

Lifting E-Africa to a New Level in Geothermal Development – the UNU-GTP Capacity Building Activities for Africa

Lúdvík S. Georgsson

UNU Geothermal Training Programme
Orkustofnun, Grensásvegi 9, IS-108 Reykjavík, ICELAND

lsg@os.is

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ABSTRACT

The United Nations University Geothermal Training Programme (UNU-GTP) in Iceland specializes in capacity building for geothermal exploration and development for professionals from developing countries. This has been achieved through training and post-graduate academic studies in Iceland and, more recently, also through short courses, workshops and hands-on training in the developing countries themselves. The annual six month training in Iceland is the core of the programme and Africa is a priority area within the UN system. With the increasing geothermal development in E-Africa the UNU-GTP is putting more emphasis than ever on capacity building for Africa.

In 2013, 21 out of 34 six month UNU Fellows in Iceland came from Africa. Of 583 UNU Fellows who have completed the 6 month training in 1979-2014, 210 or 36% have come from 16 African countries. Included here are 5 Kenyan geologists, who were given similar training by the UNU-GTP in their home country in 2012-2013. In addition, 20 of 40 UNU-GTP MSc-graduates to date are from 6 African countries, and the first three PhD-Fellowships have gone to Kenyans, with the first UNU-GTP PhD Fellow defending her PhD degree in February 2013. Most of the UNU Fellowships have been financed by the Icelandic Government, while some have been sponsored through local institutions.

Many courses and training initiatives have also been offered by UNU-GTP on-site in Africa in the last 5 years, both through UNU-GTP's own initiative, or sponsored by local energy agencies or active development agencies. These training activities were initiated with a series of annual Workshops/Short Courses, starting in Africa (Kenya) in 2005 and in Central America in 2006, funded by the Icelandic Government as its contribution to the UN Millennium Development Goals. The aim has not only been to increase capacity building, but also to further regional cooperation in geothermal development and to reach out to new countries with geothermal capacity and interest in its development. The week-long "Workshop for Decision Makers" in Kenya in 2005 was followed by annual Short Courses, first aimed only at surface exploration, but gradually extended to 3½ weeks to cover most aspects of geothermal exploration and an introduction to development. In this annual event, UNU-GTP has worked closely with Kenya, through KenGen and since 2009 also GDC. With 70 participants in the Short Course given in November 2013, more than 430 individuals from 21 countries in Africa (including Yemen) have benefitted from this training since its start in 2005.

These series have also provided a basis that has made it possible for the UNU-GTP to go one step further, and offer customer-designed Short Courses in line with the needs of clients from the developing countries through local or external financial mechanisms. Since 2010, this has become an important and increasing part of the operations of UNU-GTP, which countries like Kenya and Rwanda have benefitted considerably from.

The increased emphasis on development of geothermal resources, currently experienced in E-Africa, and especially in Kenya in association with the goals set forward in Vision Kenya 2030, has though created an overwhelming demand, which the current capacity building activities on offer, through UNU-GTP in Iceland, Auckland University in New Zealand and local universities, have had difficulty in meeting. To keep the momentum of development going and meet this demand it is therefore extremely urgent to take the local training to a new level. Here, the next step should be the establishment of a Regional Geothermal Training Centre for East Africa, located in Kenya. The UNU-GTP wants to assist in this, preferably through cooperation with GDC and KenGen, a Kenyan University, and the African Union, and with the assistance of international sponsors and donors. Here we need to see a breakthrough in 2014-2015. A similar set-up is now in operation in El Salvador for Latin America with the completion of the first Diploma Course under a similar umbrella in December 2013.

1. INTRODUCTION

The United Nations University Geothermal Training Programme (UNU-GTP) was established in Iceland in 1978. The task of UNU-GTP is to help developing countries with significant geothermal potential to establish groups of specialists in geothermal exploration and development that have the basic knowledge necessary for geothermal development. Since 1979, annual six-month courses have been held in nine different lines of geothermal and environmental science, and engineering for professionals from developing countries. The hallmark of UNU-GTP is to give university graduates engaged in geothermal work intensive on-the-job training in their chosen fields of specialization. The programme is hosted at Orkustofnun – The National Energy Authority of Iceland. During 1979-2014, 583 scientists and engineers from 58 countries have completed the six month course (Figure 1).

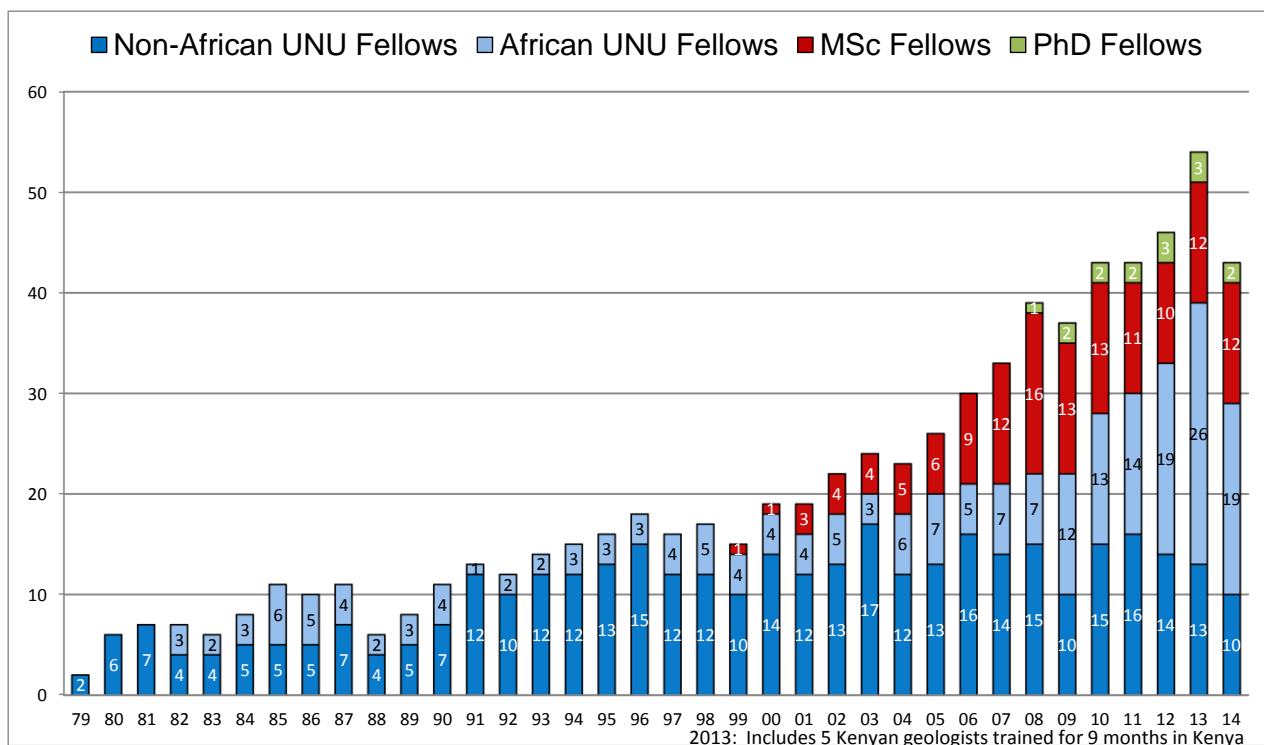


Figure 1: UNU Fellows completing the 6 month training and studying for MSc and PhD in Iceland in 1979-2014.

An MSc programme in geothermal science and engineering was started in 2000 in cooperation with the University of Iceland, and a PhD programme in late 2008. In late 2014, 40 MSc Fellows are expected to have completed their degree, with 12 pursuing their studies. Half of these 40 MSc Fellows have come from Africa. Similarly, the first PhD Fellow defended her thesis in 2013, with 2 pursuing their studies, all from Kenya.

From 2005, funding has also been secured for additional training efforts, taking the training to the partner countries. This was Iceland’s official contribution to the UN Millennium Development Goals, and has been implemented through regular workshops/short courses hosted in selected countries on different continents, in cooperation with local energy institutions/companies (Fridleifsson, 2004; Georgsson 2010). 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 is introduced and the possible role of geothermal energy in the future energy mix of the region discussed. The purpose is to educate key decision makers in the energy market of the respective region about the possibilities of geothermal energy, increase the awareness of the necessity for more effort in the education of geothermal scientists in the region, and to further the cooperation between specialists in the different countries of the region. This is followed by specialized Short Courses for earth scientists and engineers on surface exploration, deep exploration, production exploration, drilling, resource assessment, utilization, operation and management, production monitoring, environmental issues, planning and financial aspects etc., in line with the type of geothermal activity and the needs of the respective region. These have been referred to as the “UN Millennium Short Course Series”. 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) (Fridleifsson, 2010; Georgsson 2010). Specialized Short Courses have since been held annually in Africa and almost annually in Central America. Material presented and written for these events has been published on CDs and is also available on the website of UNU-GTP (www.unugtp.is) under publications.

The need for geothermal training has now grown well beyond what UNU-GTP is able to fulfil and service through its regular financing from the official development assistance (ODA) of the Government of Iceland. This has led to requests for additional services, backed up by local or international financial sponsorship. To this can be added that a lot of teaching material has been prepared through the UN Millennium Short Course Series. Together these factors played a major role in the decision of UNU-GTP to take its training activities one step further and offer courses or training fulfilling special needs of a paying customer. A formal decision on this was taken in 2009 with the first such event held in early 2010. These services with customer-designed courses and training have been increasing with every year and are now an integral part of the operations of UNU-GTP. The content of these events has varied significantly, based on the needs of the respective client. It has covered both regular Short Courses and hands-on training, and the time frame has varied from 2 days to 6 months for individual events.

This paper describes the operations of UNU-GTP, with special reference to on-site capacity building activities in Africa, concluding with some scope being given to possible future development.

2. THE UN MILLENNIUM SHORT COURSES

2.1 The East African Series

2.1.1 Introduction

It was easy to choose the region for the first event associated with Iceland's contribution to the UN Millennium Development Goals. East Africa with its huge, and to a large extent, unused potential for geothermal power development was the obvious choice, and more specifically Kenya, the leading African country in geothermal development, with about 127 MWe on-line in 2004 (Mwangi, 2005). Cooperation was sought with the Kenya Electricity Generating Company (KenGen), the main authority responsible for geothermal development in Kenya at that time. UNU-GTP had also had a long and fruitful cooperation with KenGen (and its predecessors) through training of its personnel in Iceland. KenGen had the knowledge and capability to act as a strong and active partner in this project. 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 presence of the active Olkaria high-temperature geothermal system and its geothermal power plants in the vicinity.

The first event in Africa ("Workshop for Decision Makers on Geothermal Projects and their Management") was held in Kenya November 14-18, 2005. The 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 UNU-GTP had accepted to play a leading role in guiding and implementing the capacity building component of ARGeo. The Workshop was intended to be the first step in this capacity building process.

The aim of the Workshop was to make high-level decision makers in the energy sector, better informed about the main phases of geothermal development and what kind of manpower, equipment, and financing is needed for each phase, and what was available in the region. Participation was by invitation only, as has been for all the following events, from five of the six ARGeo countries (Eritrea, Ethiopia, Kenya, Tanzania, and Uganda), plus lecturers from Ethiopia, Iceland, Kenya and the Philippines. In all, 35 participants attended, including the lecturers (Tables 1-3). KenGen proved to be a first-class host and made excellent arrangements for the Workshop. From the great 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 (Fridleifsson, 2010; Georgsson 2010).

2.1.2 The short courses

At the Workshop it was recommended that short courses focussing on surface exploration, the field of study acutely needed for most countries in the region, would follow the Workshop. These Short Courses have been given annually in Kenya since 2006. Table 1 gives an overview of the events, while Table 2 shows the participation from various countries, and Table 3 lists the number and background of the lecturers.

Table 1: Workshop and Short Courses of the UN Millennium Short Course Series, held in East Africa 2005-2014.

Event	Main site	Dates	Duration (days)
Workshop for Decision Makers on Geothermal Projects & their Manag.	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 Resources	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 & Development	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
Short Course VI on Exploration for Geothermal Resources	Naivasha	Oct. 27 – Nov. 18, 2011	23
Short Course VII on Exploration for Geothermal Resources	Naivasha	Oct. 27 – Nov. 18, 2012	23
Short Course VIII on Exploration for Geothermal Resources	Naivasha	Oct. 31 – Nov. 22, 2013	23
Short Course IX on Exploration for Geothermal Resources*	Naivasha	Nov. 2 – 24, 2014	22

* Scheduled at the time of writing

The first Short Course was the ten day "Short Course on Surface Exploration for Geothermal Resources" held in November, 2006. The intention was to give "a state of the art" overview of the methods used in surface geothermal exploration, including also a forum on the status and possibilities of geothermal development in East Africa. The event started with series of scientific lectures covering the three main fields of surface exploration of geothermal resources, i.e. geology, geophysics and chemistry of thermal fluids, including many case examples, while the latter part consisted of presentations and discussions on the status of exploration in the different countries, adding also practical training including field demonstrations and practical use of computer programs (Georgsson, 2010). The Short Course was very well received and based on the results of an assessment meeting of all participants and lecturers during the last day, it was clear that it had been a success. The basic model was one that should be repeated but suggestions were made for improvements and additions, which were realized in the next 2-3 years.

During the last 9 years, the annual Short Course at Naivasha has gradually developed into a general course on geothermal exploration, though still with an emphasis on surface exploration, extending for about 3½ week. The content of the Short Course has gradually been broadened by adding new topics, such as lectures on environmental science, resource assessment, project planning, drilling technology, well logging, well siting and, most recently, an introduction to geothermal power plants. As an example, Table 4 shows the setup of "Short Course VIII on Exploration for Geothermal Resources" which was held in late 2013. Figure 2 shows the participants in the 2012 Short Course.

Table 2: Participants in the Workshop and Short Courses in East Africa 2005-2013.

Country	Kenya 2005*	Kenya 2006	Kenya 2007	Kenya 2008	Uganda 2008	Kenya 2009	Kenya 2010	Kenya 2011	Kenya 2012	Kenya 2013	Total	6 mo. UNU Fellows**
Algeria			1					1			2	1
Burundi				2	1	2	2	1	2	2	12	1
Cameroon										1	1	
Comoros			2			2	3	2	1	1	11	1
Congo				1	1			1	3	3	9	
Djibouti		2	1	2	3	2	2	3	2	3	20	8
Egypt			1								1	1
Eritrea	2	3	2	2	1	2		2		2	16	4
Ethiopia	5+2	3	1	2	3	3	1	3	3	3	29	10
Kenya	6+9	10	13	18		21	31	30	28	32	198	49
Malawi							3	3	2	3	11	2
Morocco							1				1	1
Mozambique							1	1	2	1	5	
Niger										1	1	
Nigeria									2	2	4	
Rwanda			2	2	1	3	3	4	6	3	24	9
Sudan									2	3	5	
Tanzania	2	2	2	2	4	3	3	2	3	2	25	7
Uganda	4	3	3	2	5	3	2	2	3	2	29	10
Zambia				2	2	2	3	2		3	14	1
Yemen			2	2	1	2	1	1	2	2	13	4
Others					2					1	3	
Total	30	23	30	37	24	45	56	58	61	70	434	109

* The second number shows African lecturers, who participated fully in the Workshop;

** UNU Fellows in Iceland for 6 month training during the same period (2005-2013).

Table 3: Lecturers and supervisors in the Workshop and Short Courses in East Africa 2005-2013.

Short Course / Workshop	Home country	Neighbour. countries	Internat.	Iceland	Total	Former UNU-Fellows
Kenya 2005	9	2	1	4	16	8
Kenya 2006	11	5	0	4	20	15
Kenya 2007	16	4	0	5	25	18
Kenya 2008	19	5	0	4	28	23
Kenya 2009	27	4	0	4	35	26
Kenya 2010	27	3	0	4	34	23
Kenya 2011	27	5	0	4	36	27
Kenya 2012	40	4	0	4	48	29
Kenya 2013	40	6	0	4	50	32
Uganda 2008	1	7	2	5	15	8

Table 4: The structure of “Short Course VIII on Exploration for Geothermal Resources“, held at Lake Bogoria and Lake Naivasha, Kenya, in November 2013.

Dates	Programme	No. lectures	Practicals	Lecturer/Supervisor		
				Local	Neighbour.	Iceland
Oct. 31	Arrival at Lake Bogoria Hotel					
Nov. 1	Introductory lectures	8		8		
Nov. 2-5	Site visits to geothermal areas and geothermal field work		X	11		
Nov. 6	Site visit Menengai, drive to Naivasha		X	2		
Nov. 7	Geothermal energy, systems & hydrology - Lectures	6		2	1	3
Nov. 8	Geothermal & geological mapping - Lectures & practicals	6	X	3		1
Nov. 9-10	Geophysics – Lectures & practicals on interpret.	14	X	4		2
Nov. 11	Chemistry of thermal fluids – Lectures & interpret.	7	X	3		1
Nov. 12	Drilling, resource assessment & well logging – Lectures					
Nov. 12	Practical sessions in geophysics and geological laborat.	5	X	6		
Nov. 13	Environmental science and monitoring – Lectures & Practical, including chemical laborat.	5	X	6		1
Nov. 14	Power plants, direct use & mapping resources – Lectures	10		6		1
Nov. 15	Excursion – Olkaria geothermal field, power plants and drilling rigs		X	2		3
Nov. 16-17	Status of geothermal in E-Africa – GIS – Lectures & practs.	20	X	2	6 (+12)*	1
Nov. 18	Planning projects and case examples	9	X	4		3
Nov. 19-21	Project work in groups		X	8		1
Nov. 22	Project present, course review, closing ceremony	(10)		8		1
Nov. 23	Departure participants – Instructors assessment meeting					

* Trainees gave lectures on geothermal development in their countries, shown in parentheses.



Figure 2: Participants and some trainers in the *Short Course VII on Exploration for Geothermal Resources* in 2012.

Papers specially written for the Short Courses have been published on CDs and the presentations distributed to participants, lecturers and others interested (Georgsson, 2010; Georgsson et al., 2013). Most of the material is also available on the UNU-GTP website (www.unutp.is).

KenGen has cooperated with UNU-GTP through the series of Short Courses, and after the formation of the Geothermal Development Company (GDC) at the end of 2008, GDC came in as an additional partner in this project. This cooperation has generally meant that the costs of all invited foreign participants (travel and accommodation) and non-local lecturers (salaries, travel and accommodation) are covered by 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.

2.1.3 Results of the African 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 have now become well established as a good initial training opportunity for young East-African scientists and engineers engaged in or targeted for geothermal work. The participants get a solid introduction to state-of-the-art techniques used in the exploration for geothermal resources and the possible development of this valuable renewable energy source. In total, 433 Africans (including Yemen) have participated in the Short Courses during 2005-2013. During the same period 109 UNU Fellows from this region have been trained in Iceland. It is clear that with the Short Courses the UNU-GTP has been able to reach a far larger number of geoscientists and engineers in East Africa than through its conventional training in Iceland, and, thus, it has been possible to spread geothermal knowledge to a wider region and audience, and contribute to potential geothermal development in new countries.

The Short Courses have also been an important element in catalysing increased cooperation between the countries in East Africa. In that case Kenyans have, to a large extent, been in the role of the donor, while countries like Rwanda, Comoros, Zambia and most recently Sudan have utilized their knowledge and contracted Kenyan experts for local exploration projects. Similarly, geothermal exploration projects financed by the ICEIDA, e.g. in Djibouti and Eritrea, have been carried out partly with a multinational group including qualified experts from the neighbouring countries who have been trained by UNU-GTP earlier in their career. For a further description of the Workshops / Short Courses of UNU-GTP in Africa see Georgsson (2010; 2011, 2012) or the UNU-GTP webpage (www.unugtp.is).

2.2 Other UN Millennium Short Course Series

Similar to East Africa, in Central America geothermal resources are now playing an increasing role in the power production of countries like El Salvador, Costa Rica, Nicaragua, and Guatemala, with considerable untapped potential. Additionally, Mexico has certainly been one of the world's largest producers of geothermal electricity for a long time. Therefore Central America was chosen as the site for the second UN Millennium Short Course Series with the "Workshop for Decision Makers on Geothermal Projects in Central America" held in San Salvador in late November 2006. With 50 participants, this six day event mainly had participants from the four countries in Central America most active in geothermal development, i.e. Costa Rica, El Salvador, Guatemala, and Nicaragua.

With geothermal development in Central America at a more advanced stage compared to East Africa, it has not been necessary to put the same emphasis on surface exploration in these series. The topics have therefore differed from one event to another. The range of attendance has also broadened considerably from the start, with new nations being added most years, including now many countries of South America and several island states in the East Caribbean. In total, about 370 individuals have attended the Latin American series since its start in 2006.

The first UN millennium event in Asia was the “*Workshop for Decision Makers on Direct Use of Geothermal Resources in Asia*” held in Tianjin, China, May 11-18, 2008. China is the leading country in direct use of geothermal energy in the world, so site selection was easy after it had been decided that the third UNU-GTP Millennium Series of Short Courses should be in Asia and focus on direct heating use of geothermal energy. Countries with a need for space heating for at least a few months of the year and known geothermal resources near densely populated areas (towns, villages), were invited. The large majority of the participants came though from China. In all, 118 participants took part in the Workshop, making it the best attended UNU-GTP millennium event (Fridleifsson, 2010, Georgsson, 2010). The Workshop in Tianjin was expected to be followed by annual courses in China in specific aspects of direct utilization of geothermal energy for space heating, bathing and other purposes. This did not materialize for various reasons, the most important being the financial crisis that hit Iceland in late 2008, which led to reduced funding for the UNU Geothermal Training Programme in the aftermath of this serious event for Iceland’s economy. Nor did plans for another series in Asia on the exploration and development of high-temperature geothermal systems for electricity production.

2.3 Positive consequences

From a more general perspective, the *UN Millennium Short Course Series* have become an important channel to the more advanced training in Iceland, giving the strongest participants the chance to show their ability and strength, and consequently opening the possibility to be selected for training in Iceland. Thus, the series have to some extent reduced the need for UNU-GTP to make conventional site visits to partner countries. There are now many examples of good participants in the Short Courses being selected for the 6 month training in Iceland. And in a few cases, this has led to MSc studies in Iceland. The Short Courses have also become an important element in catalysing increased cooperation between the countries within the region.

Finally, the availability of the papers and presentations prepared for these events, not only on CDs but as open-file material on the internet has really proven important as can be seen from the high number of downloads of papers published for some of these events counted in hundreds of thousands per year for the most popular ones (Georgsson et al., 2015, in prep.).

3. SPONSORED CUSTOMER-DESIGNED TRAINING ACTIVITIES

The latest capacity building service of UNU-GTP is the customer-designed Short Courses or Training in developing countries, given for the first time in 2010. This service was triggered by the urgent need for training in countries planning fast-tracking of geothermal development (see e.g. Teklemariam, 2008; Simiyu, 2010), 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 sources (e.g. multilateral or bilateral aid agencies) 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 contents.

In 2010-2014 (August), 17 events, Short Courses or Advanced Training have been held for six different customers in four continents. The contents have varied from general geoscientific courses to more specialized ones, such as on geothermal drilling, as well as scaling and corrosion in geothermal installations. Similarly, the length has varied from 2-3 days to 6 months, based on the need and goals. Table 5 lists examples of these events, which have benefitted about 350 individuals in all. At the time of writing new courses are being developed, in geothermal project management and geothermal financing.

Table 5: Examples of customer-designed Workshops, Short Courses and Training given by UNU-GTP for different customers in 2010-2014.

Event	Location	Dates	Customer	Duration
Course on Geothermal Drilling	Indonesia	Jan. 25 – Feb. 19, 2010	SenterNovem, Bappenas, & PT. Pertamina G.E	4 weeks
Training Course on Exploration for Geothermal Resources	Silali, Kenya	May 17 – Jun. 12, 2010	GDC, Kenya	4 weeks
Course on Geothermal Exploration and Development	El Salvador	Nov. 7 – 12, 2011	Organization of American States - OAS	1 week
Course on Geothermal Technology	Naivasha, Kenya	Apr. 16 – Jul. 14, 2012	KenGen, Kenya	13 weeks
Advanced Training in Borhole Geology	Naivasha, Kenya	Jul. 16 – Dec.16 2012, Jan. 7 – Feb. 2, 2013	KenGen, Kenya	6 months
Training in Drilling Supervision	Karisimbi & Kigali	Jul. 1, 2013 – Feb. 8, 2014	ICEIDA & EWSA, Rwanda	10 weeks
Short Course for Decision Makers on Geothermal Development	Naivasha, Kenya	Sept. 24 – 28, 2013	ICEIDA	5 days
Training in TFT-Measurements of Two-Phase Flow	Naivasha, Kenya	Mar. 31 – Apr. 12, 2014	KenGen, Kenya	2 weeks
Workshop for Geothermal Development Donors	Iceland	May 27 – 28, 2014	ICEIDA, African Union	2 days

A good example is the week long “Short Course on Geothermal Exploration and Development” held in El Salvador in November 2011. The Short Course was sponsored by the Organization of American States (OAS) for the benefit of three South-American

countries, Ecuador, Colombia and Peru, all of which have since been invited to send participants to the UNU-GTP Millennium Short Courses.

It should also be mentioned here that five geologists, who completed the 3 month “Course on Geothermal Technology”, and continued for the 6 month “Advanced Training in Borehole Geology”, were assessed to have completed a programme comparable to the 6 month training in Iceland, and consequently given a similar status in the UNU-GTP system.

4. REGIONAL GEOTHERMAL CENTRES

4.1 An African Centre of Excellence for Geothermal Capacity Building

The increased emphasis on development of geothermal resources, currently experienced in East Africa, and especially in Kenya in association with the goals set forward in Vision Kenya 2030 (e.g. Simiyu, 2010; Ngugi, 2012), has created an overwhelming demand, which the current capacity building activities on offer, through UNU-GTP in Iceland, Auckland University in New Zealand, and local universities have had difficulty in meeting. To keep the momentum of development going and meet this demand, it is therefore extremely urgent to take the local training to a new level. For some time it has been discussed that the next step should be the establishment of a Regional Geothermal Training Centre for East Africa, located in Kenya, which UNU-GTP has voiced its support for.

In early 2014, GDC received the support of the Kenyan Government for establishing a centre of excellence in geothermal capacity building. ICEIDA and the Nordic Development Fund (NDF) are now (August 2014) ready to step in to secure the financial background for the centre. The African Union has also emphasized its support for such a centre in collaboration with regional and international stakeholders. UNU-GTP is expected to be a part of this project, and it would also be important to have the cooperation of a Kenyan University to strengthen the academic background. This centre of excellence is expected to offer various types of short courses up to 3 months in length, thus creating something complimentary to the training on offer in Iceland. The development of curricula is of paramount importance to the success of the centre. The linking of the UN Millennium Short Course Series to the centre could also be a possibility.

4.2 The Geothermal Diploma Course in El Salvador for the Latin American Region

In Central America, a special diploma course has been given at the University of El Salvador for few years. Initially it was supported by the Italian Development Cooperation and run in 2010 and 2012. In 2012, further financial basis was secured by the NDF and the Inter-American Development Bank (IDB) to run the course for additional three years, with the goal of reaching financial sustainability in the period after 2015. As the first phase of the project, UNU-GTP was contracted to perform an assessment of the courses run in 2010 and 2012 and to provide recommendations for an improved curriculum (Haraldsson et al., 2013). The University of El Salvador (UES) and LaGeo under the management of Consejo Nacional de Energía (CNE) joined in creating the foundation for the current Diploma Course, which was given at the UES for the first time in late 2013, and again in 2014, taking into consideration many of UNU-GTP’s recommendations. Fellowships have been awarded to participants from the whole of the Latin American Region, which meant that close to half of the participants were foreigners and the rest Salvadorians. The second phase of the project with the goal of assuring self-sustainability of the future operation of the program, is on-going. This work is carried out by the International Geothermal Center (GZB) and the International Geothermal Association Service Company (IGA Service GmbH) (de Velis, 2014).

5. THE STATUS AND THE WAY FORWARD

5.1 The Progress so far

With the UN Millennium Workshops and Short Courses, UNU-GTP has reached a much wider audience than before. More than 430 African scientists and engineers (including Yemen) have participated from 2005 to 2012 and close to 60 individuals from the region have lectured in these events. This can be compared with the 105 UNU Fellows from Africa and 4 from Yemen trained for 6 months in Iceland during the same period. It can be argued that the Short Courses are really creating a critical mass to seriously further geothermal development in the region.

The Short Courses have also opened up new connections. In East Africa, key geothermal scientists are lecturing and supervising a new generation of young and promising scientists. This way the geothermal know-how is being transferred from one generation to the next. Similar to the 6 month training, the Short Courses have also created bonds and friendship between individuals with different backgrounds and across national boundaries, which can only help the development of geothermal in the region.

The effect of the Millennium Short Courses is also reaching well beyond East Africa, with new countries being added every year, the most recent additions from Central and West Africa, as Nigeria, Niger and Cameroon have vouched for. Even though geothermal energy will hardly be a major player in the energy spectrum for these countries, at least based on the current technology, it can still play an important role in some regions as a good renewable alternative to fossil fuels and biomass.

The customer-designed short courses, which UNU-GTP started offering in 2010, have also proven to be a good opportunity for countries that are fast-tracking geothermal development, and have themselves the financial capacity or the support of external mechanisms to finance it. The first such courses were held in 2010 for four different customers, having since increased in number and become an integral part of UNU-GTP’s operations. About 350 individuals have benefitted from these activities during this period (to August 2014). This is foreseen to continue in the near future, as need demands.

5.2 Looking into the Future

The 6 months training in Iceland has been the cornerstone of the UNU-GTP operations and will continue to be so. Similarly, the academic studies in Iceland for an MSc or a PhD degree will also be given due importance. The financial climate in Iceland has been difficult after the crisis that struck the country in late 2008. Therefore, expansion in these regular operations is expected to be

slow, except through external financing as has been seen in the last four years, which has contributed to the rise in the number of UNU Fellows in Iceland, from 20-22 in 2004-2009 to 34 in 2013. This has meant, however, that UNU-GTP is currently close to the practical capacity limit that the 6 month training in Iceland can be expected to reach, at least through the current institutional set-up.

It can be mentioned here that the 6-month training is now under review, and at the time of writing, it is probable that a new line of study will be introduced in 2015, on Geothermal Project Management and Financing. Also, it is planned to introduce group work into the first half of the training. These plans will be presented when fully ready, at a later opportunity.

The two Series of the UN Millennium Short Courses have developed into a new pillar in the operations of UNU-GTP. This is expected to continue, with East Africa having some priority. New countries may still get entrance to the Short Courses in Africa, although most countries in East Africa blessed with considerable geothermal potential have participated in the events already. However, the future is likely to see some further important development. The idea of the Series developing into a sustainable regional geothermal centre has been discussed informally and external financing partners are now showing interest in participating in turning this into reality. This has also been presented and accepted at the UNU headquarters in Tokyo. The financial crisis may have delayed the action, but now the opportunity is here for rapid development.

In Central America, the financial basis for the establishment of such a centre was already secured in 2012 for 3 years, by NDF and IDB. The University of El Salvador (UES) and LaGeo, under the management of CNE, joined in creating the basis for the current Diploma Course given at the UES with Fellowships given to participants from the whole Latin American Region. UNU-GTP was in the advisory position, assessing the set-up and advising on contents of the course. Work is now on-going to strengthen its basis and background, in order to make it sustainable.

UNU-GTP foresees a similar development in the near future in East Africa. With plans of fast-tracking geothermal in the region, it has now become urgent to get a regional geothermal centre established, so capacity building in the region can keep up with the ambitious plans of geothermal development. GDC has the support of the Kenyan Government for establishing a centre of excellence in geothermal capacity building. The African Union has also emphasized its support for such a centre in collaboration with regional and international stakeholders. With ICEIDA and NDF ready to step in with GDC in securing the financial background and UNU-GTP ready to assist in developing the curricula for the planned courses, development should be expected in 2014-2015. Additionally, the UN Millennium Short Course Series could be linked to this planned centre of excellence.

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