



TAITA TAVETA UNIVERSITY

A Premier Institution in Education, Training, Research, Innovation
And Community Outreach

Centre of Excellence for Mining, Environmental Engineering and Re- source Management (CEMEREM)

Annual Report 2018

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Centre of Excellence for Mining, Environmental Engineering and Resource Management



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CEMEREM Project



In April 2016 a new project entitled “Development of a Centre of Excellence for Mining, Environmental Engineering and Resource Management (CEMEREM) started. It is a joint project of Taita Taveta University (TTU), Voi, Kenya, the University of Applied Sciences Dresden (HTWD) and TU Bergakademie Freiberg. The purpose is to develop CEMEREM at TTU in the next five years. CEMEREM has four main objectives:

- Education and training of students and staff of TTU and of members of stakeholder organisations of CEMEREM
- Promotion of research
- Development and operation of

specific laboratories for issues of the natural resources sector

- Community outreach

The project also aims to foster scientific and cultural exchange between the project partners, industrial and governmental institutions in Kenya and Germany. Until the end of 2017, the financing of the project is secured by the Ministry of foreign affairs of the Federal Republic of Germany through DAAD. The government of Kenya spends a considerable sum of money on the construction of a new CEMEREM building on TTU’s campus.



DAAD’s Film Team Underway for CEMEREM

Sustainable Partnership with East Africa

12 March 2018 A Networking conference on the CEMEREM Project was organized at Alte Mensa in cooperation with the Saxon State Ministry of the Environment, the Saxon State Economic Development Agency, the Chamber of Commerce of Chemnitz, especially represented by EZ Scout Konstantin Kotsas, and the Delegation of German Industry in Kenya, represented by Head of Energy Andreas Kaiser. A delegation of Local Government Representatives of six Southern Kenya Counties participated as honorary guests. More than 100 participants attended the event.

Prof. Dr. Ulrike Feistel of HTWD (Hochschule für Technik und Wirtschaft Dresden) and head of the CEMEREM project gave an overview of CEMEREM's activities, the Kenya

Delegation informed about recent development for economic cooperation and Andreas Kaiser explained the opportunities for business development in Kenya, especially in the sectors of water, energy and environmental technologies. Participants welcomed the informative talks and they appreciated the networking facilities offered by the symposium.



Prof. Dr. Ulrike Feistel (HTWD)

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Left: Panel Discussion „Sustainable Relationship with East Africa, Experiences from Sachsen“

Right: Deputy Governor Delegation from Kenya

Afrika-Verein Conference on Mining in Kenya and Tanzania

3 May at the invitation of the Afrika-Verein, Prof. Bongaerts took part in a conference on mining in Kenya and Tanzania. The event took place at the premises of DMT, a leading mining technology and project management consultancy in Essen. Prof Bongaerts gave a presentation on the CEMEREM project in order to show the participants, mostly of the

mining business community, how a university project can assist companies in entering the market in Kenya. In general, several other speakers evaluated the conditions for mining in Kenya as positive, whereas Tanzania was considered one of the worst countries for mining projects in all of Africa.

Short Course for Gemstone Artisanal Miners

24 - 25 May a short course related to the topic “Mining and Entrepreneurship” took place at TTU pursuant to one of the CEMEREM goal - networking and capacity building with industry. Eighteen participants including seven women attended the training course. The training was intended to revitalize and strengthen the mining and entrepreneurial capacities of artisanal miners on:

- negotiation and customer care skills
- marketing and financial management skills

Participants expressed their satisfaction for their achievement. The next short course will take place in 2019.

- effective prospecting and exploration techniques
- emerging and appropriate mining techniques
- safety and environmental issues in mining
- the new mining act 2016



Participants of the Short Course

Annual Meeting of the Africa Group of German Geoscientists

22 – 23 June Prof. Bongaerts took part in the Annual Meeting of the Africa Group of German Geoscientists, organized by the University of Applied Sciences in Neubrandenburg. The Group has a long tradition of research in various countries in Africa. Since a few years, a new approach takes place and the annual

meetings enjoy a small but highly motivated participation.

Prof Bongaerts gave a short presentation about recent developments in the financing of mining operations with a specific focus on selected African countries.

The first GMIT Symposium on Engineering and Environmental Science

28 – 30 August the first Symposium on Engineering and Environmental Science took place at GMIT in Nalaikh, Ulaan Baatar District. The meeting was attended by scientists from Germany, China, Russia and the USA and, naturally, also of Mongolia.

CEMEREM was represented by Prof. Feistel of HTW Dresden, Prof. Bongaerts, Prof. Drebenstedt of TU Bergakademie Freiberg and Arthur Ndegwa of Taita Taveta University. During the opening ceremony on the first day, Prof. Drebenstedt gave a keynote address about the overall significance of mining and its contribution to the economies of mining countries.



Prof. Drebenstedt gave Keynote

Several scientists presented papers on a large project of investigation of water resources in Mongolia and the Lake Baikal region which was recently concluded.

IMWA Conference 2018 in Pretoria, South Africa

10 – 14 September The 11th ICARD ICARD|IMWA|MWD Conference was held at the Council for Scientific and Industrial Research (CSIR) International Convention Centre in Pretoria, South Africa. It brought together the International Mine Water Association and WISA Mine Water Division (MWD) to discuss acid mine drainage (AMD) and mine water issues related to active mining and mine closure. The conference adopted the theme: “Risk to Opportunity”. The principal focus was on mine water manage-

ment solutions. More than 300 delegates participated in the conference.

Mr. Nashon Adero, a lecturer in the Department of Mining and Mineral Processing Engineering at TTU and CEMEREM PhD student at TU Bergakademie Freiberg, participated at the conference. The abstract of his research work on spatial modelling of the impacts of mining on water resources in Taita Taveta was published in the conference proceedings.

Meeting with Tanzanian CENiT@EA in Arusha

22 November – following one of the outcomes of the DAAD Networking Conference in Berlin in October 2018 – Strengthening the Network among the African Centres of Excellence, Dennis Borsdorff travelled to Arusha, Tanzania to initiate the collaboration with the CENiT@EA (Centre of Excellence for Information and Computer Technology in East Africa). This Centre is a joint project with the Nelson Mandela African Institution of Science and Technology (NM-AIST), which has a Centre for Water Infrastructure & Sustainable Energy Fu-

tures (WISE Futures) and a Centre for Research, Agricultural Advancement. Similar like TTU, NM-AIST has also facilities such as water treatment plant, solar research facilities and a Biogas Plant is to be installed on the campus. There is a high collaboration potential between TTU and NM-AIST in students and staffs exchange and in joint research projects. Follow-up meetings will be conducted in 2019. More synergies between both Universities is to be expected in the future.

TTU International Scholarship Award Ceremony

21 September the TTU International Scholarship Award Ceremony took place at the University auditorium. Political leaders, Officials from the Ministry of Education, County government, CEMEREM collaborating Institutions representatives, Parents, Staff and students of TTU attended the ceremony. CEMEREM was represented by Prof. Jan Bongaerts and Prof. Jürgen Schoenherr during their teaching activities at TTU.

Three categories of scholarship were awarded:

- CEMEREM scholarship funded through the DAAD by the German ministry of foreign affairs:

seven students were admitted to pursue Masters of Science in mining engineering

- DAAD in country scholarship: four students have been admitted to pursue Masters of Business Administration (Natural Resources Management)
- Senator Johnes Mwaruma Foundation Scholarship: nineteen students have been admitted to pursue undergraduate degree course in Education Science and two to pursue Bachelor of purchasing supplies management.



International Scholarship Award Ceremony

Networking Conference in Berlin

9 – 16 October The tenth annual meeting of the DAAD African centres of excellence took place in Berlin. CEMEREM was represented by all three participating universities: Taita Taveta University, Hochschule für Technik und Wirtschaft Dresden and TU Bergakademie Freiberg.

It was a memorable event with a ceremonial character as the culmination of ten years of continued financial support by DAAD throughout the continent. For several centres, funding by DAAD comes to an end and discussions showed that not all centres are well prepared to sustain their current level of operations. From the point of view of CEMEREM, this implies that appropriate steps



CEMEREM Stand

are taken already at this stage to secure that CEMEREM activities will be perpetuated beyond the DAAD funding horizon. One important strategy to be developed in the coming years consist in networking with government, industry and community partners in the region.



Networking Conference in Berlin

DAAD Centres of African Excellence meeting

6 – 9 November The 2nd DAAD African Centres of Excellence Alumni Conference took place in Ghana. The topic was “Sustainable Development in Africa: The Role of Science and Education”. The conference was organized by the Ghanaian Alumni Network (IGAN) with the support of the Institute for Statistical, Social and Economic Research (ISSER), University of Ghana, the Ghanaian-German Centre for Development Studies (GGCDs), and the Center for Development Research (ZEF), University of Bonn. Since Centre Co-ordinators were also invited, Prof Bongaerts travelled from Kenya to Accra.

The meeting itself took place in Akosombo at the location of the Volta Dam in the hotel of the same name. During the first meeting almost a year ago in South Africa, a

decision was made to establish a network of Alumni and platform for scientific discussion. In Ghana, a small Organization Committee reported on achievements so far. The Alumni association is now established and first activities are planned for the near future. Many Alumni gave papers on their current research projects. As a DAAD alumnus, Mr. Nashon Adero was sponsored by DAAD to present his current research entitled “Decision Support for Mine Planning: Integrating Spatial Modelling into a Systems Approach for Sustainable Communities”. The abstract was published in the book of conference proceedings.

The next meeting is planned to 2019 in Kinshasa, Democratic Republic of the Congo.



DAAD Alumni Meeting in Accra, Ghana

JKP – CEMEREM Entrepreneurship Workshop - TOOLKIT for Micro, Small and Medium Enterprises (MSMEs)

12 – 13 November The business development workshop took place at Pwani University. The main goal of the workshop was to provide the MSME owners professional tools given by six experts from industry and academia for the development their national and international businesses. The workshop was initiated by CEMEREM and organised in cooperation with Jumuniya ya Kaunti za Pwani (JKP), which is a regional economic development organization representing Kenya’s six coastal counties: Mombasa, Kwale, Kilifi, Tana River, Lamu and Taita Taveta. 46 participants were from agricultural sector, livestock sector, environmental organisation, maritime, mining and tourism companies of the JUMUIYA counties, and universities.

The workshop offered six different training topics:

- 1) Business strategy development, appropriate management style,
- 2) Helping private sector meets entry level HR needs,

- 3) ICT Opportunities for growth,
- 4) Professional Communication and Professionalism,
- 5) Legal challenges and opportunities, and
- 6) Bank as a partner for business development.

Mr Wolfgang Kraus, director of German Water Technologies (GWT)/Protoplan GmbH, guided the participants through the two days programme to address their existing challenges and to explore opportunities for their business growth.

Through the workshop, a network between MSMEs and universities was established for the further collaboration.



Organisation Team of the Workshop

CEMEREM Summer School 2018

9 – 16 July Twenty CEMEREM teachers and students participated in the 2nd Summer School organized by the CEMEREM Project Team of HTW Dresden and TU Bergakademie Freiberg. As in 2017, the program started with a lecture session given by Prof. Bongaerts, Prof. Feistel, Dr. Liu and Oscar Choque, one of Saxony's promoters for resources policy and migration. In addition, participants were also taken on excursions. The group was split into three groups based on the participants' background.

In Dresden, visits were made to DREWAG power station at Nossner Brücke, to the experimental fields and laboratories of the Faculty of Agriculture/Environment/Chemistry of HTW Dresden and Bosch Rexroth GmbH. They had a tour to Welzow-

Süd opencast lignite mine and its post-mining rehabilitation site. In Freiberg, participants visited the underground mine at "Reiche Zeche", the laboratory in Mining institute for the demonstration of a simulator for excavation, and to Agrargenossenschaft in Clausnitz. A workshop and brainstorming on the utilization of renewable energies in mining was offered by Kateryna Zharan to address a topic which plays a prominent role in the development of the mining sector in Kenya.

One more time, the CEMEREM summer school provided an excellent opportunity for participants to learn and train themselves on subjects related to mining, natural resources management and environmental technologies and gain first hand practical experience.



Visits to Welzow Open Pit Mine, Agrargenossenschaft Clausnitz, Institut of Mining of TU Bergakademie Freiberg

Phytoremediation of TTU Municipal Waste Water

June – October Michelle Zuischko, a bachelor student in institute of ecology and environmental protection at the University of Applied Science Zittau, Germany, worked on a research project related to wastewater treatment called "Phytoremediation of Taita Taveta Municipal Wastewater". The project focused on the evaluation of an environmental friendly method of removing pollutants from the wastewater at TTU by using water plants.

Currently, a lagoon system is used for the treatment of the wastewater from the various buildings on the TTU campus. However, the present wastewater treatment facility is not able to guarantee the quality of discharge water as required by the National Environmental Management

Authority of Kenya. During her research work, different samples from the oxidation ponds were analysed and various experiments were conducted to evaluate different options for successful phytoremediation. The research result will be published in her Bachelor Thesis.



Michelle Zuischko conducted an Experiment in the CEMEREM Water Treatment Laboratory

Teaching at TTU

In the fall of 2017, TTU opened two new study programmes at Master's level, one for mining engineers and the other programme as an executive MBA on Natural Resources Management. The MBA programme is taking its inspiration from the School of Business, Economics and Social Sciences and from the MBA IMRE Study Programme of TU Bergakademie Freiberg. As one essential part of CEMEREM, several teaching activities took place at TTU by HTWD and TU Bergakademie Freiberg members.

11 September – 10 November, Prof. Bongaerts was DAAD Johann Gottfried Herder Professor at Taita Taveta University in Voi, Kenya, the CEMEREM Partner. Prof Bongaerts taught two modules for the engineering students and two more modules for the MBA students. The MSc engineers were trained in project management and they learned about investment and financing for mining operations. The MBA students took a course on international mining law and another course on environmental management.



TTU Campus



Prof Bongaerts in his Lecture

8 – 10 October and 18 – 20 December: Prof. Carsten Drebenstedt gave an intensive lecture "Mine planning" to the new students of the MSc in Mining Engineering. His lecture dealt with an overview of the objectives and functions of mining for the needs and benefits of society and the economy. He also highlighted appropriate mining technologies in accordance to the types of deposits and their geological structures.



Prof. Drebenstedt and Students

9 – 17 December, Bruno Grafe, associate researcher at the Mining Institute of TU Bergakademie Freiberg completed the lecture with assignments on software for mine planning.



Bruno Grafe and Students

22 – 26 November: Prof Konietzky lectured on Geomechanics for the MSc Mining Engineering programme. He given a brief introduction in geomechanical methods and their applications in mining related areas. He also visited the soil and chemical laboratory and had a discussion with the chief laboratory technician Koti Musomba about commercialization opportunities for the soil mechanics equipment at TTU.



Prof Konietzky in his Lecture

CEMEREM Smart Biogas Project

27 October – 7 November, Niazi Azim Khan, IMRE Alumnus, and Erik Ferchau, researcher for biogas at TU Bergakademie Freiberg carried out a 8 days visit at TTU. They successfully completed comprehensive preparations and tasks for the installation and start-up of four so-called Smart Biogas Plants at TTU.

The Smart Biogas Plants are based upon an innovative and completely novel application of the well-known anaerobic digestion principle. In contrast to traditional underground dome structures, they stand above ground, they are lightweight, portable in an empty condition and without any need for preparatory civil engineering works. They operate on a multitude of biomass feedstocks. Moreover, biogas production is highly effective in comparison with underground domes and outgoing digested sludge constitute an important bio-fertilizer.

Four plants have been installed at the TTU main campus and at the campus of the School of Agricultural, Earth and Environmental Sciences (SAEES) in nearby Ngerenyi. In a first stage, they will produce biogas for TTU's Catering Department with

kitchen waste and other biomass as preferred feedstocks and be used for the research about biogas production. More importantly, be used as a demonstration plant for local farmers and would-be entrepreneurs who intend to disseminate the technology around the SAEES campus and beyond.

Vice Chancellor Professor Fred Barasa has a clear opinion about the future: "TTU CEMEREM is now equipped for three important tasks: education of our students, research on biogas and digested substrates for agriculture and land amelioration, and dissemination through future manufacturing of more plants within the region."



Installation of Smart Biogas Plants at TTU

CEMEREM Macadamia Project

Almost two years ago, during a visit of the SAEES Campus of Taita Taveta University, the "problem of nuts cracking" was identified. SAEES, in their plantation, cultivate macadamia trees. Macadamia nuts range at the top end of all nuts in terms of quality, except that they are extremely difficult to open. Current technologies often result in shells being cracked and nuts being pulverized. This makes them almost worthless for sale. Moreover, the lack of an efficient nutcracker technology significantly reduces their price for farmers. In essence, the value added is much higher for whole kernels. As a result, an attempt was made to draft a profile of requirements to be fulfilled by a better, benign, technology cracking the shells and leaving at least 80 percent of the nuts intact. Another, important, objective consisted in a minimum capacity of production expressed as the number of nuts opened per unit of time. Needless to say that this machine should also be robust, and eventually manufactured in Kenya.

TU Bergakademie Freiberg's Professor Mathias Kröger, himself a diligent and enthusiastic researcher on many

different types of nut crackers, picked up the idea and decided to develop a machine as a prototype which meets the set requirements. As a result of that initiative, his student Johannes Gebel investigated various physical principles serving the purpose and, eventually, identifying one of them as key. Experimental work in the lab justified the approach and further work on the design of the prototype machine resulted in his Master's Thesis project. Days before the Christmas season, the prototype – meanwhile patented – was demonstrated in Professor Kröger's traditional Christmas lecture with substantial media coverage.



Johannes Gebel demonstrate the Macadamia Prototype at TTU

Outlook into Future

- **Establishment of new study programmes**
 - MBA Natural Resource Management
 - MSc Process Engineering
 - BSc Environmental Engineering
 - MSc Environmental Engineering
 - PhD Mining Engineering
 - PhD Process Engineering
- **Pilot plant for biogas at TTU School of Agricultural, Earth and Environmental Sciences**
- **Pilot project for macadamia cracking machine**
- **Summer school for TTU students and staff at TTU**
- **Teaching at TTU by HTWD and TU Bergakademie Freiberg members**
- **Trilateral student exchanges**
- **Bi-annual conference on education for mining and sustainable resource management of CEMEREM in 2019**
- **Networking and capacity building with government and industry**
 - Training of engineers and resource managers
 - Short courses for practitioners in the extractive sector
 - Networking with industry in research and training
 - Support for young entrepreneurs

CEMEREM TEAM

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