TECHNISCHE UNIVERSITÄT
BERGAKADEMIE FREIBERG

The University of Resources. Since 1765.

MANAGEMENT OF ENVIRONMENT AND RESOURCES

Annual Report 2020

imre 20 YEARS

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Table of Contents

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Foreword

2020 has been an exceptional year for us from 6 March until the end. Within weeks, it became clear that the plan for the year had to be completely abandoned and changed inasmuch as possible. Instead of meetings in person, we went online, many activities became virtual and we became digitized. Here is a list of activities which did not take place:

- Fact finding mission to Senegal to identify possibilities of cooperation with the University of Dakar, especially the Department of Geology
- Fact finding mission to Cameroon to identify possibilities of cooperation on education and research in environmental sciences with selected universities
- Special DAAD Alumni seminar on photovoltaics in Freiberg with a group visit to Intersolar Europe in Munich
- Summer school for CEMEREM students of Taita Taveta University (Kenya) in Germany (it was replaced by a "Winters school" in Kenya
- Participation in the annual "Business meets Africa" conference in Chemnitz (it was cancelled in June, rescheduled for October and cancelled again)
- The annual Young Scientists Conference of National Mining University of Sankt Petersburg in June (it was organized online) and JCB was a Jury Member of one of the sessions
- DAAD Alumni seminar on Small scale mining at the National University of Technology in Dnipropetrovsk
- Teacher and student exchanges between TU Bergakademie Freiberg, Hochschule für Technik und Wirtschaft Dresden, Hochschule Zittau-Görlitz and Taita Taveta University (TTU) in the framework of the CEMEREM Project
- Several meetings such as the kick-off meeting of EURECA-PRO at the Silesian University of Technology in Gliwice (it was organized online), the monthly CEMEREM Project meetings of the German partners and key CEMEREM meetings with all partners, including TTU (all online)
- BBQ parties in the garden of Prof. Bongaerts
- Christmas party in the house of Prof. Bongaerts

Instead of deploring that situation, we have adapted our working methods to the new situation by working from home and expanding our digitized activities. This has helped to keep personal contacts but it does not replace meetings in person. We look forward to normalized conditions again some time in 2021.

Freiberg, Photo took by Yi Lin (IMRE 2004) during the IMRE 20 Years Celebration in 2019

CEMEREM Project

The CEMEREM project, established as a consortium of Taita Taveta University (TTU) in Kenya, University of Applied Sciences Dresden (Hochschule für Technik und Wirtschaft Dresden (HTWD)) and TU Bergakademie Freiberg, was launched in May of 2016. The project seeks to establish a DAAD African Centre of Excellence for Education on Mining, Environmental and Resources Management in Partnership between Kenya and Germany. CEMEREM's overarching objective consists in a contribution to a sustainable development of the natural resources sector in Kenya and East Africa.

After 5 years development, these goals of CEMEREM have been achieved as follows:

- Curricula have been reviewed and new study programmes have been established with the assistance of the German partners.
- The infrastructure and research capacity at CEMEREM has significantly improved.
- Capacity building was in progress. Most courses of the new established study programmes were covered by TTU lecturers.
- Contacts with government and industry have been enhanced.
- A project and quality management has been established.
- A sustainable concept has been developed.

Main Campus of Taita Taveta University

Visit of a German Delegation to TTU

A delegation from Germany including Prof. Jan Bongaerts, Erik Ferchau, biogas researcher of TU Bergakademie Freiberg, Susanna Kettner, CEMEREM Co-ordinator of HTWD, Prof. Knut Schmidtke, Professor of Organic Farming of HTWD, Marion Ulrich, Project Administrator of HTWD, Sieghart Hädicke, technical director of faculty Agriculture/ Environment/Chemistry of HTWD, travelled to TTU.

27 February An ideas brainstorming workshop took place at TTU Voi, Kenya. 57 participants, including staff, researchers, experts and students in different fields attended the workshop. The purpose of the brainstorming workshop was to raise and collect innovative ideas for the continuation of the CEMEREM project for the years 2021 – 2025.

28 February – 08 March The delegation travelled to the School of Agriculture, Earth and Environmental Sciences (SAEES) to complete the installation of Agro PV and Biogas plants (see page 5, 6). Prof. Knut Schmidtke gave a lecture on "Biological Cultivation" at SAEES.

Ideas Brainstorming Workshop

Measurement of biogas in the gas laboratory

Installation of the soil moisture sensor for the Agro PV project

Summer School 2020

16 – 21 November Forty teachers and students of TTU attended the CEMEREM summer school.

Since 2017, summer schools were held in Germany but, due to the COVID-19 pandemic, this year's summer school was held in Kenya. The theme of the summer school in 2020 was *"sustainable mining and the food-energy-water nexus"*.

Sustainable mining refers to the production of mineral products without exhaustion or by considering the next generation that will still benefit from the same mineral products. The Summer School began on the 16th of November 2020 with keynote speeches by the Deputy Vice-Chancellors and the Vice-Chancellor of the University. More presentations were made by various invited guests to identify specific issues surrounding mining operations and possible solutions. In the following days, participants visited CEMEREM laboratories of TTU, presented their research posters, heard lectures by various experts on mining and the environment and went on several excursions to artisanal mines, a mine rehabilitation site, a crater lake and a wildlife sanctuary. Especially the field excursions and lectures were important for practical learning and participants had the opportunity to visit places they had never been to before.

Left: Visit to the Machine-Cut Stone Quarry in Taita
Right: Visit to the Mwaluganje Elephant Sanctuary Kwale

DIGI-FACE Kick-off Meeting in South Africa

2 – 7 March The Digital Initiative for African Centres of Excellence (DIGI-FACE) is a cooperation project between a network of German and African Universities under the leadership of the University of Kehl in Germany. The German Academic Exchange Service (DAAD) funds this initiative with support from the German Federal Foreign Office (AA). DIGI -FACE aims to strengthen the African Excellence Network via the development of appropriate and user-friendly electronic and blended learning modules and digital tools, so that geographically separated participants become part of a community of learners and practitioners for interactive digital learning progress and reflexive research supervision.

The kick-off-meeting of the DIGI-FACE project was hosted by the Nelson Mandela University in Port Elizabeth in cooperation with University of Kehl. CEMEREM was represented by Prof. Jan C. Bongaerts (CEMEREM Project Leader, TU BAF), Prof. Kiptanui Arap Too (CEMEREM Project Coordinator, TTU), Dr. Nicholas Muthama (CEMEREM Project Manager, TTU) and Mr. Kibwana Zamani (ICT Manager, TTU). CEMEREM now participates in the DIGIFACE Project by exploring the best ways to utilize its outcomes to enhance teaching with a specific focus on STEM.

Group photo of participants of DIGI-FACE Kick-Off Meeting

CEMEREM Pilot Projects

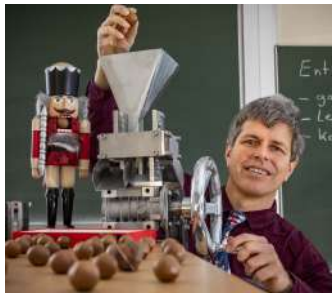
Smart Biogas project

The biogas project's aim is to foster scientific exchange between the project partners and transfer technology to the local communities. Kenyans must be enabled to reduce the impact of energy costs by using renewable energy technologies with own resources for a sustainable energy supply with protection of the environment as required under the laws of local and federal government. In 2018, four plants have been installed at the TTU main campus and at the campus of the School of Agricultural, Earth and Environmental Science

(SAEES) in nearby Ngerenyi. One of them is using in the chemistry laboratory for training students and research. Another one is used in the kitchen for the processing of kitchen waste and other biomass. The other two will become operational in 2021.

Macadamia Nut Cracker Project

As a result of initial request from SAEES, a project was started up at TU Bergakademie Freiberg with the intention to develop a nut cracking machine, especially for macadamia nuts which are characterized by a very hard shell which cannot be opened with existing devices. In Freiberg several tests with different principles were made before one promising principle was selected. This was again tested in a pilot scheme and, finally, a pilot machine has been built which meets all requirements: high availability, little



damages to the nuts, easy operation and robust engineering. Professor Kröger, who developed the machine, visited TTU and a Nut treatment factory in Kenya to identify potentials for manufacturing the machine on a commercial basis.

Agro-Photovoltaics

The Agro PV project was started up at SAEES (School of Agriculture, Earth and Environmental Sciences) for investigation of different climatic and soil conditions for plant cultivation under solar panels. Since February 2019, twelve solar panels are installed above arable land to generate electricity and to modify cultivation conditions for crops through soil improvements, better water management and less evaporation. In addition, a weather station has been built for the measurement of the air temperature

and humidity, the radiation intensity and the precipitation. Three Bachelor students and a Postdoc of the SAEES were trained to maintain the measurement system and set up a database of the measurement.

Gemstone project

This new project aims at the design and implementation of a web based platform for the trading of locally mined gemstones which enables artisanal miners to entre in direct contact with their ultimate clients, i.e., cutters and polishers anywhere in the world. The platform is embedded in a virtual sales platform. It operates with a cloud and a blockchain technology, as follows:

1. Every individual mined raw gemstone is documented in the cloud.

2. Interested buyers can place bids
3. Agreements on sales are equally are individualized and uniquely documented and traceable with the blockchain technology.

First analytical steps were taken to design the internet platform and select appropriate software.

EURECA-PRO

Together with five partners in Austria, Greece, Poland, Romania und Spain, two Saxon higher education institutions in Freiberg und Mittweida have been selected to join the „European Universities Initiative“ proposed by the European Commission. A “European University Alliance Responsible Consumption and Production (EURECA-PRO)“ will receive up to €5 million from the Erasmus+ programme and up to €2 million from the Horizon 2020 programme for three years to start implementing their plans and pave the way for other higher education institutions across the EU to follow.

The common goal of the seven EURECA-PRO-partners is to further develop research and study activities within the field of responsible consumption and production associated with goal 12 of the United Nations sustainable development goals (Envision 2030). In the long term, the partners in the alliance plan to form a virtual and integrated European Campus.

The other partners are Montanuniversität Leoben (project lead), Silesian University of Technology, Technical University of Crete (Chania), Universidad de Leon and University of Petrosani.

Prof. Bongaerts participated in the final meeting for the preparation of the proposal in Vienna on 5 and 6 February 2020.

In the fall, Montanuniversität reported a positive vote by the EU selection committee (with a very high ranking) and the project has started. Contracts have been signed, the kick-off meeting took place online on 12 and 13 November and a meeting on the design of the website and the logo, organized by University of Petrosani, took place on December 2. TU Bergakademie Freiberg is responsible for Work Package 2 which deals with the installation and implementation of a new study programme at all three levels: BSc, MSc and PhD.

Kick-Off Meeting at Montanuni Leoben (Copyright: Montanuni Leoben)

RockFeel

After completion of the InnoCrush research project on highly selective mining methods in the summer, in October, a new project under the name of “Rockfeel” was started up to implement some outcomes. Its main purpose is to develop intelligent sensors for mechanical cutting machines in mining and construction engineering. In combination with new software, these sensors will enable the design of an analysis system for the classification of rock stability, the differentiation between host rock and ore in mining and the reduction of cutting tool wear. If successful, intelligent mechanical cutting can replace traditional drilling and blasting, saving energy and waste rock handling and improving environmental performance through reduced noise and dust. The intended outcomes of the project are a prototype with proprietary software for market entry and the start-up of a company. The project is funded by the German Federal Ministry for Economic Affairs and Energy (BMWi). The University's SAXEED start-up network will become involved.

First steps to establish the project steps (process design, sensorics, data analysis) and the integration of partner companies for testing the new technology have been taken. Katharina Rosin will be responsible for marketing and the acquisition of further funding.

Project team, from left: Katharina Rosin, Dr. Taras Shepel, Dr. Jörg Bretschneider, Prof. Carsten Drebenstedt

Teaching at TU Bergakademie Freiberg

As in earlier years, Prof. Bongaserts has taught three courses for international students in mining, groundwater management and a few other study programmes. Obviously, all classes were taught online. This has been a challenge for students and teacher alike. Information and Communication Technology enables a lot of possibilities, but it does not replace the classroom atmosphere. It also requires different teaching and learning skills. The transfer of information and knowledge is based on voice communication supported by slides and videos. That may seem similar to class room teaching, but many other communication elements are missing: the body movements of the teacher, the observation if the students are interested, take notes, are bored and watch their mobile phones, switching between slides and blackboard writing and drawing (this will now be offered in online teaching), class discussions (difficult in online classrooms) and spontaneous questions and answers. There are also advantages: independence of geographical location and, at least in part, of time of the day, avoidance of travelling, easy uploading of teaching and learning materials and, eventually in the near future, systematic recording of classroom sessions as podcasts or videos.

Left: Prof. Bongaerts gave an online lecture
Right: the lecture room at TU Bergakademie Freiberg

The near future will show us whether all that will lead to virtual universities without any daily presence of students "on-site" and whether new formats of study programmes will offered by consortia of several universities with heavy reliance on online teaching. (See EURECA-PRO below.) As for STEM education, will students learn – online – to command and control "robots" doing scientific experiments in physics, chemistry, metallurgical and other laboratories instead of being trained "on the job" by laboratory technicians? Will geoscientists no longer need to do geological excursions and, instead, analyse data transmitted by drones? There are many several such open questions.

The titles of the three courses are as follows:

- Licensing, expectations and stakeholder management (Summer Term)
- Management and Finance of Mining Operations along the Life Cycle (Winter Term)
- Project and Contract Management (Winter Term)

Short Course on Mining Economics for Professors and Experts in Afghanistan sponsored by GIZ

Within the framework of a long-term project offered to the Surface Mining Institute of TU Bergakademie Freiberg and initiated by GIZ, the German Technical Co-operation Agency, University Professors and experts in mining engineering in Afghanistan become educated and trained in all aspects of miming engineering. Visits to the country have not been possible already for many years and the project has gone online well before the outbreak of the Corona Covid-19 pandemic. In the summer, JCB was asked by GIZ to organize a short online course on Mining Economics for the University Professors and mining experts. The course was offered in ten sessions from October 4 until October 11.

Guest Lecture SIR

Due to the Covid-19 pandemic, the lecture “Strategies of the International Resources Industries (SIR)” was given through distant learning methods for the first time of its 18-years history. Dr. Stefan Bartz, the guest lecturer of SIR since 2002, is also engaged in coal exit in Germany.

In February 2019 an advisory board of experts representing all relevant stakeholders in the German Energy Sector (“Coal Commission”), prepared a coal exit strategy. In July 2020, after a long controversy, the German Coal Phase-out Act was adopted. By 2038 at the latest, the use of coal for power generation is to be completely ended. However, the majority of plants will be closed already in the 2020s. This is a big challenge for companies in coal mining and power generation sectors.

Dr. Stefan Bartz at the IMRE Alumni Seminar 2018 in Chengdu

The transition causes a tremendous workload. Mining strategies have to be revised with a focus on earlier mine closures. Existing mine rehabilitation plans are being changed. Decommissioning and dismantling of power plants must be prepared and put into execution. It is evident that this is far beyond a “business-as-usual” situation.

Coal excavators of open pit mines will be decommissioned in the future (Copyright: Dr. Stefan Bartz)

7 February: PhD Doctoral Degree awarded to Nicoleta Reinhardt

Resource Efficient Product Provision - Closing the resources loop for waste mobile phones and smartphones

The main objective of the PhD project focuses on developing incentive-based approaches for the sustainable and resource-efficient provision of small electronic products and the exploitation of strategic and critical metals from electronic waste. The project has developed a simulation model to estimate the inventory and monetary value of strategic and critical metal inventories in selected electronic devices. The analysis indicates that traditional value creation combined with continuously increasing consumption, fast technological growth and short product lifecycles cannot be sustainable. The world faces the need to shift towards more sustainable business models. This led to the development of Product Service Systems (PSS) to deliver new innovative business models and a closed supply chain for strategic and precious metals in small electronic products. The highest benefit of implementing a PSS system would be ensuring that the smartphones can be collected at the end of their use life and recycled, thereby reducing the need for primary mining, as well as the use life prolongation in comparison with the state of art.

Nicoleta Reinhardt works currently at the environmental office of Chemnitz dealing with issues of climate protection and climate resilience of the Chemnitz city.

From left: Dr. Norman Pohl, Prof. Michael Höck, Nicoleta Reinhardt, Prof. Magnus Fröhling, Prof. Johannes Stephan, Prof. Carsten Felden

7 June: PhD Doctoral Degree awarded to Jan Pfeifer

Two hundred years of commodity cycles - Dynamics of the Metals & Mining Industry in light of Modern Portfolio Theory (MPT)

This thesis investigated if elements of MPT can be used to obtain deeper insights into aspects at the junction of corporate finance, mineral economics and economic geology. It showed that (i) naturally occurring ores act as diversified metal portfolios, (ii) commodity cycles for metals last between six and 20 years and depend on their usage pattern, (iii) over time different movements exist within the risk-return framework of MPT, which can be associated with expanding or consolidating economic conditions within the metal subsector, (iv) the behaviour of the safest and optimal portfolios through time can help to spot times of crises as well as times of exceptional high returns for the Metals & Mining sector, (v) MPT findings can be used to improve resource development strategies with an inter-generational perspective, (vi) MPT in combination with commodity cycle insights show that specific metal shortages recur at the same industrial cycle stages during different technological epochs. This exploratory study provides therewith fundamentally new insights on the behaviour and dynamics of the Metals & Mining industry in the context of historical facts and can help to better anticipate future developments of it.

Jan Pfeifer has returned to Canada and he is now the engagement manager of Hatch, a leading engineering consultancy company operating in the mining, energy, infrastructure, digital, and investments sectors.

In the front row, from left: Prof. *Helmut Schaeben, Jan Pfeifer, Prof. Jan C. Bongaerts*

12 June: PhD Doctoral Degree awarded to Kateryna Pollack

Implementation of Renewable Energy into the Mining Industry

The PhD project aims to develop a mathematical model as a decision-making tool towards implementing renewable energy (RE) into the mining industry. The decision itself refers to a substitution of the genset by the hybrid system in the sense of no return (to the conventional system). The mathematical model is based upon the concept of LCOE. The PhD thesis consists of the three main parts as follows:

i) mathematical model on the integration of RE in the mining industry: break-even times of diesel and hybrid PV-diesel systems,
ii) a survey analysis, and
iii) a case studies analysis, a cost analysis, a SWOT analysis.

The outcomes of the survey allow for identifying the prioritization on the use of RE in mining operations. The case studies and cost analysis derive a practical decision rule based on a cash flow approach. The SWOT analysis evaluates RE integrated into the mining industry in a wider context, giving a perspective on RE applicability within the range of external and internal opportunities and constraints. This PhD project intends to enhance the attention of decision makers on RE and fossil fuel technologies towards increasing the attractiveness of RE in powering the mining industry.

Kateryna Pollack works currently as technical project manager at VNG AG—Verbundnetz Gas Agbo, a natural gas company headquartered in Leipzig, Germany.

From left: Prof. Jan C. Bongaerts, Kateryna Pollack

10 November: PhD Doctoral Degree awarded to Mariia Hess

Decision making on sustainable consumption of interior paints: Comparing two case studies conducted in Germany

Decorative paint products may evaporate hazardous emissions such as volatile organic compounds and formaldehydes. This PhD thesis addresses its objectives towards the issues of environmental consciousness and the awareness of possible environmental and health impacts of paint products among the average consumers. Potential solutions to direct average consumers' awareness of environmental and health effects of the products they purchase were investigated. Therefore, two questionnaire surveys were conducted on several trade fairs for construction products in Germany. On the one hand, the first survey targeted visitors of these trade fairs, i.e. average consumers of construction products. On the other hand, the second survey with in-depth interviews targeted participants of these trade fairs that included manufacturers of indoor paints and varnishes as well as companies who used painting pigments in their manufacturing process. The results of the surveys were evaluated using statistics as well as decision-making methods. Environmental Product Declaration appeared to be a medium from in communication between a paint manufacturer and a consumer.

Mariia works now at the Helmholtz Institute Freiberg for Resource Technology. She is responsible for marketing and public relations of a project "recomie" to develop sustainable solutions on mining legacies.

From left: Dr. Jiangxue Liu, Mariia Hess, Prof. Jan C. Bongaerts

Environmental innovation at local government level

The PhD project of Florian Unger analyses the influences and impacts of the implementation of environmental innovations towards climate protection at a local government level. The consideration of the environmental innovations as one of the options to reduce the environmental damage through the impacts of behaviour change, modified products as well as production processes, usually focuses on the economical interactions taking place in the market sector. The local government level, or generally speaking the public sector, however, as an actor and initiator of environmental innovations is rarely investigated.

In general, the local government represents the level that has the immediate means of action for the achievement of local and national climate protection goals. It is therefore of a particular interest to identify and differentiate the different impact drivers which influence the development of environmental innovations on local level.

The main objective of the PhD project is to generate a closer insight into the evolution of innovations by the example of municipal administrations in Germany. To tackle this research complex, the project primarily deals with the question of what factors drive the innovation behaviour of the employees of the local government.

The methodical design for the PhD project is based on the Grounded Theory approach. The aim of the Grounded Theory is to generate theoretical statements in the course of the research through a gradual data collection process and the repeated test of their theoretical relevance of the "grounded" theory model. This approach is finally used to provide a model of the impact of environmental innovation in the municipal administrations in the field of local climate protection.

Currently Florian is summing up the main results of the Grounded Theory process. The PhD project has already been conducted for several years additionally to Florian's day-to-day work at the Energy Agency of the City Council of Frankfurt am Main, where he is responsible for the development of the climate protection strategy.

Life Cycle Analysis for the Recultivation of an Open Pit Mine

In the summer, the Surface Mining Institute received a request for a study on the environmental impacts of the flooding of a closed open-pit lignite mine. The standard process for flooding in Germany consists in a natural re-fill of the groundwater table within the open pit after groundwater pumping is terminated. For the specific closed mine, this would lead to the creation of a saline lake, due to the natural conditions of the available groundwater. Since the water authorities do not allow the creation of such a lake, alternative technical solutions are required and their environmental impacts must be shown.

In that context, two technical solutions were studied:

i. pumping up freshwater from nearby deep wells to fill up the mine or transporting freshwater from a distant source through pipelines and

ii. pumping up the salty groundwater for deposit in an closed salt mine at some distance.

Both technical solutions were evaluated in terms of their environmental impacts with the help of a Life Cycle Analysis and using the UMBERTO software package. It turned out that the second solution is not preferable from an environmental point of view and that the first solution should be studied further to improve its environmental performance.

The project resulted in a report for the client and in a Master's Thesis report by Nomin Ganbaatar, now graduated from TU Bergakademie Freiberg. In this context, it was decided to expand research on mining with a focus on Life Cycle Analysis. As a result, another student started work on her Master's Thesis project related to the LCA of drilling and blasting. This is a conventional technology with severe environmental impacts and attempts are being made to replace it with selective cutting technologies (See RockFeel on page 8). The Thesis will result in a complete overall LCA analysis for comparison with the LCA outcomes of selective cutting technologies.

International Online Workshop on Green Mining

In the context of the Eastern Partnership Programme of the European Union (aiming at relations between the EU and Armenia, Azerbaijia, Belarus, Georgia, Moldavia and Ukraine) and with support of the German Ministry of Foreign Affairs (Auswärtiges Amt), a four days Online conference took place in cooperation with TU Bergakademie Freiberg, Ural University of Mining in Yekatarinburg (Russia), Belarus National University of Technology and National Technical University "Dnipropetrovsk Polytechnika".

Participants met online on four days in November and December. Prof. Bongaerts gave three presentations entitled:

- Recultivation of mining sites: use of Life Cycle Analysis for the flooding of open pit mines
- Renewable energy in mining operations
- Opportunities of and limits to recycling for the supply of natural resources

Publications

Hess, M., Bongaerts, J.C. 2020. *Differences in Perception of the Environmental and Health Impacts of Decorative Paints among the Average Consumers. Sustainability 2020, 12(11), 4495. doi: 10.3390/su12114495*

Attended Conferences

POCACITO Post-Carbon Cities of Tomorrow Workshop, Presentation on the Post-Carbon City Frankfurt am Main - Quo Vadis?, supported by the European Recovery Program of the Federal Government of Germany, 3th February 2020 Participant: Florian Unger
Kick-off Meeting URBACT Network Zero Carbon Cities, 8th – 9th July 2020 Participant: Florian Unger
Workshop with the Ministry of Energy Israel, Presentation of the Low-Carbon City Strategy of the City of Frankfurt am Main, 10th August 2020 Participant: Florian Unger
Ecoprofit-Network Workshop Germany, Presentation on the potential of the Ecoprofit network approach to support the local climate protection targets, 1th October 2020 Participant: Florian Unger
International Urban Cooperation Programme (IUC), 6th Exchange meeting of EU and Japanese Cities, 24th November 2020 Participant: Florian Unger
URBACT Zero Carbon Cities Masterclass session 1 & 2, 8th – 9th December 2020 Participant: Florian Unger

Master Thesis Colloquia

Hassan Afzal	Organizational Development and Change: A Proposed Business Plan for a Company
Anthony Ansu-Gyeabour	Emission of Carbon Dioxide (CO_2), Methane (CH_4) and Nitrous Oxide (N_2O) from Hydroelectric Reservoirs in Tropical Areas and Substantiated Improved Climate Mitigation Option (HydroResp)
Ahmer Rehman	A Business Plan for Marketing of Shan Foods in German Supermarkets
Unjila Nifat	Analysis of consumer behaviour with respect to second-hand clothing with a case study of Bangladesh
Rizwan Nasir	Marketing of Electric Vehicles in Pakistan - Consumer influencing Factors for the Adoption of EVs
Kwabena Ofori	Health and Safety Management in the Construction Industry: Assessment of the Building Construction Sector in the Accra Metropolis of Ghana
Najamulhuda Ali	Changes in rainfall pattern and climate change in Pakistan and Nigeria
Rubaya Hossain	A Student Project on Plastic Packaging in Bangladesh
Nomin Ganbaatar	Umweltbilanzierung von wasserwirtschaftlichen Aufgaben in der Wiedernutzbarmachung der Tagebaue im Helmstedter Revier
Suren Dhanasekaran	Integrated Reporting in Forest Sector: the quality of Environmental Disclosure evaluation
Md Saqib Farabi	A methodology for forecasting lithium demand for e-mobility in Germany: a scenario approach

Development of Sustainable Packaging

As part of the #EUGreenDeal, the Circular Economy Action Plan tightens the requirements on packaging and plastics products, particularly items of single use. **Peter Görlitz, IMRE 2009**, supports this development as sustainability manager of a packaging company. His role involves running trials with paper packaging in collection, sorting and reprocessing systems and guiding the internal development of new products with design for recycling guidelines.

These activities take place in an environment of conflicting priorities between food safety and shelf life, recyclability and recycled content, suitability for mass production and costs, as well as the latest developments in materials, sensor technology and robotics. Furthermore, it means engagement with numerous stakeholders, starting from the European Commission, national legislators, Extended Producer Responsibility schemes, trade associations going down to municipalities, retailers, brand owners, operators of sorting and reprocessing facilities, certifiers and many more.

Peter Görlitz at the IMRE 20 Years Celebration

Even though recycling systems for packaging are widespread in most European countries, for a truly circular economy, significant developments in the fields of technology, legislative framework and supply chains are still needed.

For more information of his project please assess:

https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en#documents

Conserving Biodiversity in High Seas

Since 2012, **Jiliang Chen, IMRE 2002**, is specialized in climate change policies and the conservation of the Antarctic marine ecosystem. He engages in the Commission for the Conservation of Antarctic Marine Living Resources and the Antarctic Treaty Consultative meetings, and publishes papers in various journals and newsletters. He is now leading an ocean policy program of a Chinese environmental NGO, Greenovation Hub.

The main goal of his program is to support China's constructive participation in the governance of the high seas. He works on issues including marine protected areas and sustainable fishery in various international negotiations. “The next decade would be critically important for combating climate change and biodiversity degradation. We hope the next conference of the parties of the convention on biological diversity will set up ambitious goals to boost conservation actions in next decade,” Jiliang said, „the climate crisis and the nature crisis is interconnected. We must act now, before it is too late!”

Jiliang Chen at the International Symposium on the Conservation and Sustainable Use of Marine Biological Diversity Overseas beyond National Jurisdiction

Jiliang Chen at the IMRE 20 Years Celebration

Installation Photovoltaic and Solar Water Heating Systems at DAAD´s Regional Office in Mexico

In the second week of December 2020, a 4.44KWp photovoltaic system has been installed at DAAD´s regional office in Mexico City which is responsible for Mexico as well as Costa Rica and Central America. The system has 12 solar modules of 370Wp each and a central 3.8KW SMA inverter. It will produce estimate of 6 000 KWh electricity yearly and avoid 5 CO_2 tonnes of Green House Gases (GHG) emitted to the atmosphere.

The installation was completed by the local company ECOMADI in which **Augusto Mosqueda Solis, IMRE 2006** is the technical leader. Together with DAAD, he has been working during the second half of 2020 in order to make this project as sustainable as possible.

The project also includes the installation of a flat collector type solar water heating system with a 150lts storage tank.

Both systems are expected to provide 100% of hot water and electricity needs of DAAD´s regional office. Final permits are expected to be issued in January 2021 in order to let the system operate as a grid tied system.

Photovoltaic and Solar Water Heating systems installed at the DAAD's regional office in Mexico City

Innovative Exploration

TheiaX (*theiax.de*) is a spin-off project of the Exploration department of the Helmholtz Institute Freiberg for Resource Technology (HIF) part of the Helmholtz-Zentrum Dresden - Rossendorf e. V. (HZDR). Having been granted a 12-month funding via the Helmholtz Enterprise program, the aim is for TheiaX to become a stand-alone legal entity by Q2 2021.

The backbone of TheiaX is the combination of hyperspectral imaging technology and in-house developed machine learning algorithms to support mining companies with their resource modelling.

TheiaX offers sustainable, reproducible and tailored Outcrop, Mine-Face and Drill-Core mapping services. When compared to traditional methods, TheiaX is safer, quicker, provides a better spatial understanding of mineralogical variability and allows for near-real-time decision-making.

Christian Christesen, IMRE 2011, responsible for Technology Transfer at HIF, has actively supported TheiaX since 2019. Chris is also part of the core TheiaX team and is responsible for sales, business development and project management.

In 2020, with proven and validated tailored solutions for the mining industry, TheiaX provided services (via HZDRI GmbH) in Greenland, Bulgaria, Greece, Czech Republic and Germany.

Christian Christesen at the IMRE 20 Years Celebration

Development of Sustainable Artisanal and Small-Scale Mining in Ghana

Torkornoo and Associates (TAL) was established in 2004 first by **Samuel Torkornoo** who was later joined by **Edmund Hassan** (both are **IMRE 2002**). The company provides a wide range of consultancy services to the natural resources sector of Ghana and West Africa as a whole. TAL's core business is in the business of mining, spanning mineral exploration and related activities in the entire value chain of mining.

Despite the ravaging effect of Covid-19, the year 2020 was memorable for Sam and Edmund. Their collaboration with two partners from Sachsen yielded very positive results:

Together with *Beak Consultants* of Freiberg, TAL won a contract sponsored by the World Bank group to investigate and geologically identify economically viable areas for artisanal and small-scale mining concessions in the Dunkwa area of Ghana.

Similarly, with *ibes AG* of Chemnitz, TAL won another World Bank sponsored project to undertake pilot feasibility studies for the establishment of small scale mining incubation centres in Ghana. The study sought to provide a framework for piloting and implementation of incubation centres as part of a package of formalizing and creating conditions for orderly, safe, sustainable and environmentally sound development of artisanal and small-scale mining in Ghana.

Edmund Hassan and Samuel Torkornoo working on site of a small-scale mine in Ghana

DAAD Alumni Seminar 2021: Water in Africa in Balance with Human Needs and Nature with Participation in IFAT Africa 2021

Over 300 million Africans have no access to clean and safe water for drinking. 700 million Africans lack adequate sanitation because of poor living conditions. Both have a serious impact on poverty reduction efforts and economic progress. In a publication entitled „Africa Water Vision 2025" by the UN Economic Commission for Africa, key issues related to water management were identified and an "Africa Water Vision 2025" was proposed.

It is the intention of the convenors to deliver a practical contribution to some of the objectives of the "Africa Water Vision 2025" with a seminar programme sharing experiences with water projects having passed an „African Test of Performance". The projects will be presented by the convenors and by the Alumni participants. The envisaged audience consists of „practicing experts" who are involved in water projects and show a strong motivation to learn from each other and, in consequence, extend the established DAAD Africa Alumni Water Network (GAWN Germany Alumni Water Network).

The seminar and the participation in IFAT Africa 2021 are offered by the German Academic Exchange Service (DAAD) in the framework of the programme Alumni Special Projects. The International Alumni Seminar is organized by TU Bergakademie Freiberg in Partnership with Hochschule für Technik und Wirtschaft Dresden. The costs will be mainly covered by funds from DAAD provided by the German Federal Ministry for Economic Cooperation and Development (BMZ).

The seminar is scheduled in the run-up to the trade fair IFAT Africa 2021, the leading German Industry and Trade Fair for Waste, Water and Environmental Technology in the region. The partner host university of the seminar will be University of Johannesburg.

Alumni Meeting 2021 in Kenya: An Environmental Management System for Taita Taveta County as a Pilot Project for East Africa

As the ninth DAAD African Centre of Excellence, funded by the German Federal Foreign Office through DAAD, the Centre of Excellence for Mining, Environmental Engineering and Resource Management (CEMEREM) started in April 2016. It is a joint project of Taita Taveta University (TTU), Voi, Kenya, the University of Applied Sciences Dresden (HTWD) and TU Bergakademie Freiberg to implement training and research activities in Mining, Environmental Engineering and Resource Management

As the first generation of CEMEREM Alumni will be graduating in November of 2020, this proposal for an Alumni Seminar is submitted to DAAD. In addition, other Alumni of TU Bergakademie Freiberg and of HTWD, especially from Africa will be invited to apply. Other DAAD African Centres of Excellence will be encouraged to advertise the event for their Alumni as well.

Experiences within the CEMEREM project resulting from teaching and, more so, from student and staff research projects have revealed numerous environmental problems impacting and, ultimately, threatening the sustainable availability of the natural resources of Taita Taveta County.

A research overview prepared by TTU of Taita Taveta County's current state of the environment and the interaction between its inhabitants and the county's natural resources shows that the implementation of an Environmental Management System (EMS) is necessary and highly recommended. The study identifies several major areas of action. The seminar has the purpose to develop the concept of such an EMS for the benefit of the County and for other regions around the world.

Alumni Meeting 2021 - 2022: Sustainable Mining, Natural Resources Awareness and Social Acceptance of Mining

For mining companies, sustainable practices are essential for their "licenses to operate" and their managers need to be environmentally and socially responsible and ensure that costs are covered by revenues. Sustainable mining offers new opportunities for "the capacity for the biosphere (environment) and human civilization to coexist".

In many resource dependent countries, people resist – sometimes vigorously – mining projects because they see no benefits for their communities and fear the environmental impacts. Gold mining in Latin America meets with protests featuring "Agua si, oro noi" (yes to water, no to Gold). In many countries, coal mining is challenged. Often, protests are raised against foreign mining companies and resistance may lead to interruptions of mining operations.

All this shows the importance of the subject of the Seminars for Alumni who work as professionals in the mining and minerals sector, the mining equipment sector, investors in these sectors, trade unions, consultancy, government agencies, NGOs and research institutions.

The host of venue of the Alumni Seminar in 2021 is the Faculty of Mining and Petroleum Engineering (TFFM) of Institut Teknologi Bandung (ITB), one of the leading universities of Indonesia. The host of the alumni seminar in 2022 is the Faculty of Mineral Resources Technology at University of Mines and Technology (UMaT) in Tarkwa, Ghana.