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Biosensors Based on Isothermal DNA Amplification for Bacterial Detection in Food Safety and Environmental Monitoring

Anna Toldrà

KTH Royal Institute of Technology, Sweden

The easy and rapid spread of bacterial contamination and the risk it poses to human health makes evident the need for analytical methods alternative to conventional time-consuming laboratory based techniques for bacterial detection. To tackle this demand, biosensors based on isothermal DNA amplification methods have emerged, which avoid the need for thermal cycling, thus facilitating their integration into small and low-cost devices for in situ monitoring. This review focuses on the breakthroughs made on biosensors based on isothermal amplification methods for the detection of bacteria in the field of food safety and environmental monitoring. Optical and electrochemical biosensors based on loop mediated isothermal amplification (LAMP), rolling circle amplification (RCA), recombinase polymerase amplification (RPA), helicase dependent amplification (HDA), strand displacement amplification (SDA), and isothermal strand displacement polymerisation (ISDPR) are described, and an overview of their current advantages and limitations is provided. Although further efforts are required to harness the potential of these emerging analytical techniques, the coalescence of the different isothermal amplification techniques with the wide variety of bio sensing detection strategies provides multiple possibilities for the efficient detection of bacteria far beyond the laboratory bench.

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Assessing COVID-19 impacts on Agricultural Food Production among Smallholder Farmers in Northern Drakensberg Areas of KwaZulu Natal, South Africa

Bonginkosi E. Mthembu

Mangosuthu University of Technology, South Africa

In South Africa, 11.8 million people experience hunger with 20% of the population facing high levels of acute food insecurity. COVID-19 pandemic with associated mitigation measures, including climate change, high food prices, exacerbated the already deteriorated food insecurity in South Africa. COVID-19 pandemic disrupted agricultural food production and food supply chain in various parts of the world. However, the degree of COVID-19 pandemic disruptions on agricultural food production is very scanty in rural farming systems in South Africa. Smallholder farmers play a major role in agricultural food production and therefore are key to sustainable household food security. The purpose of the study was to assess the extent of COVID-19 pandemic and its impact on food production among smallholder farmers in northern Drakensberg areas of Bergville. Survey study, which was smallholder farmer centred, was conducted through the use of in-depth individual farmer interviews to investigate the impacts of COVID-19 pandemic on food production. The survey focused on farmer participation in production of staple crops of maize, dry beans and soybeans pre-COVID-19 and during COVID-19. Majority of farmers (92.4%) reported experiencing difficulties in accessing key resources such as agricultural inputs and other essential services during COVID-19. The study indicated decline in number of farmers producing staple crops during COVID-19 pandemic and this was accompanied by decrease in crop yields. Food production practices and processes were severely disrupted by COVID-19 lockdowns associated with movement restriction measures that were undertaken to curb the spread of COVID-19 pandemic in the local area. It is essential that COVID-19 policies and legislation sensitive to the plight of smallholder farmers are advocated because these farmers commonly depend on local agricultural food production for their income and livelihoods.

Biography

Dr. Bonginkosi E. Mthembu is Head of Community Extension, Faculty of Natural Sciences at Mangosuthu University of Technology, Durban, South Africa. He teaches Field Crop Production, Soil Science, Land Use Planning and Extension. His skills and expertise are in cropping systems, sustainable agriculture, crop production, soil fertility, agroecology. He is an Alumni of the: Cwaka College of Agriculture, Empangeni, South Africa (Diploma in Agriculture); University Of Fort Hare, Alice (B Agric; B Agric. Hons); North Carolina A&T State University, NC, USA (MSc. Plant & Soil, MSc Agric. Educ.); University Of KwaZulu Natal, Pietermaritzburg, South Africa (Ph.D.). He is conducting research on COVID-19 impacts and implications to agri-food sector. Other research include Mixed Cropping and Agroforestry systems in collaboration with the University of KwaZulu Natal, Council for Scientific and Industrial Research (CSIR) and Water Research Commission. The purpose is to achieve sustainable food production systems with the protection of the environment.

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Role and Effect of Nanomaterials in The Production of Biodiesel Based on Feedstock

Farjana Akhter Supty
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Biodiesel is the most time desired cost effective, sustainable and environment friendly renewable energy source which is produced from the vegetable oil or animal's long chained fatty acid esters. This process can reduce 56%-86% greenhouse gases emission. Nowadays developed countries use many modification form of biodiesel but it is still going on researching to make it accessible for all countries to decrease global warming overall. But it has been found that biodiesel production is still limited commercially for slow mechanism route, different types of feedstock need different types of production methods, huge fuel consumption etc. These problems can be solved by implanting proper use of nanoparticles in this nanotechnology era. zanoparticles can give a good thermal conductivity, increase the brake power, do nonstop power generation, increase conversion of yield, maintain a good methanol to water ratio, increase surface area to volume ratio, increase efficiency. These particles have effect on reaction temperature, time, density and other operating parameters. Nanomaterials basically act as catalyst can maximize the production, improve quality of biodiesel, reduce the cost of raw materials by producing more product from same amount of raw materials than before, increase sustainability and can give eco-friendly biodiesel production by alternative productive mechanism route for sustainable commercialization. Nanoparticles also can play an amazing role in the pre-treatment of the production. A study showed that the use of nanoparticles can reduce 22%-23% of fuel consumption. Overall, nanoparticles give high efficiency and negligible toxic effect. In this paper, different types of processing routes, mechanism methods, configuration, catalytic properties based on nanoparticles type as well as the roles, effects, the possibility of the outstanding contribution of nanoparticles as an alternation of energy source will be discussed in details.

Biography

Supty is a B.Sc. Materials Science and Engineering student at Rajshahi University of Engineering and Technology. She has strong academic achievements and extra curriculum activities experience. She has analytical thinking, problem solving, communication skills as well as has skill on many necessary software. She is very keen to pursue her career in research on nano-materials and advanced materials. Recently, she is working on environment to reduce pollution and global warming.

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Microplastics and associated chemicals: methods, interactions, and perspectives

Virgínia Fernandes
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Plastic has been a fundamental material in modern society and every year more than 300 million tonnes are produced. Plastics contain in their composition one or more polymers and other chemicals, that, when degraded (through various biotic and abiotic processes), generate microplastics and associated chemicals (MP/AC) released in various compartments, raising concerns about their negative impacts on the environment and human health (1-2). The polarity of the MP surface enables interactions (sorption and desorption) with surrounding AC that can be facilitated in environments where plastics are degraded by UV radiation and temperatures. Moreover, MP aging reduces the hydrophobicity of plastics thereby increasing their sorption capacity for hydrophilic contaminants (3). Therefore, MP can be a vehicle for AC, namely, additives such as plasticizers, flame retardants, stabilizers, and sorbed contaminants such as metals, polychlorinated biphenyls (PCB), pesticides, and polycyclic aromatic hydrocarbons (PAH) (3-4). MP have become ubiquitous and detected in marine and freshwater, soils, air, food, and several species including humans (1). Studying microplastics is very complex as there are many factors to account for, such as differences in particle sizes, constituents, shapes, additives and contaminants, concentrations, and many more. To address these issues, reliable information on the assessment of MP/AC is crucial. However, the analytical methodologies used to identify/quantify MP/AC are relatively limited and not uniform/standardized, and the complexity of comparing experimental setups and data reporting is a critical issue (5). Moreover, the consequences of body exposure to MP/AC are not well understood, and consequently, information is missing for a thorough risk assessment and development of new strategies.

Biography

Virgínia has a degree in chemistry; Master degree in environmental sciences and PhD in chemistry (2012). She is Post-Doc Researcher at REQUIMTE/LAQV – Instituto Superior de Engenharia do Porto do Instituto Politécnico do Porto (ISEP). She published 42 publications in international peer journals and 7 book chapters. Virgínia has been involved in 18 R&D projects (11 national and 7 international). She has supervised 2 PhD, 19 MSc and 9 BSc and she has given invited lessons in BSc and MSc from ISEP and Nova Medical School. Her nuclear scientific area is analytical chemistry namely extraction and analysis of pesticides and other contaminants in food, environmental and human samples. Her research addresses all aspects of the analytical process and data processing using many types of analytical techniques applied in novel and useful ways. Her interests also extend to toxicology, human health and nutrition (http://orcid.org/0000-0003-3979-7523).

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Comparative analysis of Gordonia strains genomes capable of utilizing dibenzothiophene

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FRC PSCBR RAS, Russia

Sulfur makes up 0.05% to 10% of crude oil composition, with most of it bound as condensed thiophenes, which can make up to 75% of the total sulfur. When burning fossil fuels, a large amount of sulfur dioxide is emitted into the atmosphere, which is a serious source of air pollution, contributes to the appearance of acid rain, and also changes the natural balance of chemical elements in the environment, thereby affecting the biological diversity of ecosystems. The most convenient and eco-friendly method of desulfurization is biodesulfurization – the process of removing sulfur using microorganisms. As a rule, such microorganisms are used that are capable of utilizing sulfur through the 4S pathway (the metabolic pathway for extracting sulfur without changing the rest of the molecule), which facilitates the maintenance of the fuel calorific value. The aim of this work is the implementation of the comparative analysis of the genomes of dibenzothiophene-utilizing strains of Gordonia alkanivorans 135 (CP046257.1), Gordonia amicalis 1D (CP023405.1), and Gordonia amicalis 6-1 (CP096596.1). The genomes of the strains were sequenced and completely assembled. Structural annotation of genomes was performed using Prokka software, RAST, and NCBI Prokaryotic Genome Annotation Pipeline. Functional annotation of genomes was performed using the KEGG service. For a more detailed understanding of the structure of the genomes of DBT-degrading strains of the genus Gordonia, the degree of gene order between the genomes of the two species was determined using the MAUVE program. The results showed that the main blocks retain a similar arrangement on the chromosomes, and in general the structure of the genomes is similar. However, multiple small rearrangements are observed, which probably occurred as a result of the recombination process and the activity of a large number of transposases. The analysis of the obtained results showed that, despite the ability of the strains to utilize dibenzothiophene as a source of sulfur, the dsz operon genes are absent in the strains. However, in all the researched strains in the category of «Sulfur metabolism» were found genes that are presumably related to the dszC genes.

Biography

Frantsuzova Ekaterina Eduardovna is a postgraduate student and junior researcher in the G. K. Skryabin Institute of Biochemistry and Physiology of Microorganisms Russian Academy of Sciences (IBPM RAS) a separate subdivision of the Federal Research Center "Pushchino Scientific Center for Biological Research of Russian Academy of Sciences" (FRC PSCBR RAS). She received a bachelor's degree in biology from Kuban State University and a master's degree in microbiology and biotechnology from Pushchino State Institute of Natural Sciences. She is interested in genomic and transcriptomic analysis of bacteria.

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Leveraging Autonomous Technology to Build Climate-Resilient Agriculture: A Case Study of Digital Cotton Field in China

Justin Gong

Co-founder of XAG Co., LTD, China

With the advent of the 5G era, the development of the Internet of Things, big data and artificial intelligence has brought a new definition to agriculture. Automation technologies, featuring drone, robot, and other unmanned system, can help ease farmers' workload and deliver efficiency, reliability, and productivity gains at minimal impact to the environment. However, although the technology advances fast, farmers are still facing great challenges. Labor shortage, climate change, misuse of chemicals could all lead to a bad yield and threaten environmental health. The purpose of this study is to analyze economic advantages and ecological benefits of the climate-smart agriculture ecosystem, which includes three steps: (1) Build digital farming infrastructure such as high-definition field maps and RTK navigation stations. (2) Develop precision farming equipment to reduce labor. (3) Help farmers connect all kinds of technologies in a digital platform and utilize big data and AI to make scientific decisions. The cost–benefit analysis and sensitivity analysis study were conducted for the comparison between traditional cotton fields and a digital corporate cotton farm. The result showed that at a certain critical size, the use of autonomous equipment can reduce the cost of production compared to traditional agriculture. Fixed equipment costs, labor costs, water costs and energy costs have a large impact on the critical size. On large-scale cotton farms, digital agriculture tends to be more economical than traditional agriculture. The GHG Protocol was also used to measure and calculate GHG emissions of the digital cotton field that was only managed by two people. A 22% reduction in GHG emissions was achieved through four main emission sources within the farm gate. In conclusion, unlike traditional methods that rely on experience and resources, the climate-smart management solution can reduce water consumption, pesticide, and fertilizer, lower input costs, and create new agricultural employment opportunities.

Biography

Justin Gong is the Co-founder & Senior Vice President of XAG and a DBA candidate at Université Paris Dauphine. As an entrepreneur specializing in rural economy and social innovation research, he has been dedicated to promoting and scaling up digital technology in agricultural production. He joined XAG as the Co-founder in 2013, taking charge of corporate strategy and marketing. Before returning to China, he was previously a film producer and overseas correspondent in Australia. In 2016, Justin Gong founded XAG Academy, which so far has trained about 80,000 talents for smart agriculture applications. In August 2018, Justin gate-crashed the Forbes China 30 Under 30, marking his contribution in the field of agriculture. With years of practical experience in the field of smart agricultural technology, he is also the 11th Council Board Member of Chinese Society of Agricultural Engineering, Grosvenor Council Member of National Geographic Society, and United Nations ESCAP-CSAM Consultant.

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Dynamics of the taxonomic structure microbiome of the arable land

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Microbial diversity reflects the diversity of soil conditions. To study the soil microbiome, it is necessary to use not only the methods of classical microbiology, but also the methods of metagenomics to assess the phylogenetic diversity of microbial communities. The purpose of the work is to study the dynamics of changes in microbial communities during the year on the arable soil of the Belgorod region (Russia). The study area is an arable land formed by typical chernozem soil, on which Hordeum vulgare L. v. medicum grows. At the place of sowing, standard agrotechnical methods of tillage were used. The study area is characterized by a temperate continental climate with an average July temperature of 19.3ºC, an average January temperature of -10.4ºC, and there are also 145 frosty days a year and 480 mm of precipitation per year. One monitoring site was investigated and sampled during 2021 (February, April, July and October). Sampling was carried out at a depth of 0 to 20 cm in accordance with ISO 10381-1 (2002). DNA was isolated from the samples using the FastDNA SPIN Kit for Soil protocol (MP Biomedicals, UK). Libraries were prepared according to the protocol "Preparing 16S Ribosomal RNA Gene Amplicons for the Illumina MiSeq System" using a universal primer pair on the V3-V4 variable region of the 16S rRNA gene. Sequencing was performed on the MiSeq platform (Illumina) with v3 reagents (600 cycles) at the BioSpark (https://biospark.pro/). A detailed physical and chemical agronomic analysis of the soil was carried out at the monitoring site. It has been established that soil acidity ranges from slightly alkaline in spring to slightly acidic in summer. Soil carbon content is high (from 7,4±0,7 % to 8,6±0,9 %) and only decreases in spring (5,0±0,5 %) due to the depletion of plant residues by this time of year. The amount of available nitrogen (from 35,0±2,2 mg/kg to 45,5±1,9 mg/kg), phosphorus (from 190±16 mg/kg to 354±45 mg/kg) and potassium (from 590±71 mg/kg to 1260±180 mg/kg) is large. All considered soil characteristics indicate that the soil is fertile and not depleted. The sequences were analyzed using the QIIME2 v.2022.2 program (Bolyen et al., 2019). Sequence quality control was performed using the Deblur plugin (Amir et al., 2017) with Positive mode (chimeric sequences are removed by consensus; then SortMeRNA is used, which compares all raw reads to the GreenGenes reference database (Bokulich et al., 2018); sequences with e-value ≤ 10 are retained after this read step has been shortened in length), so amplicon sequence error correction and denoising with sOTU generation is performed.

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Ecosystem services assessment of soil and water conservation based on scenario analysis method in a red soil hilly catchment of Southern China

Sun Li-ying

Zhejiang University of Media and Communications, China

Statement of the Problem: Soil erosion is quite severe in the hilly red-soil region of southern China due to the unique natural conditions, high population density, and prominent contradiction between people and land. Soil and water conservation (SWC) in agricultural watershed were carried out in large scale to alleviate soil erosion. The trade-offs of the ecosystem services (ES) of SWC and economic development are of significance to the sustainable development of these hilly regions.

Methodology & Theoretical Orientation: Due to the lack of ES evaluation indicators and unified calculation methods in line with regional characteristics, this study proposes a framework of scenario analysis by using ES mapping, ES scoring, and economic analysis technology for ES and economic-benefit trade-offs under different scenarios. The study area was the Xiaoyang catchment located in Ningdu County,Jiangxi Province, which is a typically hilly red-soil region of southern China.

Findings: From the results of scenario analysis, an obvious phenomenon is that some SWC practices can affect the value of some ES indicators, while some have no clear trend. By computing the ES scores for the four scenarios, the ranking was S3 (balanced), S1 (conservation), S2 (economic), and S0 (baseline). S3 ranks second in net income (with CNY 4.73 million), preceded only by S2 (CNY 6.36 million).

Conclusion & Significance: Based on the above rankings, S3 is the relatively optimal scenario in this study. The contributions of this study are the method innovation with the localization or customized selection of ES indicators, and scenario analysis with ES scores and economic-benefit trade-offs in different scenarios.

Biography

Sunliying has her expertise in paradigms for integrated soil and water conservation over main water erosion regions in China. In slope scale, rill erosion processes, rill morphology characteristics and their responses to soil texture, rainfall intensity and slope gradient were particularly investigated. In catchment scale, spatial allocation of soil and water conservation measures was carried out according to the soil erosion processes, topography and vegetation. The main objectives of soil and water conservation were extended form traditional soil and water losses prevention to the improvement of multiple ecological services, like carbon sequestration, landscape pattern change and habitat quality improvement, etc. Moreover, the trade-offs of soil and water conservation improvement and economic development were explored for the target of regional sustainable development.

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Establishing empirical models for predicting forest carbon uptake using seven environmental drivers

You-Ren Wang

University of Oslo, Norway

Net Ecosystem Production (NEP) of forests is the net carbon dioxide (CO2) fluxes between land and the atmosphere due to forests' biogeochemical processes. NEP varies with natural drivers such as precipitation, air temperature, solar radiation, plant functional type (PFT), and soil texture, which affect the gross primary production and ecosystem respiration, and thus the net C sequestration. It is also known that deposition of sulphur and nitrogen influences NEP in forest ecosystems. These drivers' respective, unique effects on NEP, however, are often difficult to be individually identified by conventional bivariate analysis. Here we show that by analyzing 22 forest sites with 231 site-year data acquired from FLUXNET database across Europe for the years 2000-2014, the individual, unique effects of these drivers on annual forest CO2 fluxes can be disentangled using Generalized Additive Models (GAM) for nonlinear regression analysis. We show that S and N deposition have substantial impacts on NEP, where S deposition above 5 kg S ha-1 yr-1 can significantly reduce NEP, and N deposition around 22 kg N ha-1 yr-1 has the highest positive effect on NEP. Our results suggest that air quality management of S and N is crucial for maintaining healthy biogeochemical functions of forests to mitigate climate change. Furthermore, the empirical models we developed for estimating NEP of forests can serve as a forest management tool in the context of climate change mitigation. Potential applications include the assessment of forest carbon fluxes in the REDD+ framework of the UNFCCC.

Biography

You-Ren Wang was born in Taipei, Taiwan. He received bachelor's and master's degrees in Physics from National Taiwan University and Ph.D. in Physics from the University of Wisconsin-Madison, US. His research field was experimental astroparticle physics (neutrino). Later he changed his field from physics to environmental sciences, believing it is closer to the real world. He was particular interested in the research related to climate change. He has now a postdoc researcher in Centre for Biogeochemistry in the Anthropocene, University of Oslo. The study he just finished was to disentangle effects of natural and anthropogenic drivers on forest carbon uptake, using in-situ measured FLUXNET data, modelled sulphur and nitrogen deposition data, and GAM regression technique. Another ongoing study is to evaluate global and regional land surface temperature rate of change in the past decades, using MODIS remote sensing data and ERA5-Land reanalysis data with fine resolution and global coverage.

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Integrated Sand Resources Utilization in Agriculture and "Sponge City" Construction

Yuming Su

State Key Laboratory of Silica Sand Utilization, USA

Aeolian sands are common materials to obtain from desserts, but they are usually poorly graded, inactive, and low in material strength. Thus, they are not appropriate to be directly utilized in most construction and engineering applications and are not considered a resource. Intensive studies have been conducted over the past couple of decades in the State Key Laboratory of Silica Sand Utilization in China, to modify and process aeolian sands into engineered sands. The approach, in general, is using sand as the core material and applying various coatings to meet the desired engineering needs. After innovative research and developments, a series of sand-related products have been invented and widely used in many industries and sectors, such as 1) foundry, 2) stormwater treatment and management, 3) agriculture, 4) building, and 5) oil and gas production. In this presentation, two sand–related products and their associated applications are introduced. 1) Sand-based Pervious Brick: thanks to the special sand coatings and brick formation, the bricks are pervious, with micro pores and full surface infiltration features. The initiative of Sponge City construction in China is introduced, and this Sand-based Pervious Bricks have been wildly used in some stormwater management projects during the Sponge City construction. Case studies in China are introduced. 2) Air-permeable Watertight Sand (hereinafter "Breathable Sand"): Multiple coating and surface modification processes are applied to aeolian sand particles, and thus the air permeability can be retained, while the material is watertight due to its water repellency properties. Breathable Sand has been used as a watertight liner in various agricultural applications. Studies showed that about 30%-80% water saving can be achieved with a thin layer of Breathable Sand applied below the roots of the plants. Case studies showed that the roots were stronger and the average leaf count, grain weight, grain per ear, matured grain count, and grain maturity rates were also higher. International case studies are introduced.

Biography

Dr. Su has more than 20 years of work and research experience in water resources engineering, specializing in stormwater management. He is actively involved in "Sponge City" Initiative in China, by promoting international collaboration and sustainable stormwater management concepts and technologies in China. His recent projects include designs of flood controls, green infrastructure, pervious pavers, and stormwater harvesting and reuse, as well as stormwater policy studies. Besides as vice director of State Key Laboratory of Silica Sand Resources Utilization, he serves as an advisory committee member in a couple of Sponge City organizations and institutes. He was a Senior Project Water Resources Engineer with Golder associates, specializing in stormwater management, design, modeling, and planning in the USA. He conducted hydrologic and hydraulic analysis, land development planning, grading and drainage designs, erosion and sedimentation control designs, stormwater pollution prevention plan preparations, stormwater models, low impact development (LID), and best management practice designs for various sites and various clients. He is a Diplomate of Water Resources Engineer by American Academy of Water Resources Engineers (AAWRE), and a Founding Member.

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BIM for Landscape Design Improving Climate Adaptation Planning: The Evaluation of Software Tools Based on the ISO 25010 Standard

Evelina Keibach

Middlesex University London, UK

Statement of the Problem: Climate change is one of the biggest threats to humanity. Specialists warn that increasing temperatures are harmful to health while promoting cardiovascular and respiratory diseases including mental problems. Nonetheless, scientists agree that climate change is inevitable, therefore more concern is growing on climate adaptation strategies besides climate mitigation. Meanwhile, planners are challenged to design the outdoor spaces efficiently and effectively adapting to the forthcoming floods and heatwaves caused by climate change. However, the potential of digital tools allowing to improve climate adaptation planning and supporting decision making is not fully realized in practice. Furthermore, the comprehensive comparative analysis of different software tools calculating and simulating the adaptive capacity of design is rather missing. The purpose of this study is to investigate the capabilities and limitations of software tools simulating landscape design adaptability using the ISO 25010 quality model.

Methodology & Theoretical Orientation: the implementation of the ISO 25010 framework to the research ensures a wide range of quality measures including software functionality, reliability, performance efficiency, usability, compatibility, and information quality. The objective experiments are conducted with five software tools implemented on the case study project - a residential urban quarter in the South of Germany.

Findings: The comparative analysis of different climate adaptation software tools have different focus on climate adaptability aspects and measures which leads to different types of output. However, most of the tools deal with compatibility issues causing data loss and remodeling. Moreover, climate adaptation tools are limited to functional aspects or performance efficiency.

Conclusion & Significance: This paper compares a wide range of climate adaptation planning tools considering the implementation process, time resources used and final results of the case study project. The results inform software developers on the limitations of software tools and inform planners on their potential.

Biography

Evelina Keibach passed her BIM Management studies with distinction at the Middlesex University of London. She has developed her expertise in the climate adaptation planning as part of the healthy and livable cities program while working in the world-leading engineering company of Ramboll. Her recent research is focused on the software tools enabling climate adaptation planning and the evaluation methods using the ISO 25010 framework. Therefore, the significance of her research is the practical and theoretical approach.

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Greening Urban Areas with Decentralized Wastewater Treatment and Reuse: A Case Study of Ecoparque in Tijuana, Mexico

Gabriela Muñoz Meléndez[1] and Lina Ojeda-Revah[1]

[1]*El Colegio de la Frontera Norte, Mexico*

In rapidly growing urban areas, such as Tijuana, Mexico, the presence of urban green spaces (UGSs) can help stem soil erosion, improve infiltration, slow runoff, decrease flooding, reduce air pollution, and mitigate climate change. In many water-scarce parts of the world, where centralized wastewater treatment is not accessible or practical, decentralized wastewater treatment systems (DEWATSs) have the potential to supply the water needed for irrigating UGSs. Here, we first review UGS systems supported by DEWATSs and the water quality guidelines and challenges associated with implementing DEWATSs for urban greening in different countries, including Mexico. We also critically examine the linkages between the lack of UGSs in Tijuana, Mexico, extensive soil erosion, and failing sanitation infrastructure that has led to the infamously poor water quality in the Tijuana River. Tijuana's Ecoparque Wastewater Treatment Facility, a low-energy, aerobic DEWATS, which collects, treats, and discharges residential sewage for localized landscape irrigation, demonstrates how DEWATSs can meet the water demands for urban greening in rapidly urbanizing cities. The aerobic decentralized treatment using a gravity-fed trickling biofilter resulted in a >85% removal of chemical oxygen demand and dissolved organic carbon. Prior to treatment facility upgrades, there was a ~2 log reduction in total coliform and Escherichia coli and a <20% decrease in ammonia from the influent to final effluent. After the addition of a maturation pond in 2020, the effluent met Mexico standards for irrigation reuse, with a ~4 log reduction in fecal coliforms from the influent to final effluent. Case study results demonstrated the potential for decentralized wastewater treatment to meet effluent standards for landscape irrigation, provide water for urban greening, and prevent pollution in the Tijuana River and other urban waterways.

Optical remote sensing for glacier monitoring: case studies in Chile

Guido Staub
University of Concpeción, Chile

Glaciers, in the current context of a latent climate emergency, are a sensitive element that unequivocally expresses the effects of climate change. In Chile, glaciers are widely distributed in the Andes Mountains throughout the whole country. Chile concentrates the largest glacier surface area in South America (80.5% of the total surface covered by glaciers in South America). From north to south, glaciers in Chile vary morphologically as a result of the rugged national geography and its number and extent increase in the southernmost regions. In this contribution, we present with the help of case studies carried out in Chile during the last years, how optical remote sensing techniques can provide a powerful tool to survey remote glacier areas, where conventional surveying techniques are difficult to be applied. Different classification approaches were tested for their eligibility to identify these snow and ice types in the Tyndall glacier area in the Southern Patagonian icefield. As no labeled data was available for the investigated remote area, a novel method was tested to obtain labeled Sentinel-2 compliant data from theoretical spectral reflectance curves. The achieved classification results show that all examined classification approaches are suitable for detecting different spectral snow and ice classes on the glacier surface. Furthermore, it is necessary to estimate the relationship between the changes in glacier surface and volume and variations of climate parameters such as temperature and precipitation. The variations in volume and extend of five glaciers in the central Andes and three in the Southern Patagonian Ice Field were determined and put in the context of regional climate change and variability. Based on remote sensing observations and subsequent image processing, the results indicate that all glaciers show significant retreat in area and loss in volume. Furthermore, statistical analysis shows a close relationship between glacier retreat and climate variations.

Biography

Guido Staub is with the Department for Geodetic Sciences and Geomatics Education of the University of Concepción in Chile. He holds a doctorate degree in Engineering from the Institute for Photogrammetry and Remote Sensing at the University of Karlsruhe, Germany His research and professional experience are related to lectures and scientific investigation in the broad field of Photogrammetry, Remote Sensing and digital image processing for environmental and climate change studies.

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Evaluation of Future Streamflow in the Upper Part of the Nilwala River Basin (Sri Lanka) under Climate Change

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Climate change is a serious and complex crisis that impacts humankind in different ways. It affects the availability of water resources, especially in the tropical regions of South Asia to a greater extent. However, the impact of climate change on water resources in Sri Lanka has been the least explored. Noteworthy, this is the first study in Sri Lanka that attempts to evaluate the impact of climate change in streamflow in a watershed located in the southern coastal belt of the island. The objective of this paper is to evaluate the climate change impact on streamflow of the Upper Nilwala River Basin (UNRB), Sri Lanka. In this study, the bias-corrected rainfall data from three Regional Climate Models (RCMs) under two Representative Concentration Pathways (RCPs): RCP4.5 and RCP8.5 were fed into the Hydrologic Engineering Center-Hydrologic Modeling System (HEC-HMS) model to obtain future streamflow. Bias correction of future rainfall data in the Nilwala River Basin (NRB) was conducted using the Linear Scaling Method (LSM). Future precipitation was projected under three timelines: 2020s (2021–2047), 2050s (2048–2073), and 2080s (2074–2099) and was compared against the baseline period from 1980 to 2020. The ensemble mean annual precipitation in the NRB is expected to rise by 3.63%, 16.49%, and 12.82% under the RCP 4.5 emission scenario during the 2020s, 2050s, and 2080s, and 4.26%, 8.94%, and 18.04% under RCP 8.5 emission scenario during 2020s, 2050s and 2080s, respectively. The future annual streamflow of the UNRB is projected to increase by 59.30% and 65.79% under the ensemble RCP4.5 and RCP8.5 climate scenarios, respectively, when compared to the baseline scenario. In addition, the seasonal flows are also expected to increase for both RCPs for all seasons with an exception during the southwest monsoon season in the 2015–2042 period under the RCP4.5 emission scenario. In general, the results of the present study demonstrate that climate and streamflow of the NRB are expected to experience changes when compared to current climatic conditions. The results of the present study will be of major importance for river basin planners and government agencies to develop sustainable water management strategies and adaptation options to offset the negative impacts of future changes in climate.

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Performance analysis of a novel integrated photovoltaic–thermal system by top-surface forced circulation of water

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Almost 80–90% of energy is wasted as heat (provides no value) in a photovoltaic (PV) panel. An integrated photovoltaic–thermal (PVT) system can utilize this energy and produce electricity simultaneously. In this research, through energy and exergy analysis, a novel design and methodology of a PVT system are studied and validated. Unlike the common methods, here the collector is located outside the PV panel and connected with pipes. Water passes over the top of the panel and then is forced to the collector by a pump. The effects of different water-mass flow rates on the PV panel and collector, individual and overall efficiency, mass loss, exergetic efficiency are examined experimentally. Results show that the overall efficiency of the system is around five times higher than the individual PV-panel efficiency. The forced circulation of water dropped the panel temperature and increased the panel efficiency by 0.8–1% and exergy by 0.6–1%, where the overall energy efficiency was ~81%. Bangladesh is confronting a great deal of energy emergencies and genuine desertification issues in provincial areas. These issues could be ameliorated if sustainable power sources are utilized as an essential source of energy in rural regions. Although Bangladesh has a considerable amount of fossil resources, the amount is degrading to a great extent as the dependency on it is remarkable. For instance, the primary sources of energy in this country are natural gas (60%) followed by hydropower and coal, which are probably going to be exhausted very soon due to their extensive use [1]. Therefore, if no advanced innovation is introduced, then Bangladesh will face a tremendous energy crisis in the future. In these cases, sustainable power sources are the only hope for the general population of Bangladesh. Individuals have an expansive unsatisfied need for energy that is developing by 10% yearly [2, 3]. In the last few years, the government has taken several initiatives to address the energy crisis. Not only in the public sectors, but also this issue is given much importance from different individual sectors. Although power generation in the most recent years has increased a lot, still it is not enough to face the soaring demand of the country. Moreover, Bangladesh has the lowest per capita consumption of energy in South Asia [3]. Presently, the total generation capacity is 15 821 MW [1, 4]. Coal, gas and diesel are being used in Bangladesh for producing electricity as primary resources. At present, there is a huge gap between production and demand. The demand is increasing day by day and there is a prediction that it will reach ~40 000 MW by the year 2030 [5].

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Population Status and Ecology of the Steno-Endemic Fairy Shrimp Chirocephalus sibyllae Cottarelli and Mura, 1975 Inhabiting a Mountain Temporary Pond (Central Italy)

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High-elevation ephemeral waters are sentinels of climate change, as they quickly respond to decreasing precipitation levels and increasing air temperatures. Fairy shrimps are among the most threatened invertebrates in ephemeral waters, as they are extremely vulnerable to habitat loss. Chirocephalus sibyllae is a fairy shrimp endemic to the Palazzo Borghese temporary pond, located within Sibillini Mountains National Park (Central Italy). The aims of the present study were to: (i) evaluate the physicochemical characteristics of C. sibyllae habitat, with special reference to climate changes over twenty years; (ii) document the life history, size, and abundance of C. sibyllae; and (iii) document the coexisting zooplankton fauna in Palazzo Borghese pond. The zooplankton community was monitored fortnightly, during the filling phases of the pond, from April 2019 to June 2021, using an 80 µm mesh net, within transects of known length. On each sampling occasion, physicochemical parameters were measured, and water-level fluctuations and pond surface area were recorded. Compared to what was reported in the literature, in the last two years the wet phase of the Palazzo Borghese pond was shorter, and the pool dried up much earlier than in the past. The water quality was good and reflected the typical characteristics of high-mountain oligotrophic ponds. According to the extreme unpredictability of environmental features, the zooplankton community was composed of a very limited number of species, adapted to face drought conditions for most of the year. The year 2019 was configured as the season with the most favorable conditions for the development of C. sibyllae; in 2020, the short duration of the pond did not allow the species to complete its life cycle. Climate change seems to pose the main threat to the species, considering that the progressive increase in air temperatures and the decrease in snowfall will, likely, lead to increasingly shorter filling phases of its habitat.

Biography

Barelli Maria Gaetana is a science professor at the G. Peano scientific high school in Monterotondo, Rome. He has participated since 2019 in the monitoring study of the Chirocephalus marchesonii Lago di Pilato Monti Sibillini and the Chirocephaus sibyllae Laghetto of Palazzo Borghese Monti Sibillini Italy, with the research group of the University of Perugia coordinated by Prof. Lorenzoni. You are the guide of the Sibillini National Park.

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Identification and characterization of Peruvian native bacterial strains as bioremediation of Hg-polluted water and soils due to Artisanal and Small-Scale Gold Mining in the Secocha Annex, Arequipa

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Statement of the Problem: The water and soils pollution due to mercury emissions from mining industries represents a serious environmental problem and continuous risk to human health. Among the 25 regions of Peru, three are responsible for more than 70 percent of the official gold production, La Libertad (29.6%), Cajamarca (25.9%) and Arequipa (15%). However, illegal mining in some Peruvian regions has been increasing. Secocha annex located in the Mariano Nicolás Valcárcel district in the Camaná province, Arequipa, has seen a tremendous boost activity due to the poor legislation on the use and type of land, which has caused informal settlements dedicated to mining. With gold reserves of narrow high-grade veins, where the width range of the vein is from 1 and 10 cm and its grades vary between 10 and 30 g/ton, this zone suffers the consequences of gold overexploitation and environmental mercury pollution. In 2018, the residents asked the Ministry of the Environment to declare Secocha in a state of sanitary emergency due to the high contamination by mercury of the soils and aquifers. Likewise, they also requested to identify the effect on the health of the inhabitants, especially in children, pregnant women, and the elderly.

The main objective of this work was to identify bacterial strains obtained from contaminated soils of the Peruvian region of Secocha, which have growth capacity on mercury substrates to evaluate their adsorption behavior and mercury removal capacity. Through DNA analysis (99.78% similarity), and atomic absorption spectrometry, the gram-positive bacterium Zhinhengliuella alba sp. T2.2 was identified as the strain with the highest mercury removal capacity from culture solutions with an initial Hg mercury concentration of 162 mg·L-1. The removal capacity reached values close to 39.5% in a period of incubation time of 45 days, with maximum elimination efficiency in the first 48 hours.

These results are encouraging and show that this native strain may be the key to the bioremediation of water and soils contaminated with mercury. The importance of reducing the use and emission of mercury in mining activities is obvious, and the Peruvian government has implemented several strategies to do so, as besides being one of the countries that signed and ratified the Minamata Convention. In addition to that, the remediation and sanitation of the different environmental sources are required for the protection of human health. In this context, different techniques are used for this purpose. However, remediation by microorganisms has proven to be an economical technique, being the most environmentally friendly and a great option for the sustainability of contaminated systems using endogenous bacteria.

Biography

Dra. Ing. Patricia López Casaperalta specialist in environmental sciences and technologies with experience in environmental assessment and impact in mining and industrial processes. With determination and passion to improve safety, health and care for the environment. She is director of the Mining Engineering program of catholic university of Santa Maria, where she develops research, management and university teaching tasks. Her article entitled Identification and characterization of native Peruvian bacterial strains as bioremediation of water and soil contaminated with Hg due to Artisanal and Small-Scale Gold Mining in the Secocha Annex, Arequipa. Has allowed identify and to register bacteria with the capacity for bioremediate soils contaminated with mercury as a result of mineral extraction. demonstrating that bioremediation is a promising, economical and viable alternative

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Exploring Current Status and Evolutionary Trends on the Paid Use of State-Owned Forest Resources in China: A Bibliometric Perspective

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State-owned forest resources occupy an important position in China and the development of their their paid use will help to improve the economic benefits of these resources. The purpose of the paid use of state-owned forest resources is to carry out research on forest tourism, forest science education, forest experience, the underforest economy and economic forest, and timber forest construction, utilizing leasing and franchise right transfer, which is performed to ensure that the ownership of state-owned forest resources remains unchanged. In 2017, the United Nations (UN) approved The UN Strategic Plan for Forests 2017–2030 following The UN Forests Instrument. It is proposed to enhance the economic, social, and environmental benefits of forests, improve forest-based livelihoods, and contribute to economic development. The implementation of this document is critical to the 2030 Agenda for Sustainable Development. According to the Global Forest Resources Assessment 2020,the global forest area for paid use is as follows: around 1.15 billion hectares of forests worldwide were mainly used for the production of wood and non-timber forest products, and 186 million hectares of forests were designated for social services, such as recreation, tourism, educational research, and cultural and spiritual heritage protection. Since 2010, forest designated for this purpose has grown by 186,000 hectares per year Categorizing the research status of the paid use of state-owned forest resources in China could promote the sustainable and efficient use of stateowned forest resources, and guarantee nationalforest resource ownership. It is important to implement a pro-cess of sustainable development.

Biography

Wei Xue is a PhD candidate at Beijing Forestry University and received her master's degree from Tianjin University of Science & Technology in 2020. Her current research fields focus on forest resource management, R&D investment performance of listed companies, etc. She has participated in the cooperation between China and UNESCO to support South-South cooperation on climate change, poverty alleviation in China's state-owned forest farms, the accounting of gross ecosystem product, wildlife conflict management under the condition of economic-biological coupling, and the incubation path of technological enterprises in Tianjin. She has won the national first-class scholarship, excellent graduate student, and the first-class prize of the Ziyao Cup Business Elite Challenge.