	0	5	18
Kenya 2008	28	19	5	0	4	23
Uganda 2008	15	1	7	2	5	8
Kenya 2009	35	27	4	0	4	26

exploration in the different countries and practical training including field demonstrations and use of computer programs. The Short Course was very well received and from the results of an assessment meeting of all participants and lecturers during the last day, it was clear that the Short Course had been a success. The basic model was one that should be repeated but suggestions were made of improvements and additions.

Table 4: UNU-GTP Workshops and Short Courses held in East Africa 2005-2010 as a part of the UNU Millennium Development goals

Event	Main site	Dates	Duration (days)
Workshop for Decision Makers on Geoth. Projects & their Man.	Naivasha	Nov. 14-18, 2005	5
Short Course on Surface Exploration for Geothermal Resources	Naivasha	Nov. 13-22, 2006	10
Short Course II on Surface Exploration for Geothermal Resourc.	Naivasha	Nov. 2-17, 2007	16
Short Course III on Exploration for Geothermal Resources	Naivasha	Oct. 24 - Nov. 17, 2008	25
Short Course on Geothermal. Project Management & Developm.	Entebbe	Nov. 20-22, 2008	3
Short Course IV on Exploration for Geothermal Resources	Naivasha	Nov. 1-22, 2009	22
Short Course V on Exploration for Geothermal Resources	Naivasha	Oct. 29 - Nov. 19, 2010	22

During the last 5 years, the annual Short Course at Naivasha has gradually developed into a more general course on geothermal exploration. In 2007, a few days of field work and demonstrations were added at the start of the course. This part has been held at Lake Bogoria in the Central Kenyan rift and has been entirely handled by the KenGen/GDC staff. And in 2008, 4 days of project work were added at the end of the course, which at that time had become 3½ week long. This model was followed in 2009. The topic of the Short Courses has also gradually broadened by adding varying types of lectures to its content, including environmental science, resource assessment, project planning, drilling technology, well logging, well siting and an introduction to geothermal power plants. As an example, Table 5 shows the set up of the “*Short Course IV on Exploration for Geothermal Resources*” held in November 2009. Figure 4 shows the participants in the 2009 Short Course. The 2010 Short Course is planned to be in a similar mould.

Presentations and papers specially written for the Short Courses have been published on CDs and distributed to participants, lecturers and others interested (Georgsson and Simiyu, 2006; Georgsson et al., 2007; Georgsson et al., 2008a; Georgsson et al., 2009).

Table 5: The structure of “Short Course IV on Exploration for Geothermal Resources” held at Lake Bogoria and Naivasha, Kenya, November 2009

Dates	Programme	No. lectures	Practicals	Lecturer/Supervisor		
				Local	Neighb.	Iceland
1. Nov.	Arrival at Lake Bogoria					
2. Nov.	Introductory lectures	8		8		
3.-6. Nov.	Site visits to geothermal areas and geothermal field work		X	8		
7. Nov.	Site visit and drive to Lake Naivasha		X			
8. Nov.	Geothermal energy, power plants, drilling, etc.- Lectures	5		4		2
9. Nov.	Geothermal activity and geology – Lectures & mapping	6	X	3		1
10.-11.No.	Geophysics – Lectures & interpret.	14	X	3		2
12. Nov.	Chemistry of thermal fluids – Lectures and interpretation	8	X	2		1
13. Nov.	Practical sessions in geophysics and chemistry		X	4		2
13. Nov.	Hydrology, resource assessment,	4		4		

14. Nov.	logging and well siting Excursion – Olkaria geothermal field, power plant and drilling rigs			2		4
15. Nov.	Environmental science – lectures and measurements	5	X	6		1
16.-17. No.	Status of geothermal in E-Africa – Planning projects	15	X	3	5 (+ 5)*	
18. Nov.	Case examples	5	X	1		3
19.-21. No.	Project work in groups		X	7		3
22. Nov.	Project presentations, course review, closing ceremony	(8)	X	1		1
23. Nov.	Departure participants – Instructors assessm. meeting					

* Trainees from countries outside ARGeo gave lectures on geothermal in their countries, shown in parentheses



Figure 4: Participants in the 2009 Short Course with the Olkaria II power plant in the background

A special addition in November 2008 was the “*Short Course on Geothermal Project Management and Development*”. This three day event, given in Entebbe, Uganda, was co-organized by the UNU-GTP, KenGen and the Ministry of Energy and Mineral Development (DGSM) in Uganda. The timing and location of the Short Course was scheduled prior to the ARGeo C-2 conference to strengthen this event. ARGeo may not have developed into the forum it was scheduled to become but its biannual conferences have become very important venues for cooperation and exchange of ideas and information for the geothermal community in East Africa, and are worthy of good support. The Short Course was mainly aimed at high level managers/employees in ministries / energy companies / research institutions in East Africa. The participants came from 10 countries in East Africa and Yemen (Table 2). Teaching and organization was partially in the hands of experts from Kenya, Ethiopia and Uganda, all former UNU Fellows, and partially in the hands of five Icelandic and two international experts in geothermal utilization and development from El Salvador and the Philippines (Table 3). The lectures

(Georgsson et al., 2008b) and project work covered the status of geothermal energy in the world, with emphasis on East Africa, phases of geothermal development, resource assessment and geothermal project planning and management. The intention was to promote and improve focus in planning of geothermal projects in the region to move the development of geothermal resources into the production stage. The course was well received and seemed to add an important piece to the capacity building in the region.

Participation in the Short Courses in Kenya has increased with every year, not least due to the big pressure on capacity building in Kenya itself, needed for its intended fast-tracking of geothermal development in the next few years. New countries have also been added to those invited most years, and in some cases, like for D.R. Congo, Rwanda, The Comoros, Yemen and Zambia, they were participating for the first time in UNU-GTP events. Yemen has been included despite being on the other side of the Red Sea and thus in Asia, as it has common geological features with East Africa. The highest number of participants in a single event is 45 for the 2009 Short Course, and the total number of participants is now reaching close to 200 persons (Table 2). Similarly, the number of lecturers has increased with the length of the Short Courses as can be seen from Table 3, which also shows that most of the African lecturers/supervisors are former UNU Fellows trained in Iceland.

Results of the Short Courses

The Short Courses in East Africa have certainly proven to be a valuable addition to the capacity building activities of the UNU-GTP in Africa. They are now established as a good first training opportunity for young African scientists and engineers engaged in geothermal work. They have been given an introduction to state-of-the-art exploration techniques for geothermal resources and the possible development of this valuable renewable energy source. In total, 157 Africans (including Yemen) participated in the Short Courses during 2006-2009 compared to a total of 34 UNU Fellows from Africa (including Yemen) being trained for 6 months in Iceland during the same period. Furthermore, the Short Courses have become a new channel to the more advanced training in Iceland with the strongest participants showing their ability and strength, and thus opening the possibility to be selected to go for training in Iceland. There are now many examples of good participants in the Short Courses being selected for the 6 months training in Iceland. And in four cases it has even led to MSc studies in Iceland (Georgsson et al., 2008c; Fridleifsson and Georgsson, 2009), first of whom completed his MSc in April 2010.

The Short Courses have also been an important element towards increased cooperation between the countries in East Africa. Here, Kenyans have mainly been in the role of the donor, while countries like Rwanda, The Comoros and Zambia, have utilized their knowledge and contracted them for local exploration projects. Similarly, geothermal exploration projects financed by ICEIDA, e.g. in Djibouti and Eritrea, have been carried out partly with the assistance of a multinational group including their neighbouring countries.

The UNU-GTP foresees a further development of the Short Courses in Africa, and hopes that in the near future they may develop into a permanent school for geothermal training. Additional countries may also get entrance to the courses though most countries in East Africa blessed with considerable geothermal potential have now already sent some participants to the Short Courses.

For a further description of the Workshops / Short Courses of the UNU-GTP see Georgsson (2010) or the UNU-GTP webpage (www.unugtp.is).

Customer-designed short courses

The latest capacity building service of the UNU-GTP has been to offer customer-designed short courses in developing countries, done for the first time in 2010. This new service of the UNU-GTP has been triggered by an urgent need for training in countries planning fast-tracking of geothermal development, while it has also been an offspring of the regular training and Short Courses and the material prepared there. This has proven a good opportunity for some countries/institutions in need of a rapid capacity building process, beyond what UNU-GTP can service under its conventional operations, and which have themselves the strength or the support of external mechanisms to finance such events. The paying customer defines the outline of the Short Course, while UNU-GTP is a guarantee of the quality of the content. The first such courses have been held in 2010 for four different customers in 3 countries. The contents have varied from general geoscientific courses to geothermal drilling, or scaling and corrosion in geothermal installation.

RESULTS OF THE UNU-GTP TRAINING FOR AFRICA AND FUTURE PLANS

UNU-GTP has, through its training programme in Iceland, given 129 Africans the opportunity of intensive 6 months training in geothermal sciences or engineering, since its start in 1979. In recent years, with larger groups and higher priority to Africa, its share has risen to about 29%, of the total. If we, however, look at it in a shorter

term, during the last 10 years, the African participation has been 33%, while during the last 2 years, half of the UNU Fellows have come from Africa, or 25 out of 50, some though financed through external sources. The large majority of the UNU Fellows from Africa is still active in geothermal exploration and development.

High priority has also been given to Africa in selection of candidates for MSc and PhD studies in Iceland on a UNU-GTP Fellowship. To date 25 MSc Fellows have completed their studies at the University of Iceland, of which 12 (48%) are Africans. The first 2 PhD Fellows are both Kenyans, and two additional former UNU Fellows have now also started their PhD studies at the University of Iceland (from Djibouti and Eritrea), both funded through Icelandic sources.

With the Millennium Workshops and Short Courses, the UNU-GTP has reached a much wider audience than before. Almost 200 African scientists and engineers (including Yemen) have participated in these Series during 2005-2009 (Table 2), and about 40 additional individuals from the region have lectured in the events. This can be compared with the 38 UNU Fellows from Africa and 3 from Yemen that received 6 months training in Iceland during the same period.

The Short Courses have also opened up new connections. In East Africa, key geothermal scientists in the region are lecturing and supervising the young and promising scientists, with the knowledge thus being transferred from one generation to the next. They have also created bonds and friendship between individuals with different background and across boundaries, which can only help the development of geothermal in the region.

An important part in the development of these Series is also how they have come to act as a channel to the more advanced training in Iceland for some of the best participants. Many of the East Africans participating in the Short Courses have now come for 6 months training in Iceland and a few have already continued for MSc studies.

Most important is though that these Series are expected to develop into a sustainable regional geothermal centre under the umbrella of the UNU-GTP. The idea is now under discussion and external financing partners have shown interest in participating and turning this into reality. The idea has also been presented and accepted at the headquarters of the United Nations University in Tokyo. Here the financial crisis may have delayed action but hopefully this can be seen turning into reality during the next two year.

In 2010, the UNU-GTP has also opened a new service in offering customer-designed short courses. This has been a good opportunity for some countries in a fast-tracking developing mode of geothermal, which have had themselves the strength or had the support of external mechanisms to finance it. The first such courses have been held in 2010 for four different customers in 3 countries. The UNU-GTP foresees that service of this type may become an important part of its operations in the near future.

The financial crisis in the world has hit Iceland badly. In recent years, the operations of the UNU-GTP have almost solely been financed by the Government of Iceland (>90%). Even though the Government has emphasized that development aid through UNU-GTP has a high priority, some cut-downs are foreseen, which may affect the operations of the UNU-GTP to some extent in the near future, after a long period of continuous expansion. The 6 months training in Iceland is the cornerstone of the UNU-GTP operations and will continue to be so along with the more advanced studies for an MSc or a PhD degree. The UNU-GTP Millennium Series of Short Courses will though certainly get its fair share, and will be continued as possible with East Africa having a priority here. Expansion is unfortunately hardly in the framework until the financial climate in Iceland has improved, except based on external financing, which though seems to be a realistic possibility despite the difficult international economic climate.

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