



TECHNISCHE UNIVERSITÄT
BERGAKADEMIE FREIBERG

The University of Resources. Since 1765.

MANAGEMENT OF ENVIRONMENT AND RESOURCES

Annual Report 2019



Compiled and edited by:

Prof. Jan C. Bongaerts (JCB) and
Dr. Jiangxue Liu (JL)

Designed by:

Dr. Jiangxue Liu

Table of Contents

International Activities	1
Teaching & Research Activities	11
IMRE Alumni Activities	19
Outlook into the future	29

URM TEAM

**Head of the Chair of Environment
and Resources Management (URM)**

Prof. Jan C. Bongaerts



Research Associate

Dr. Jiangxue Liu



Research Associate

M. Sc. Katharina Rosin



Contact:

Prof. Jan C. Bongaerts: j-b.bongaerts@ioez.tu-freiberg.de
Dr. Jiangxue Liu: jiangxue.liu@bwl.tu-freiberg.de
M.Sc. Katharina Rosin: katharina.rosin@bwl.tu-freiberg.de
Institut of Mining at TU Bergakademie Freiberg
Gustav-Zeuner Str. 1a
09596 Freiberg, Germany

CEMEREM Project

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. It is funded by German Federal Foreign Office through DAAD. CEMEREM has four main objectives:

- Education and training of students and staff of TTU and of members of stakeholder organizations of CEMEREM
- Promotion of research
- Development and operation of specific laboratories for issues of the natural resources sector
- Networking with partners from Government and Industry for contribution to a sustainable growth of academic education at TTU

After four years development, TTU and its German partners jointly established five new study programmes:

- MBA Natural Resource Management
- MSc Process Engineering
- BSc Environmental Engineering
- MSc Environmental Engineering
- MSc Mining Engineering

Five pilot project were developed:

- Smart Biogas Project
- Efficient Macadamia Nuts Cracking Project
- Gemstone Platform Project
- Compatible Solar Panel Project
- Business Incubation & Development Centre (BIDC) for building the network with partners from Government and Industry



DAAD's Film Team Underway for CEMEREM



CEMEREM Exchange Activities

Teaching at TTU

10 – 19 February Prof. Feistel and Phillipp Marx at the Hydrology Institute of HTW Dresden gave lecture on “Climate Change”, and completed the installation of the weather station and gave training on measuring probes

20 – 23 March Dr. Weyer at the underground mining institute of TU Bergakademie Freiberg gave lecture on “Ming Ventilation”

22 – 27 April Dr. Ibrahim Muritala, associate researcher in German Aerospace Center (DLR) gave lecture on “Petroleum Engineering and Reservoir Engineering”

26 August – 13 September Prof. Feistel gave lectures on “Water Quality, Pollution and Modelling” and “Engineering Hydrology”

7 – 21 September Ms Kupka of the Institute of Ecology and Environmental Protection of HSZG gave training courses for MSc Process Engineering students

Training at HSZG

20 – 26 October Two lecturers of TTU, Phillis Mbinda and Eric Munene Kinyua were trained at HSZG on Process Engineering.



Dr. Weyer with the MSc Mining Engineering Students



Ms Kupka at SAEES



Ms Kupka in the PE Laboratory

Summer School 2019

14 – 21 July Twenty CEMEREM teachers and students from four departments at TTU participated in the 3rd Summer School with the topic “Water, Mining and Agriculture”. The Summer School started with a lecture session given by Prof. Bongaerts, Prof. Grischek, Prof. Feistel, and Dr. Liu.

After the excursion to LMBV in Leipzig related to redevelopment and recultivation of mining landscapes, participants were gathered into three groups based on their background. Groups with mining, engineering and business background visited the laboratories of the Faculty of Agriculture/ Environment/ Chem-

istry of HTWD, the underground mine at “Reiche Zeche” and the laboratory of the Surface Mining institute, The group with agricultural background visited Agrargenossenschaft in Clausnitz, an agricultural cooperative with biogas plant, vegetable oil production, windmills and PV panels, and the organic farm “Vorwerk Podemus”. All participants spent a full day at the water dam Einsiedel and the associated drinking water factory and, after lunch, at a drinking water storage and distribution plant in Chemnitz. In this way, they had the opportunity to move along and see the entire drinking water supply system.



*Left: Visit to the LMBV
Right: Visit to the Water Dam Einsiedel*

Students Exchange

19 May – 20 June Levent Köksal, a bachelor student at the Institute of Ecology and Environmental Protection of HSZG worked on his research topic related to Sustainable Waste Management System for a Kenya Municipal Site.

19 November – 18 December Five students from TTU visited TU Bergakademie Freiberg for a one month research stay. The purpose of the visit was develop their concepts of their Master Thesis. During the research stay, the students worked with their supervisors on their concept and gained additional skills on using different software. They went on excursions for a better under-

standing of underground mining technologies and the utilization of biogas as a renewable energy source.

25 November – 6 December Five students of MSc Environment Engineering of TTU had two weeks intensive course related to “Water, Analysis and Engineering Hydrology” at HTW Dresden. They had lectures and practices in laboratories related to water treatment and water quality assessment. They learned about the technologies applicable for small scale water treatment and Decentralized sewage treatment Technology. They visited the Hosterwitz Water Treatment Plant to gain first hand practical experience.



*Left: Presentation Day at the Surface Mining Institute at TU Bergakademie Freiberg
Right: Visit to the Saxon Mining Bureau in Freiberg*

CEMEREM Projects

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 s



(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 2020.

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

A new 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 enter 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 individualized and uniquely documented and traceable with the blockchain technology.

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

CEMEREM Conference

17 – 18 September The Conference was held in Voi Wildlife Lodge at Voi town, Taita Taveta County. Participants were drawn from academia, industry, especially the extractive industry, government, students and alumni of TTU.

The main theme of the conference was entitled: **SUSTAINABLE DEVELOPMENT IN THE EXTRACTIVES INDUSTRY IN AFRICA**

The conference had three sub-themes anchored on the following three priority areas.

- Impacts on environment, economy, health (of the general popula-

tion and immediate workers in the mines) and social well-being;

- Holistic stakeholders' involvement, including local and indigenous communities and women;
- Sustainable mining practices through the provision of financial, technical and capacity-building support to developing countries.

Some prominent guests attended, among them the Chancellor of Meru University of Science and Technology (MUST), the Hon Rtd Marsden Mardoka and John Omenge, Permanent Secretary of the Mining Ministry, Kenya.



Group Photo of the CEMEREM Conference

DAAD Kontaktseminar in Ethiopia

11– 15 June Prof. Bongaerts took part in a Seminar organized by DAAD in Addis Ababa. The seminar offered the opportunity to representatives of German Universities to meet with counterparts of Universities in Ethiopia to introduce themselves and learn about mutual interests, especially with respect to their intention to submit joint proposals for the ERASMUS PLUS programme of the European Union. Before the meeting itself, which took place on 13 and 14 June, Prof. Bongaerts travelled to

Mekelle to meet with representatives of the university there and discuss similar joint activities.



Group Photo of the Seminar Participants

“Business Meet Africa” in Chemnitz

19 June As usual, every year in June, the Chamber of Commerce of Chemnitz – in co-operation with Member of Bundestag Frank Heinrich, organizer this one-day event. It is attended by ambassadors and their staffs of African countries in Germany and by the Business Community of Saxony and beyond. The message of the conference was very clear: the German Government, the public business promotion agencies (including State-owned Development Bank KfW) and the organisations of the Business Community (Chambers of Commerce, German Association of

Mittelstand and others) consider the African continent as a large and important market for technology transfer, co-operation in manufacturing and in services and job creation. Once again, the German government is increasing its budget for development in Africa, focussing, however, on countries with own policy strategies and policy instruments in those directions. Co-operation is shifting from development aid towards business partnerships, entrepreneurial endeavours and the creation of employment.

39th Meeting of Africa Group German Geologists

29 June – 1 July Afrikagruppe deutscher Geologen is an informal group of geologist and related scientists with specific interests in all „geo aspects“ in Africa, reaching from paleology, geology, hydrology and water resources, soil science, including erosion and soil improvement techniques, agriculture, especially in arid conditions, use of biomass up to community development. Given the age of many members, the group was almost extinct, until some years ago, a new generation moved in. The meetings are combined with an excursion and individual members act as hosts at their universities. The ex-

ursion took part at two locations. The first location is an archaeological site high above the Danube River now called „Heuneburg“, showing a partly reconstructed town of the Celtic Age (2500–2600 years ago) and the second location is a re-naturalized stretch of the Danube River nearby, illustrating novel concepts to manage floods with natural landscape modelling techniques. The papers given reflect the entire spectre of the group. Prof. Bongaerts gave a presentation about Mining 4.0 reflecting the current trends in atomization and digitalization in the mining industry.

Conference in Aberden

1 – 4 September Upon invitation of Professor Ulrich Schlie of the Zentrum für Diplomatie of Andrassy Universität in Budapest, Prof. Bongaerts participated in a Joint Seminar entitled „Current geopolitical challenges and their impact on leadership in a disruptive age“. The Seminar was organized by the Centre for Diplomacy at Andrassy Universität Budapest and the Centre for Global Security and Governance at the University of Aberdeen in Aberdeen, Scotland. Participants were

students, PhD candidates and teachers of both universities and of some German universities. JCB gave a presentation on „Natural resources and the world ahead“, followed by a discussion. The audience appeared to be very interested and surprised by the many facts and figures showing the dual dependency of countries on natural resources. Those countries which have them and mine them depend on those countries who need them. Clearly, especially developing countries depend on the

industrial countries for revenues from exports of mined mineral products. The host of the event was Professor Thomas Weber, Chair in Histo-

ry and International Affairs and Director, Centre for Global Security and Governance, University of Aberdeen.

Senegal - German Business Dialogue in Frankfurt

15 November Prof. Bongaerts (and Professor Drebenstedt who joined later) accepted an invitation for a „Senegal – German Business Dialogue“ in Frankfurt. The meeting was organized by SenGermany e.V., a small NGO of highly qualified professional Senegalese residents in Germany, all extremely fluent in German with the aim of promoting relations and co-operation between the two countries. The topic of the meeting was focussed on the development of the mining sectors and its contribution to economic and social development. One specific aspect related to the use of renewable energy technologies in mining operations.

The Minister of Mines, Lady Dr. Aïssatou Sophie Gladima Siby, and

the Ambassador of Senegal to Germany, Cheikh Tidiane Sall, attended with presentations. The minister is a very competent geologist herself and a graduate of the University of Dakar. The School of Geology was founded in 1981 and has delivered more than 300 graduates. Senegal has a growing mining sector (large volumes of potassium, a world-class deposit of Ilmenite producing Titanium Dioxide and Zircon, Gold mining and new Gold discoveries in the Birimian Greenstone Belt, substantial offshore discoveries of oil and industrial minerals for the construction industry) but, so far, no academic institution for the education of miners.



Senegal - German Business Dialogue in Frankfurt

Teaching at TU Bergakademie Freiberg

Prof. Bongaerts now teaches three courses every year for students from Study Programmes, including Sustainable Mining and Remediation Management, Advanced Minerals Resources Development, Groundwater Management and others. During the Summer Term, he teaches a course entitled „Licensing, Expectations and Stakeholder Management“. This course deals with mining law, mining licenses, the identification and management of stakeholders and taxation of mining operations. In the Winter Term, he teaches „Project and Contract Management“ and „Management of Financing of Mining Operations Along the Life Cycle“. The course on project management deals with fairly standard issues, such as Critical Path Analysis, Critical Chain Analysis, Budgeting of Projects, Uncertainty in Project Management and Trade-Offs between time and resources in Project Management.

The course on financing starts with a basic introduction to the reading of Balance Sheets and Income Statements and calculations of Net Present Value, Internal Rate of Return and many other Performance Indicators. It continues with the specific

problems of financing mining operations, which are characterized by

- (i) high risks,
- (ii) long lead time periods for exploration and construction without revenues,
- (iii) shorter or longer operation time periods with fluctuating product prices and strong competition and
- (iv) a closure and rehabilitation time period for which funds must be accumulated.

Students from many countries attend these courses. Next to attending classes, they need to accomplish many assignments in working groups. An evaluation made in December shows that this teaching format provides a high learning effect.



Students in the Lecture

Teaching at HTW Dresden

Environmental engineering students at our Partner University of Applied Sciences Dresden (HTWD) need insight in Environmental Management theory and practice and, for that reason, Prof. Bongaerts was asked to give a guest lecture on the subject. A time period of ninety minutes is

much too short for a complete overview of this subject, but at least some key elements both theoretical and practical – were explained and illustrated. Students received the 127 pages presentation for their information and self-study.

Publications

Pollack, K., Bongaerts, J.C. 2019. *Mathematical Model on the Integration of Renewable Energy in the Mining Industry. International Journal of Energy Sector Management. doi.org/10.1108/IJESM-12-2018-0006. (Research Article)*

Pollack, K., Bongaerts, J.C., Drebenstedt, C. 2019. *Towards Low-Carbon Economy: a Business Model on the Integration of Renewable Energy into the Mining Industry. 28th International Symposium on Mine Planning & Equipment Selection, 2-4 December 2019, Perth, Australia. (Conference Paper)*

Pollack, K., Bongaerts, J.C., Drebenstedt, C. 2019. *Towards Low-Carbon Economy: a Mathematical Model on the Integration of Renewable Energy into the Mining Industry. XII Russian-German Raw Materials Forum, 27–29 November 2019, St. Petersburg, Russia – presentation.*



Winning Team Member of the Energy System Challenge Case Competition in St. Petersburg

Assessment of a highly selective mining extraction chain of minerals

In the frame of the research project “InnoCrush” an innovative highly selective extraction chain of minerals was developed. The extraction chain combines a high automatic selective cutting and a selective comminution for increasing the efficiency and sustainability in the mineral extraction process. The research work focuses on the extraction of minerals from vein deposits, which is commonly in small mineral occurrences and with difficult assess. The conventional mining and processing methods are

often not feasible due to their technical, economic, environmental and social restrictions. The main objective of the research work of Dr. Jiangxue Liu and Katharina Rosin within the InnoCrush project is to evaluate of the new process chain respect to its economic feasibility, its environmental impact and its impacts on stakeholders. In order to achieve this task, an integrated economic-environmental-socio evaluation model will be developed.

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

This PhD 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 sub-sector, (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 (i.e. super cycles) 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.

Thesis submitted in December 2019

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 dissertation project has developed a simulation model to estimate the inventory and monetary value of strategic and critical metal inventories in selected electronic devices. The current Waste Electrical and Electronic Equipment (WEEE) management system for mobile and smartphone waste streams has been explored to identify the potential for closure of the resource cycle. Subsequently, a cost-benefit analysis for the end-of-life management of mobile phones and smartphones was developed to find out whether there is a significant potential for saving by recycling these products. Furthermore, a structural identification and

evaluation of implementation barriers for a circular economy (CE) within the small Electrical and Electronic Equipment (EEE) sector was made, followed by the prioritization of potential strategies which can support the implementation of CE in the small EEE sector. Moreover, a value chain analysis of the current linear economy of the small EEE sector, its economic, social and environmental consequences was done. The analysis indicates that traditional value creation combined with continuously increasing consumption, fast technological growth and short product lifecycles cannot be sustainable. A more sustainable business models is required. This leads 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.

Thesis submitted in April 2019

Implementation of Renewable Energy into the Mining Industry

The PhD project of Kateryna Zharan aims to develop a mathematical model based upon the concept of LCOE 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 PhD thesis consists of the three main parts as follows: (i) mathematical model on the 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

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

The PhD project focuses on the essential criteria that a user considers during a decision-making process involving interior paints. Therefore, a quantitative study with a questionnaire survey was conducted on trade fairs for the construction products in Germany. This study involved end-users of construction products. Additionally, a qualitative study with a similar questionnaire survey was conducted on trade fairs for the construction products. Architects, engineers, sales engineers, product managers working for the manufacturers of paint products or companies who use painting pigments in their manufacturing process participated in this survey. The studies have the following objectives: (i) an investigation of end-users' and experts' opinions on

try 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.

Intended date of finish: March 31, 2020.

questions related to the importance of providing Material Safety Data Sheets for interior paints, (ii) an investigation of end-users' and experts' opinions towards transferring the information regarding the Life Cycle Assessment to end-users, and (iii) a comparison opinions of end-users with those of experts. Material properties of paints, legislation certificates in the European Union, and other criteria are involved in the decision-making process within the construction industry. Paints with ecological labels receive the highest attention in this PhD project that discusses consumption of construction products with respect to sustainability.

Intended date of finish: March 31, 2020.

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 environmental damage costs through behavior, products and production processes, usually focuses on the interaction 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.

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 behavior of the employees of the local government.

The methodical design for the PhD project is based on the so called 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.

<p>ICCA 2019, Collaboration on Climate Action, Heidelberg, 22—23 May 2019 Participant: Florian Unger</p>
<p>Climate Minicipal 2019, Frankfurt am Main, 18 September 2019 Participant: Florian Unger</p>
<p>Energy efficiency drives companies forward - heat transition as an action strategy, Conference organized by Federal Ministry for Economic Affairs and Energy (BMWi), HA Hessen Agency , Frankfurt am Main, 13 March 2019 Title of presentation: "The impacts of network approaches towards energy efficiency" Participant: Florian Unger</p>
<p>European Union Programme, International Urban Cooperation Japan, Exchange Meeting of the EU and Japan, Tokyo, 17 May 2019 Title of presentation: "the international cooperation between the City of Yokohama and the City of Frankfurt am Main" Participant: Florian Unger</p>
<p>KLiB-up Municipal Workshop, workshop organized by Potsdam Institute for Climate Impact Research (PIK), Potsdam, 27 June 2019 Title of presentation: "'nudging approach' to reduce energy consumption in private households" Participant: Florian Unger</p>
<p>International Urban Cooperation Conference (IUC), Brussels, 20—21 November 2019 Title of presentation: "'Energy Transition in urban areas" Participant: Florian Unger</p>

Hassan Afzal	Organizational Development and Change: A Proposed Business Plan for a Company
Tanmay Moharana	Digital Transformation Initiative in the Mining and Mineral Processing Industry. Scope, Challenges of Implementation and Impact on Sustainability
Atefeh Maghaminik	Technical and economic analysis of a methane oxidation system for gas detectors
Samiksha Samiksha	Ranking innovative biomethane technologies with complex decision-making methodologies
Hamman Aburumalia	Ökologische Rahmenbedingungen für das Recycling des Goldes und Palladiums aus Laptops
Yu Kang	Hochwasserschutz: Eine Bewertung von Maßnahmen mit der Methode des „House of Quality“ – Fallstudie China
Laura Beiras	Estimation of aviation carbon footprint. Case Study Berlin Tegel Airport
Carlos Andres Gallego Jimenez	The Role of Rare Earth Elements in the Adoption of Renewable Energy Technologies in Colombia /
Ximena Castaneda Caramargo	Feasibility Study of Solar Panels as a Source of Sustainable Energy in Rural Areas on the Municipality of Tumaco, Narino in Colombia
Muhammad Azfar Khan Durrani	Market Analysis for Recyclable Product in Developing Countries – Case Study Pakistan
Taimoor Majeed	Circular Economy in the Textile Industry
Adams Kyei Nyarko	The impact of Small Scale Mining on Agriculture and Food Supply – a Case Study of Ghana
Ram Krishna Awasthi	Climate Smart Agriculture in India: A Case Study
Van Thai Hua	Eco-Industrial Parks: Concept overview, barriers to implementation and some suggestions

International DAAD Alumni Conference Mining 4.0

30 April – 5 May Twenty five Alumni from German universities travelled to Freiberg for the first international Alumni Seminar on Mining 4.0, which stands for the automatization and robotization in mining.

The Seminar programme offered a deep insight in the content and the implications for future mine development and mine operation of Automization, Information Technology, the Internet of Things, Cloud and Fog Computing. Lectures by Professors Drebenstedt, Mischo, Joseph and MSc Lösche for Professor Jung illustrated current activities in Research and Teaching of TU Bergakademie related to Mining 4.0 with applications in the development of algorithms, the use of sensors, information and communication technology and machine construction for mining, both above ground and underground.

Guest lecturers Prof. Rudy Sayoga Gautama of Institute Technology Bandung, Indonesia and Prof. Bayanmunkh Myagmagsuren of German Mongolian Institute for Resources and Technology in Nalaikh (Ulaan Baatar District) illustrated the implications of Mining 4.0 for the mining industries on mining engineering education in their countries.



Participants reported about their own projects in a poster session and they received a short course on data analytics for mining 4.0 by Dr. Michael Suci of start-up talpasolutions GmbH from Essen. They were shown into University laboratories and research centres and they spent a whole day in the university mine for a hands-on approach to research projects related to underground information and communication technology, the use of sensors for location of man and machine and for health and safety and the automated steering and operation of machinery, as exemplified in „Robot Julius“. The Seminar terminated with a visit to a MIBRAG surface mine, with special insights into the control room in order to demonstrate the current status of Mining 4.0 in Germany's lignite mining sector.

Alumni Seminar in Freiberg



Excursion to Reiche Zeche and MIBRAG



Visit of re:publica in Berlin



IMRE 20 Years Anniversary

30 September – 05 October All in all, 80 of 360 IMRE Alumni participated in some of the events organized during the celebration week. With financial support by DAAD, 25 IMRE Alumni travelled from their countries to Freiberg and many others came at their own expenses. The Anniversary celebration started with an opening Ceremony in Senatssaal with guest speakers Professor Unland and Professor Nippa. Prof. Unland, Rektor twenty years ago, remembered the initial challenges of the University after 1992 and highlighted the need to have more international students who wanted to become environmental experts. This was the main reason to setup the IMRE Programme. Prof. Nippa, as the founding IMRE Director, explained how IMRE started – with the support of Dr. Stefan Dirlich, first IMRE co-ordinator. Prof. Bongaerts gave a “lecture” as he had done many years earlier.

Other activities included a city walk “On the Trails of Alexander von Humboldt”, an all-day geocaching tour to (re)discover treasures of Freiberg, a poster session with presentations about “TWENTY YEARS - IMRE AND ME”. The gala show was certainly the most important and



most festive event of the entire week and the Alte Mensa was packed.

The Celebration week ended with an excursion to Grüne Schule in Zethau for a nostalgic stay with hikes and sleeping in two story beds at the same place where many IMRE went to for the so-called Get-Together-Weekends at the start of their study times. IMRE Alumni have come from 66 countries all over the world and those present had good opportunities for meeting each other again and for contacting IMRE of other generations they had never met before.

Opening Ceremony



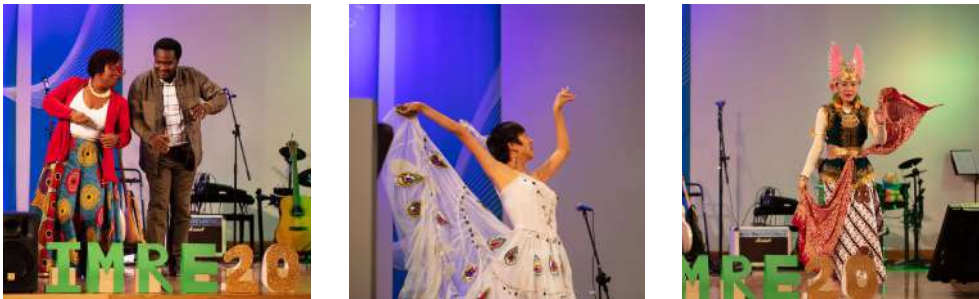
City Walk - On the Trails of Alexander von Humboldt



Geocaching



Gala-Event



Excursion



Get Together Weekend



Tanmay Moharana - Start-up—Hermit Labs



In November 2019, the European Institute of Innovation and Technology or EIT – which is an initiative by the European Union organized the finale of the EIT Jumpstarter Start-up program, at Riga, Latvia. In total six teams from around Europe were selected in the finale event.

Hermit Labs, a start-up by Tanmay Moharana (IMRE 2015) was among the 6 finalists in the Raw Materials category. The team had reached the finale after a rigorous round of multi-stage competition which spanned over 6 months and more than 60 teams from around the European Union.

Hermit Labs is a connected mining solution provider that integrates smart sensor systems, machine learning, and AI-based analytics to continuously monitor asset and in-

frastructure condition and enable predictive maintenance.

The startup is currently based out of the Freiberg Innovation Incubator and is a part of the SAXEED technology incubation program at TU Bergakademie Freiberg. It has a 10-members, among them two other IMRE Alumni (Samiksha Sakhya and Abhimanya Reddy). The advisory board consists of Prof. Dr. Jan C. Bongaerts (Chief Advisor), Dr. Jiangxue Liu and Dr. Arun Prakash of Micromechanical Materials Modelling at TU Bergakademie Freiberg.

Hermit Labs is currently working on multiple projects with multinational companies in India and Chile and providing them with integrated connected mining solutions using Internet of Things and artificial intelligence.



Left: Tanmay Moharana, Right: Partipants of the CII certified training on ISO 14064, 2019

Annisa Rahmawati - Protecting our Forest

Annisa Rahmawati, (IMRE 2010), is working as a Senior Forest Campaigner at Greenpeace Southeast Asia based in Jakarta, Indonesia. She is campaigning for the protection for the forests and peatlands in Indonesia, which are a gigantic carbon storage facilities of earth and therefore very important to combat climate change.

“Our time is very limited,” Rahmawati said, “along in the past 30 years, more than a quarter of Indonesian forests have been destroyed and mostly to produce palm oil and pulp



Annisa Rahmawati

commodities.” This is equal to 35 million hectares and the same size as Germany.

By buying the products that coming from the suppliers link to deforestation and fires, we are giving incentive to them and we are unwittingly contributing to the forest destruction, pushing endangered species like Orang-utans and Sumatera Tiger into extinction, and drive human rights violations. This is the reason why she is working closely with palm oil farmers and local communities together to find solutions for sustainable production of palm oil without further destruction of forests and environment.



A Greenpeace investigator documents the devastation of a company-identified ‘No Go’ area of peatland in the PT Bumi Sawit Sejahtera (IOI) oil palm concession in Ketapang, West Kalimantan. This area of the concession suffered extensive fires in 2015. © Greenpeace,

Augusto - Atmospheric water production with solar photovoltaics in Mexican Desert

As a consulting project and prototypes manufactured previously, Augusto Mosqueda S, IMRE 2006, together with the local companies ECOMADI and Proyecto Medra installed the technology called EOLE WATER® in the region of Zacatecas, Mexico. This area is known for its lack of drinkable water sources and scattered communities with very poor people.

During the last two years, four machines were installed in the communities of Valparaiso, Pinos, Apulco and Palos Colorados, all within the state of Zacatecas.



Visualization of the machines on the Community of Pinos, Zacatecas

After the installation and operation on the machines, some lessons were learned and it was decided to test a local prototype in order to improve some problems found such as the programming of operating hours, measuring of relative humidity, type of material use for the condensation process.

This prototype was down escalated and built at the Technical University of the Central Valleys of Oaxaca (UTVCO), where Augusto is associate professor at the renewable energy faculty.



Escalation of the prototype in order to perform improvements

Jonathan Gador - Scaling up sustainable rural water supply systems in Ghana

Since many years Jonathan Gador, IMRE 2000, has been involved in the design and construction of Rural Water Systems in Ghana, to provide potable water to the communities in the rural area, where the communities were scattered and the supply of electricity was non-existent. The supply of potable water depended mostly on hand pump boreholes, which was often distant from the communities and demanded the use of man power to pump water. Jonathan and his company developed a system called Limited Mechanized Water System with using the solar energy, which improved the ability to pro-

vide potable water to very remote areas in Ghana and brought the fetching points mostly within the communities or closer to them. They have set up a special team to train community maintenance teams to ensure that they have capacity to maintain these solar energy sources in their communities.

They are currently designing a system even for larger communities with using clean energy sources. Some projects will supply water to 40 new cities and towns using solar energy to reduce the costs and increase the sustainability of powering water systems in the near future.



*Left: Hand pump boreholes used in the past
Right: Solar Powered Limited Water System in the Northern Part of Ghana*

DAAD International Alumni Seminar 2020: PV Technologies and Projects

In contrast to Germany's "Energiewende", energy systems in many developing countries are (still) characterized by a heavy dependency on fossil fuel (with the exception of large hydro), insufficient generation capacity and grid connections, frequent power cuts, expensive back-up systems, monopoly structures and lack of private investors. Given these problems, however, governments in many of these countries change their energy policies with the aims of (i) promoting renewable energy technologies, (ii) creating (competitive) energy markets (iii) and motivating entrepreneurship and investors. As a result, in many developing countries, renewable energy technologies are considered as challenging and innovative for the provision of electricity.

The seminar will give an opportunity to participants to learn about

- Recent research on PV technologies, both at laboratory and pilot plant levels, current developments in Germany's "Energiewende": Policy and legal developments, current status of the renewable energy industry,

position of renewable energy in the energy markets, players in renewable industry, future outlook

- Selected innovations in PV technologies and PV applications
- Networking with representatives from government, (Energy Agencies), industry associations (Chamber of Commerce) and business firms (manufacturers and project developers)
- visits of laboratories, pilot plants, companies and projects with personal communication

The seminar is organized as a preparation to the visit to the trade fair **The Smarter E Europe** in Munich. This is the most important innovation hub for new energy solutions, dedicating itself to all topics relevant for the industry, offering visitors a comprehensive overview of trends, technologies and innovative concepts for the new energy world.



Alumni Meeting 2020 in Ukraine: Worldwide Small-Scale Mining, Sustainability in Mining

Within the mining sector, a substantial contribution is delivered by so-called Artisanal and Small-scale Miners (ASM). According to Intergovernmental Forum on Mining (IGF), the number of ASM workers has increased from 6 million in 1993 to around 40.5 million. A large share of mining of critical minerals, for instance Cobalt, is from ASM. Many ASM workers operate illegally. ASM activities cause severe health and environmental problems. It is, therefore, important to study this subsector and raise awareness about it. The first seminar reveals the importance of the need for knowledge and insight in the structures, the ways of operation and the problems related to safety and the ecology of ASM.

The second seminar deals with sustainable mining, refers to the development of minerals and energy resources for the best possible economic and social benefits with the least possible environmental impacts. This implies that, in all stages of a mining project, economic, environmental and community aspects,

together with health and safety should be integrated. It is important for the seminar participants to update the most recent developments related to sustainable mining.

The seminars have the following objectives and expected outcomes for the alumni:

- Improved knowledge base about the subjects of the seminars
- Improved interdisciplinary thinking
- Incentives to apply new and creative ideas gained from the seminars in professional activities
- Improved capabilities for disseminating outcomes of the seminars in training as multipliers
- New contacts with invited experts and partners from Business and Industry
- Development of Self-entrepreneurship
- Academic paper(s) on some important results
- Strengthening the connection with the universities mentioned
- Networking