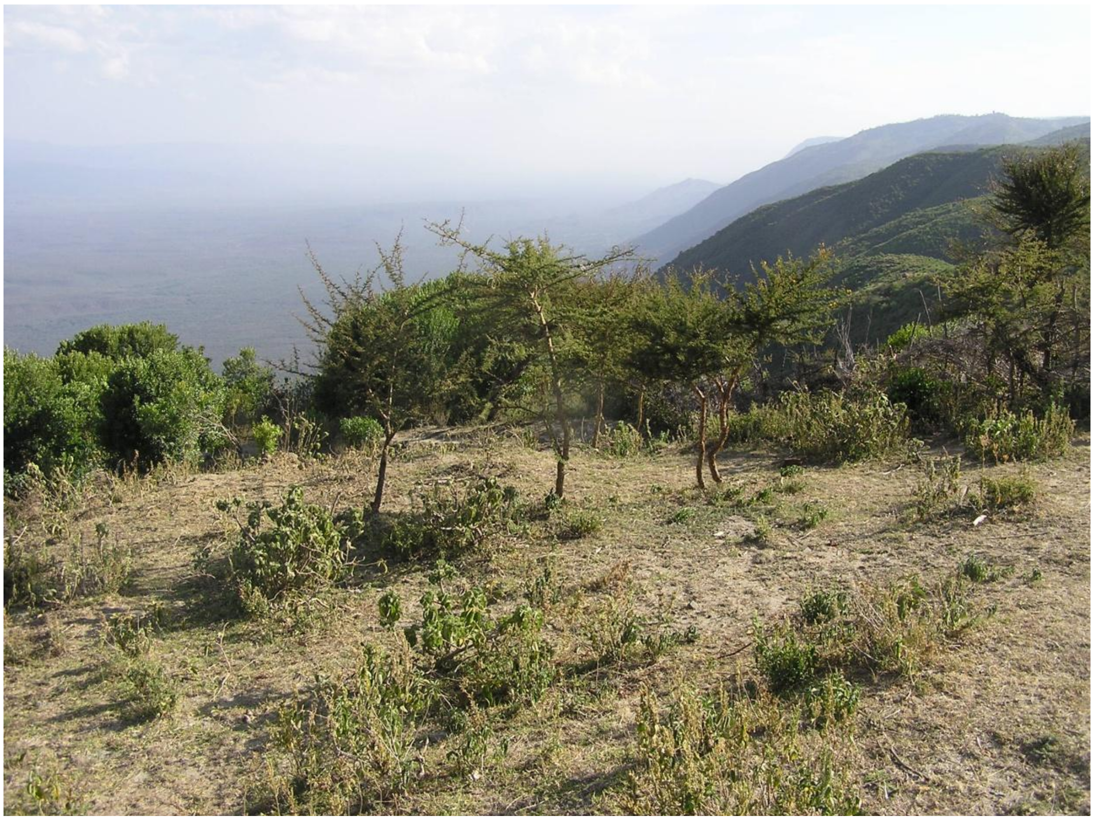
The Proliferation of University Programs in Water Resources for Developing Nations

A Case for Support



Prepared by
UniWater Education Limited
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Can you imagine a world where .....

- *safe water is easily accessible for all people for domestic purposes*
- *industry uses fresh water responsibly and where the environment is not harmed*
- *the water sector is operated by professionals who have been educated in-country*
- *stewards of the environment are nationals*
- *reliance on foreign aid is minimized or eliminated, and*
- *children and women fill their days going to school or engaging in productive activities, rather than filling water jugs many kilometres from their homes?*

........we can

Introduction

Every day the media describes in detail how the World Water Crisis impacts millions of people and the environment as a whole. The western world is flush with NGOs who pull at our heartstrings by showing us the many children who will die today due to a lack of adequate drinking water, while asking for donations. Unfortunately, what isn't widely known is that people in developing nations suffer because of poorly installed water wells that go dry, or as a result of no maintenance being done on the water systems. This world doesn't need more NGOs, or more money. What it could use most is having people with technical expertise that ensures that

> ...wells are properly placed and designed to maximize the amount of water that can be extracted from the ground,
>
> ...aquifers are properly managed so they are able to continue to produce water into the future,
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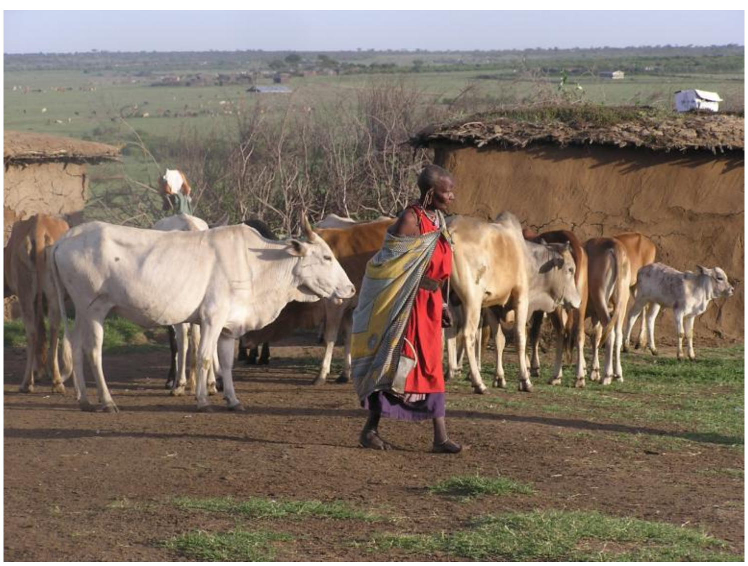
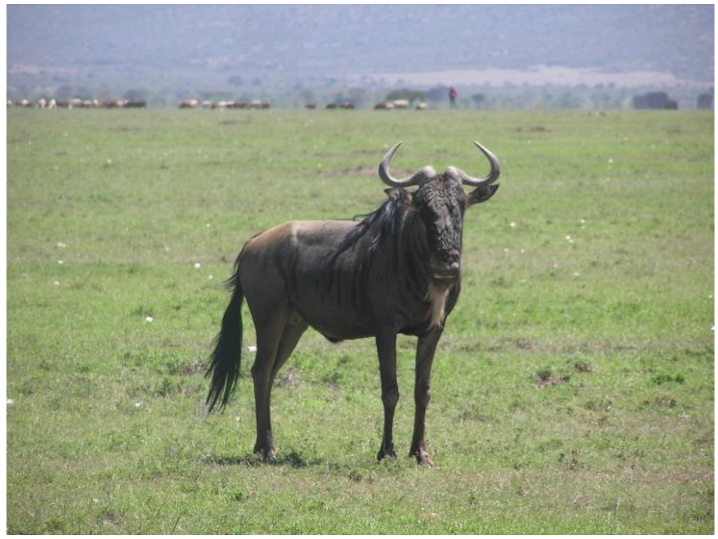
> ...water systems are adequately maintained so they operate for decades instead of months, and
>
> ...ecosystems are protected for the use and enjoyment of future generations.



Unfortunately, while North America enjoys the benefits of having more than 4,000 technical specialists and professionals per million people, these numbers drop to 35 per million people in sub-Sahara African nations (New Partnership for Africa's Development (NEPAD); http://www.nepadst.org/platforms/suswater.shtml). This lack of specialists is seen as being a factor in stunting the economic growth of these countries now and far into the future. And securing and sustaining water is a flagship research and development program of NEPAD.

The lack of local groundwater specialists plays a role in how aid programs are supported by foreign NGOs. The role of hydrogeologists (technical experts in groundwater systems) is largely underutilized by NGOs due to the perceived added costs that it involves (http://www.rwsn.ch/documentation/skatdocumentation.2011-12-21.2247027239/file). Unfortunately, when cost and short-term water supply are the sole determinants of the success of a project, the long-term sustainability of the resource may be compromised. Having more professionals available in country would ensure the security of aquifers and ecosystems are preserved, the quality of water projects would soar, and the suffering of many people would end.



Program Description

UniWater Education Limited (UniWater) is preparing an education program that is focused on applied hydrogeology, in particular Water Resources for Developing Nations. It is a one-year, masters' level post-graduate program. An outline of the program is described in Attachment A. The program itself had been taught at the University of London (UCL) for more than 35 years. The unfortunate aspect of the UCL program though was that students needed to leave their home countries in order to study. Many of these students did not relish the idea of returning to the poverty of their home country after having a taste of western life. This is the innovative aspect of what UniWater is doing – we are taking the program to established sub-Sahara African universities in order to educate Africans in their home countries. Since this is a one-year program, we anticipate the graduates will be able to enjoy the support of their families, and will remain there after graduating to help solve local water issues.

Our goal is to get as many programs started as quickly as possible, to make the biggest impact on this crisis.

The curriculum will be modular in format, and will consist of 'core' modules as well as 'elective' modules that are selected at a university level according to local issues (ie the hydrogeology of the Rift Valley, the effects of mining or oil & gas production, or the health effects of fluoride). All programs will include aspects of social interactions with communities, database management, quality control of data and technical modules that deal with water chemistry and the siting of boreholes.

In developing the curriculum, the module contents will be reviewed by practising professionals currently working in the industry. In this way, the new programs will be up to date with methods that are currently used in industry in developed countries. Also, equipment suppliers will be asked to demonstrate new equipment, and local material suppliers will be asked to supply appropriate supplies to enable graduates to work with materials that are currently on the market.

In order to qualify, a hosting university needs to have high quality math and science departments, and it has to demonstrate its desire to see this program initiated. So far, we have received responses from twelve universities that wish to run this program, and another sixteen universities who are interested in partnering with them to ensure the longevity of the program.

Other Considerations

An important aspect of the program is to involve government agencies to develop or augment their Water Ministries so that the infrastructure is established for these new graduates to work effectively in their field of expertise. This will sometimes involve setting up a department or encouraging the department to establish a database that will allow for sharing of hydrogeological information, and develop policy that will protect aquifers. This will ensure the employment prospects for future grads, and thereby sustainability and proper management of the resource.

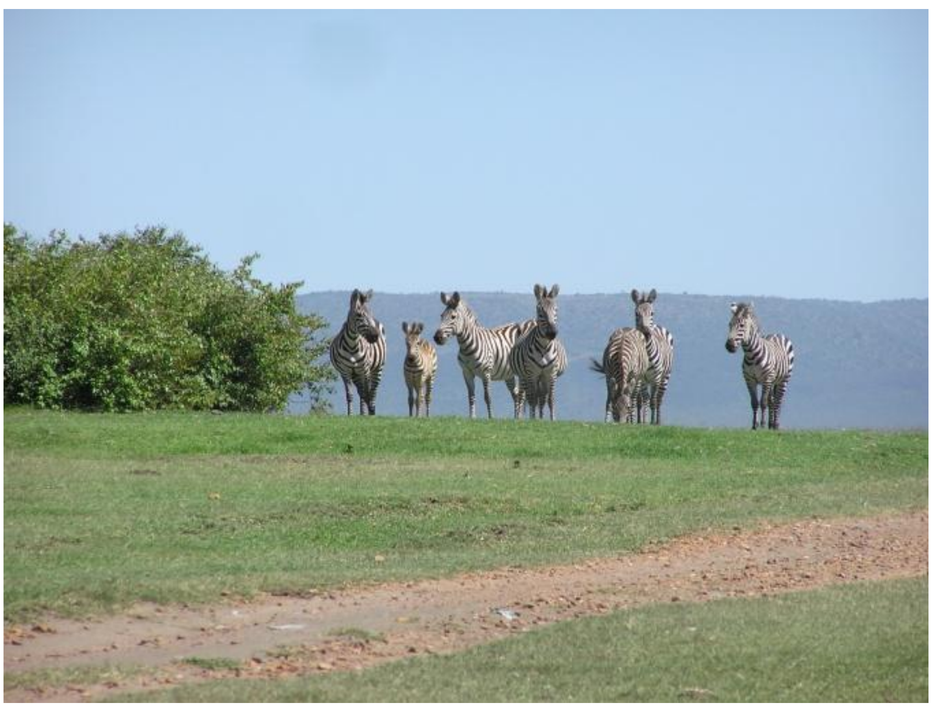
Another aspect is opening communications up between working professionals, students, university professors, drilling contractors, suppliers of materials and governmental officials. In African countries, sharing of knowledge is not intuitive. Therefore, a venue needs to be established that cultivates this interaction. The International Association of Hydrogeologists (IAH; http://www.iah.org) supports the idea of establishing national chapters, and based on experience in Canada, a socializing atmosphere where presentations are given on a range of technical subjects offers such an environment. The IAH is fully behind the idea of facilitating these opportunities.

This idea of spreading knowledge through expansion of technical programs is promoted by the organization Hydrogeologists Without Borders (http://hydrogeologistswithoutborders.org), and this method of partnering new university programs with universities with existing hydrogeology programs has been demonstrated by the six MSc programs initiated in central and south America by the Central American Water Resource Management network (http://www.caragua.org).

Once the curriculum is developed, we anticipate expanding the program to more universities each year, eventually expanding to the Asian continent, or to wherever the need is greatest at that time.

Our Current Situation

At the present time, UniWater is operating as a non-profit organization registered in Alberta, Canada. The Board of Directors has been established and work is being done on the curriculum and obtaining funding to cover the start up costs. It is estimated that we will require $188,600 to establish an office presence, hire 1 full-time and 2 part-time staff members, and to cover fees associated with development of the curriculum. Budget details are provided in Attachment B.



The timeline we have set for start-up activities can be found in Attachment C. In essence, we are working towards creating the curriculum, having it reviewed by working professionals in the industry, meeting approval deadlines set by the governing bodies of the various universities – all with the goal of having the first students enrolled by September 2013. This is a very aggressive schedule given the number of activities that need to be accomplished.

At the current time, UniWater is working towards having new programs established at the University of Zambia and Calabar University in Nigeria. Once the curriculum is finalized, the programs are approved and the programs are in the final stages of production, we anticipate we will have time to select the next universities for student intake in September 2014. Attachment D lists the universities who have expressed interest to date.

Anticipated Impact

UniWater's goal is to start two new programs in September 2013, and then three in each of the successive four years. If each program enrols a minimum of eight students in its first year, and 10 in each of the next four years, (although Calabar University anticipates 25-30 students/year!) we will collectively have educated approximately 450 new groundwater professionals by mid 2018. Once the curriculum has been developed, implementing the program will be a repetitive process. This program can be scaled up as needed. This would make a significant impact in the realm of capacity building in the water sector.

After graduating, it is anticipated that these graduates will be qualified to work in industry, government, consulting, community-based organizations, NGOs or research. The partnerships formed between the north-south universities will transfer learning between the learning institutes and would encourage the exchange of students and faculty into the future. Graduates involved in research would further enhance the scientific base of the host country to contribute to finding future solutions to the water crisis. The quality of water projects will improve, and rural water systems will be completed for less cost, and more projects will be completed. The quality of the infrastructure will improve and the sustainability of aquifers and surface water will increase. In time, reliance on foreign-based NGOs will diminish.

Anticipated Funding

The project budget from the time of inception to the delivery of the program at the first two universities in September 2013 has been developed. The total amount of the project is **$384,000**.

The cost of operating a program has not been considered at this time, but it will depend upon funding structures that are unique to each university. Students will need to be supported, and it is estimated that each student's cost will be $10,000 per year. This cost will include tuition, books, accommodation and a living stipend to compensate for lost income.

There will also be funding required for visiting professors to visit universities where expertise is lacking. The funding required for this is unknown at this time.

At this time, UniWater Education is seeking partners to provide funding to cover the program start-up costs. As part of this proposal, we hope to secure the following contributions:

Grand Challenges Canada (application to be submitted Aug 31, 2012)	$100,000 cash
International Development Research Centre, small grants (application to be submitted Aug 31, 2012)	$60,000 cash
Shell Foundation (letter of intent to be submitted Sept 6, 2012)	$65,000 cash
University of Toronto (Canada) Scarborough Campus Dept of Physical and Environmental Science	$ 72,000 in kind
University of Calabar, Nigeria	$ 24,000 in kind
University of Zambia	$ 24,000 in kind

It should be noted that UniWater has donated more than $39,300 in kind to the project from November 2011 to the end of August 2013 in the form of volunteer hours.

Please contact Laurra Olmsted at UniWaterEd@gmail.com, or phone (403) 225-1401 in Canada with questions.

Attachment A

Proposed Master of Science Program in Water Resources for Developing Nations

Overview:

In general, the MSc program is 12 months in length, running each year from September to August. It consists of 9 months of classes and labs, followed by 3 months for an individual project. However, depending upon the structure identified by each individual university, the program may extend over a different time period.

The outline in black font will constitute the core of the program, with electives selected by the University are shown in green.

Outline

1. PRELIMINARY CONCEPTS

- 1.1. Historical Perspective
  - 1.1.1. Key Contributors
- 1.2. Introduction to Geology and Geological Environments
  - 1.2.1. Igneous
  - 1.2.2. Sedimentary Rocks
    - 1.2.2.1. Alluvium
    - 1.2.2.2. Consolidated Basin Deposits
    - 1.2.2.3. Limestones and Karst
    - 1.2.2.4. Glacial Deposits
    - 1.2.2.5. Effects of grain size and mineral content
  - 1.2.3. Metamorphic Rocks
    - 1.2.3.1. Cratons
    - 1.2.3.2. Fractured PreCambrian Basement Rocks
  - 1.2.4. Effects of Faults, Fractures
- 1.3. Basic Hydrogeology
  - 1.3.1. Use of Groundwater vs Surface Water
  - 1.3.2. Regional vs local flow (Toth model)
  - 1.3.3. Groundwater in the hydrologic cycle
  - 1.3.4. Geothermal springs
  - 1.3.5. Water budget
  - 1.3.6. Age of Groundwater
  - 1.3.7. Darcy's Law

11. **GEOTECHNICS**

- 11.1. Dewatering excavations
- 11.2. Dams
- 11.3. Effects of rebounding water tables/pressure

12. **FIELD METHODS**

- 12.1. Surveying and GPS
- 12.2. Assessment of potential drill sites
- 12.3. Contaminant assessment for domestic supplies
- 12.4. Contaminant investigations
  - 12.4.1. Integrating soil and groundwater investigations
  - 12.4.2. Site Assessment
  - 12.4.3. Logging of drill cuttings
  - 12.4.4. Piezometer completion methods
  - 12.4.5. Piezometer development
  - 12.4.6. Groundwater sampling and handling
  - 12.4.7. Results interpretation

13. GROUNDWATER MODELLING

- 13.1. Model selection
  - 13.1.1. Two Dimensions
  - 13.1.2. Three Dimensions
- 13.2. Model Type
  - 13.2.1. Finite Difference
  - 13.2.2. Finite Element
  - 13.2.3. Equations
- 13.3. Building the model
  - 13.3.1. Simulation of Boundaries
  - 13.3.2. Vertical Discretization
- 13.4. Calibration and Sensitivity Analyses
- 13.5. Use of Particle Tracking
- 13.6. Forward Protections
- 13.7. Verification of Results
- 13.8. Case Study

Attachment B
Timelines

The following timelines have been established:

Administrative	
Formalize Partnerships	Sept 2012
Secure Funding	Sept 2012 onward
Selection of Round 2 Participants	April 2013
Program	
Identify Sources of Existing Curricula	Sept to Dec 2012
Meetings in Nigeria and Zambia	Nov 2012 and April 2013
Prep lecture notes, labs, tutorials, exams	Oct 2012 to Feb 2013
Compilation of Binders/CDs	May 2013
First Students Initiate Studies	September 2013
Approval Process (University specific)	
Dept of Academic Board	Aug 2012
Faculty Board of Studies	Sept 2012
Faculty Board	Oct 2012
Graduate School Board	Nov 2012
Committee of Deans	Dec 2012
Senate of the University	Jan 2013
Advertizing of Programs/Registration	January to September 2013
Development of Collaborative Relationships	
Between universities	September 2012 onwards
With government agencies	July 2012 onwards
With IAH/Burdon Groundwater Network	Ongoing
With drillers and suppliers	September 2013 onwards

Attachment C
Collaborating Organizations

Potential Hosting Universities

University of Nairobi, Kenya
University of KwaZulu-Natal, South Africa
Sokoine University of Agriculture, Tanzania
University of Development Studies, Ghana
North-West University, South Africa
University of Calabar, Nigeria
University of Zambia
University of Mines & Technology, Ghana
University of Dodoma, Tanzania
Kigali Institute of Science and Technology
University of Malawi
University of Zimbabwe
Ahmadu Bello University, Nigeria

Mentoring Universities (with established programs)

University of Dar es Salaam, Tanzania
Ibn Tofail University, Morocco
University of Pretoria, South Africa
INRGREF Tunisia
University of Toronto, Scarborough Campus, Canada
University of Namibia
Cadi Ayyad University, Morocco
Hawassa University, Ethiopia
University of Khartoum, Sudan
University of the Free State, South Africa
University College London, UK
Kigali Institute of Science and Technology, Rwanda
Oregon State University, USA
University of Addis Ababa, Ethiopia
Austin College University
University of Glamorgan, Wales
University of Strathclyde, Scotland
University of Witwatersrand, South Africa

Federal University of Technology, Nigeria
Université Cheikh Anta Diop, Senegal
Botswana International University of Science & Technology

Other Collaborating Organizations
International Association of Hydrogeologists
Burdon Groundwater Network
Ministry of Water and Environment, Uganda
Mundell & Associates, USA
Hydrogeologists Without Borders
Groundwater Science, USA
O'Brien & Gere Consultants, USA
Sorensen Groundwater Consulting, USA
CAP-NET
Rural Water Supply Network