- ISSUE 22 – Jan 2024

NEWRI update

A word from the Executive Director

Dear Friends and Colleagues,

I sincerely hope that all of you enjoyed a festive holiday season and the start of a new year. As we begin 2024, NEWRI is nearing the mid-term of our five-year tranche of funding. In fact, since the last newsletter we held our Industrial Advisory Board meeting, engaged in a mid-term review with Singapore PUB, held the NEWRI Governance Committee meeting, and recently hosted Senior Minister of State Dr. Amy Khor. In all of these meetings, NEWRI was identified as being a highly successful and incredibly well performing institute. In fact, our continued and proven successes have led us into discussions of the next (fifth) tranche of funding (TR5). Due to the tremendous efforts from our staff, faculty, and students, NEWRI is tracking well ahead of the majority of our key performance indicators (KPIs) and is well aligned for addressing Singapore's national environmental priorities as well as further co-creation with our numerous private sector partners.

For me, it has now been six years since I first began as Executive Director of NEWRI and as a Professor at NTU. The time has flown by and of course challenged by the global pandemic. I was greatly honoured to be re-appointed for another five year term as Executive Director and re-appointed as a President's Chair Professor. I tremendously appreciate the continued confidence that NTU and our government agencies have extended to me as the leader of this incredible group of approximately 300 talented faculty, staff, and students. Of course, our continued successes and ever-increasing advancement would not have been possible without the hard work and support of the entire NEWRI team. I still remember well my first week as the Executive Director of NEWRI back in 2018, and I quickly realized that NEWRI needed major changes to meet the rapidly approaching KPIs for Tranche-3. Through cross-cutting interdisciplinary teamwork, we were able to uplift NEWRI from well behind on the KPIs to meeting or exceeding all of them within the two years that remained. I cannot express enough my thanks to all of those who worked relentlessly to get NEWRI back on track and make it the successful institution it is today.

However, I must especially recognize one person in particular who was particularly tenacious, diligent, and passionate in our efforts to bring NEWRI back on track, Ms. Eileen Lui our Senior Assistant Director who retired at the end of December 2023. Eileen was an absolute gem and one of the most energetic, knowledgeable, and professional colleagues I have ever had the privilege to work alongside. I cannot count how many times Eileen and I exchanged emails and reports until the wee hours of the morning, preparing for VIP visits, budget accounting, and various other critical tasks. Despite her incredible service to NEWRI and to assisting me directly on complex budget matters, she was always quick with a smile, a kind jester, or a witty remark to brighten my day. I feel incredibly fortunate to have worked with Eileen and I am fully aware that the rest of our team feels the same way. We will miss her tremendously, but also happy to see her finally get some very well-deserved rest and relaxation.

(Continued next page..)

What is in your BPA-free bottle? CNA Insider finds out

Are BPA-free plastic bottles really safe? Here's what you need to know

Chemicals found in tap water is harmful to health?

Chlorine and other types of disinfectants used to ensure that tap water remains pathogen-free and safe to drink.

NEWRI partners with LKC Medicine for bilateral research on environmental health

Partnership heralds' opportunity for NEWRI researchers to interface with the LKC medical school

Singapore–China joint flagship project launching ceremony held at Cleantech One

Ceremony to launch MOU inked by the NRF and China's Ministry of Science and Technology, to promote research and development, while nurturing research talents.

Affordable water purification system for developing nations

Local start-up Atera Water and NTU scientists and the SIT developed a new type of membrane-based water filtration system

Turning kale waste into treasure

New technique to convert kale waste for use in health and personal care products.

A word from the Executive Director

(….Continued from previous page)

I am excited to share some new appointments and transitions within the NEWRI leadership. First, Professor Grzegorz Lisak has been offered and subsequently accepted to a Deputy Executive Director of NEWRI. He will join Dr. Adil Dhalla who also plays this role, beyond his other positions NEWRI Chief Operating Officer (COO), the Managing Director of Singapore's national membrane translation center (START), and leading the Singapore Membrane Consortium (SG MEM). Promoting Prof Lisak to Deputy Executive Director position was not only to have additional help in leading this large, growing, and vibrant institution, but also because NEWRI is rapidly expanding in the area of resource recovery and solid-waste upcycling. This was heard loud and clear during Senior Minister of State Dr. Amy Khor's visit to NEWRI in January. The immediate and future national priorities are in this realm of carbon capture, circular economy, and achieving net zero. Prof Lisak and his team of resource recovery experts have made incredibly positive strides in aligning NEWRI with the national and global priorities within this domain. I am pleased to have Prof Lisak be a part of the leadership team of NEWRI and together we will all help NEWRI grow even further and achieve even greater successes.

Another receive leadership appointment was offered and subsequently accepted by Prof Richard Webster, who will now be the Director of NEWRI Community (our philanthropic arm enabled by the Lien Foundation) as well as remaining a leader in NEWRI Education. Prof Webster is a passionate leader who has been engaged with NEWRI Community in various aspects, including the recent handover even of a silicon carbon membrane filtration drinking water system to the underserved mountainous communities in Chiang Rai, Thailand. The majority of our NEWRI Community projects involve some degree of pollutant monitoring, an area in which Prof Webster is well renowned. I look forward to seeing Prof Webster lead NEWRI Community to new opportunities and successes.

I also wanted to recognize Dr. Babu Narayanswamy, who has taken on far more workload and leadership roles in this tranche of NEWRI (TR4). Under Dr. Babu's leadership, NEWRI has greatly improved our safety training and compliance, as well as significantly grown our analytical laboratory capabilities. Consolidating these areas under Dr. Babu's leadership absolutely increased his workload and responsibilities; however, Dr. Babu took on these new roles with vigor and stamina and today, NEWRI operates in a far safer and efficient manner. We thank Dr. Babu for his leadership role and his relentless work to ensure our workplace is safe and efficient.

So, as we enter now into 2024, we do so at an all time high for NEWRI. Our new leadership team is here to help all of our team members as well as interface with our stakeholders. We have gained several new faculty and a multitude of new grants in all of our domains. With the new also we have lost some faculty who moved on to other institutions and/or research domains. Together, we will continue to redevelop and focus NEWRI to better address Singapore's national needs while also co-creating new technologies with our corporate partners as well as self-discovered intellectual property. We are well aligned for the next tranche of funding, as we continue to work each and every day for greater wins and success stories. I feel fortunate to be the leader of such an amazingly talented and tenacious team!

Sincerely,

Shane A. Snyder

NEWRI IN THE NEWS

STnews (source)

NTU researcher hopes to help poorer countries have a sustainable water supply

Naeem Nadzri is part of a team of 20 young people under Singapore's inaugural Climate Youth Development Programme who will be heading to COP28 in Dubai. Mr Naeem hopes to be part of the conversations on this issue, and to connect with stakeholders to better understand how water scarcity affects different countries, particularly in developing countries.
(Link here)

ST news (source)

S'pore scientists studying if chemical found in tap water is harmful to health

Chlorine and other types of disinfectants kill harmful bacteria and viruses, and are used to ensure that tap water remains pathogen-free and safe to drink. Professor Snyder said, "The DPG-chlorine by-product is not an immediate cause for concern in Singapore, as the concentrations found in tap water here were much lower than what would be expected in other countries."
(ST link here) / (Asiaone link here)

ST news (source)

Affordable water purification system for developing nations

Local water tech start-up Atera Water and scientists from NTU and the Singapore Institute of Technology (SIT) have developed a new type of membrane-based water filtration system for large-scale clean water production that is more affordable. In addition, the new system has only half the carbon footprint of conventional water treatment plants. This is made possible through an efficient nanocomposite membrane named CLARITY, made using common polymers at a fraction of the cost of the more expensive membranes used by developed nations.
(ST Link here) / (NTU Link here)

NTU news (source)

Turning kale waste into treasure

Scientists from NTU Singapore have developed a new technique to convert kale waste for use in health and personal care products, reducing food waste and emissions. Phytochemicals found in plants are known to prevent damage to cells in the body and are widely used in consumer products. They include health-promoting supplements, like antioxidants and lutein, as well as face scrubs and hair shampoo with kale extracts.
(Link here)

HAPPENINGS IN NEWRI

NEWRI news (source)

NEWRI partners with LKC Medicine for bilateral research on environmental health

Prof Shane Snyder was given a courtesy Professor appointment at the Lee Kong Chian School of Medicine (LKC), NTU. This appointment heralds a unique opportunity for NEWRI researchers to interface with the LKC medical school team towards research collaborations that enable more holistic evaluation of environmental exposures and potential health outcomes.
(NEWRI Link here)

NEWRI news (source)

Singapore–China joint flagship project launching ceremony held at Cleantech One

Two joint flagship projects in the fields of water and environment, with the MOU inked by the National Research Foundation Singapore and China's Ministry of Science and Technology were announced earlier in April 2023. This significant announcement of "All Round High Quality Future Oriented Partnership" by both Singapore and China, aims to promote research and development, while nurturing Singaporean and Chinese research talents.
(NEWRI article here)

NEWRI news (source)

Interview with Associate Prof Darren Sun Delai

We caught up with Associate Prof Darren Sun and what it means to be part of the NEWRI Ecosystem, as well as an insight into his recent achievements; the Issuance of Electronic Certification at the 55th Assembly of Advanced Materials Congress in Stockholm, Sweden in the field of Environmental Nanomaterial and Technology.
(NEWRI article here)

ARTICLES Environmental Sensing, Modelling & AI Machine Learning

HYBRID LOW-COST OPERATIONAL SYSTEM FOR REMOTE MONITORING OF WAVES AND CURRENTS IN COASTAL WATERS

Contributed by: Dawn Pang, Prof Adrian Law

AP photo

Climate change and sea level rise is an existential threat for Singapore, with its densely-utilised coastline subjected to tide-driven currents and storm surges as well as waves that are generated by winds and vessel movements. Formulating and improving the coastal protection schemes around the country requires the detailed information of currents and waves in its coastal waters over a prolonged period, to establish the proper design magnitude with different return periods to suit the various coastal protection objectives. Owing to the low sea state in the narrow coastal waters in Singapore, the monitoring of waves and currents also necessitates a high-resolution remote-sensing approach that does not affect the vessel traffic.

A new 3-year project, **Hybrid Low-cost Operational System for Remote Monitoring of Waves and Currents in Coastal Waters**, has been awarded to NEWRI by PUB; led by the Principal Investigator, Professor Law Wing Keung, Adrian (faculty in the School of Civil and Environmental Engineering and the Technology Leader of the Modelling and Artificial Intelligence division of NEWRI) together with Co-PI is Dr Nguyen Khac Tien Phuoc who is a Senior Research Fellow in the same division.

The project aims to develop a new Hybrid Low-cost Operational System for Remote Monitoring (HLOSRM) of waves and currents in coastal waters. HLOSRM shall fuse the multimodal data from shore-based X-band radar, UAV-LIDAR (Unmanned Aerial Vehicle-Light Detection and Ranging), and spectral images from multi-satellite and UAV sensors to achieve this objective.

Project Team at the proposed radar location on Kusu Island.

From left to right, Dr Nguyen Khac Tien Phuoc (Co-PI), Dr Kieu Trung Hieu, Prof Adrian Law (PI), Ms Dawn Pang, Ms Trinh Ha Linh.

The new system utilises advanced machine learning to integrate the data from these remote sensors with vastly different temporal and spatial scales to provide accurate, long-term, low-cost monitoring for surface currents and waves in Singapore's coastal waters. The availability of such detailed information shall be highly beneficial for coastal protection, navigation, offshore operations, and recreation in the future.

UAV (Unmanned Aerial Vehicle) can be mounted with different sensors including LIDAR, hyperspectral and multispectral cameras. The new approach offers potential cost savings, and can be executed expeditiously on-demand over a wider targeted coastal area.

ARTICLES Membrane Technology

SINGAPORE–CHINA JOINT FLAGSHIP PROJECT LAUNCHING CEREMONY HELD AT CLEANTECH ONE (10 OCTOBER 2023)

Contributed by: Goh Kunli, Prof Wang Rong
Photos: Alvin Goh

Event delegates invited

Representatives from the JiangSu government, China's Ministry of Science and Technology, as well as members of NTU faculty.

Two joint flagship projects in the fields of water and environment, with the MOU inked by the National Research Foundation Singapore and China's Ministry of Science and Technology were announced earlier in April 2023. This significant announcement of "All Round High Quality Future Oriented Partnership" by both Singapore and China, aims to promote research and development, while nurturing Singaporean and Chinese research talents.

One of the projects, involving Nanyang Technological University (NTU) and Yangtze River Innovation Centre for Ecological Civilization, sets its sights to develop an integrated biotechnology-membrane system to achieve a more robust wastewater treatment process and recovery of valuable minerals from domestic and industrial wastewater. The state-of-the-art nanofiltration membranes with advanced bioprocesses for next-generation wastewater management, water reclamation and resources recovery, addresses our needs for an ever-challenging urban water management, targeting industrial and municipal wastewaters and finding solutions to strengthen current capacities to meet future demands for wastewater treatment and resource recovery. This SGD 3 million NRF funded endeavour is headed by Prof Wang Rong.

Event delegates were invited to the ribbon cutting ceremony signifiying an auspicious start

The strategy amalgamates membrane technology with advanced biological processes to realize more holistic, cost-competitive and energy-efficient wastewater treatment systems. The core technology is centered on the development of novel chemically resistant membranes, facilitating proof-of-concept of a new biological process for industrial wastewaters, and enabling high technological readiness level demonstration of an enhanced membrane bioreactor technology for municipal wastewater reclamation.

The ribbon-cutting took place at Cleantech One with delegates from China's Yangtze River Innovation Centre for Ecological Civilization (headed by Prof. Li Aimin) and NEWRI's (led by Prof Wang Rong) representatives and guests-of-honour Mr Fang Wei, Vice-governor of the Jiangsu Government, and NTU's Prof Ling San and Prof Lam Khin Yong gracing the occasion.

Prof Li Aimin spoke about the significance of this collaboration

Prof Wang Rong showing delegates the NEWRI laboratories

Event delegates were invited to the ribbon cutting ceremony signifiying an auspicious start

The JiangSu government delegation greeted by Prof Ling San, Prof Lam and Prof Shane Snyder

Prof Wang Rong showing guests-of-honour Mr Fang Wei and *delegates the NEWRI laboratories*

ARTICLES

INTERVIEW WITH ASSOC PROF DARREN SUN DELAI

Contributed by: Alvin Goh, Prof Shane Snyder

Please share with us what it means to you being on the NEWRI team?

It my honour to be part of the NEWRI Ecosystem with such excellent platform and amazing team members to work with. The creation of novel materials and innovative technologies can and are applied to solve real-world industrial challenges, providing solutions to industrial needs and creating the new enterprise opportunities for economical growth. NEWRI also encourages the combination of advance research and engineering application to translation.

Dr Darren Sun with Dr Rajendra Singh, chairman of People World Commission on Drought and Flood, Sweden. He is the winner of Stockholm Water Prize 2015, am award known as "the Nobel Prize for Water".

Could you share some of your recent achievements and it significance?

The Issuance of Electronic Certification at the 55th Assembly of Advanced Materials Congress in Stockholm, Sweden is a recognition of the achievement in the field of Environmental Nanomaterial and Technology. The achievement comes from the mass production of 3D Printed Membrane for the use of water reclamation and clean energy application. The 3D printer eliminates the conventional way of production which generate a lot of toxic waste solvent, wastewater and gases (such as volatile organic compound). The 3D Printed membrane (water filtration) can be incorporated with multifunctional properties through additive manufacturing, this allows us to reduces organic / bio-fouling problems. This allows more compact plant to be built as the water treatment plant footprint is significantly reduced as lesser membrane is required to treat the same amount of water.

I understand that NanoSun is celebrating its 10th anniversary in 2023, as well as the Jurong Island Challenge Award (JIIC) that was recently awarded. Could you tell is more?

This project aims to target high-strength industrial wastewater up to 50,000 ppm COD from chemical production plants in Jurong Island. The team worked closely with the site owner to understand about their production wastewater and their cleaning cycles, so to optimizes the processes to get a more consistent waste quality. In this project, we combined the most-advance-technology available to purifies the wastewater to cooling tower standard, so this can help to provide make up water to close their water loop. In this project NanoSun also will be using their 3D printed membrane as part of this system. This will help the owner to save up to 40% of their cooling tower needs.

This year 2023 is the 10th anniversary for the founding of NanoSun. NanoSun started off with angel fund raising more than S$14 million, I really appreciate the faith given by the investors who trusted and supported me to bring NanoSun to its success. Today NanoSun has more than 30+ staffs and producing own Membrane and Nanomaterials also the solution provider to major industry players in Singapore and Asia. The first 5 years with NTUitive incubator at Innovation Center there after NanoSun moved out of the university to new office and factory in Tuas. In 2021, NanoSun received the award from OCBC and Business Times for the Emerging Enterprise Award and Best Innovation presented by Ms Low Yen Ling (Minister). Today NanoSun works with MNCs and HK Government in multi-million-dollar project to bring membrane technology into very-difficult-to-treat leachate wastewater treatment for zero-liquid discharge. NanoSun also works with major semi-conductor partners in Singapore, Malaysia and China for membrane water reclamation and major chemical producers and refineries in Jurong Island to treat high COD and TDS wastewater. NanoSun will be more than happy to be part of NEWRI's ecosystem. Because NTU is also a shareholder of NanoSun, NanoSun hopes to work closely with NEWRI and NTU.

You have been working with PUB since the establishment of NEWater, could you talk a bit about the new PUB project with NEWRI and how it's a game-changer for water reclamation.

The emergence of Artificial Intelligence (AI) and Cloud Computing has led to a disruptive growth in the demand for semi-conductor. Consequently, more wastewater generation from the increase production yield. Water recycling make up to 70% of the operating cost of semi-conductor production.

The Nano-Coagulant Project is the first in the world attempt to create reusable coagulant targeting fluoride wastewater coming from the semi-conductor. This project aims to remove the sludge generation entirely from conventional treatment for fluoride wastewater. As the conventional method would generate fine suspended CaF2 particles during chemical precipitation and its very difficult to settle due to its high positive charge, causing high turbidity level in the treated water. In addition, trace organic compounds used by semi-conductor fabrication is also a challenge for water recycling and reuse. The use of nano-coagulant will de-stabilized these positively charge CaF2 while the nano-coagulant will also function as a catalyst for oxidation reaction of these trace organic compounds. The nano-coagulant can be further recycled and reused in the later recovery stage, these recycled nano-coagulant can be reuse and recovered CaF2 can be used as upcycling material for other purposes. In-short, the novelty comes from the reduced sludge generation, higher water quality for reuse and resource recovery at its point of generation.

Darren obtained his PhD degree in Chemical Engineering from The University of New South Wales, Australia. He has research interests in the field of membrane water and wastewater treatment, water reclamation and signal atom metal stabilization, particularly in applying physical and chemical principles for fundamental research. Recently he is heavily engaged in the study of 3D printing membrane production and nano materials for clean water and energy production including hydrogen from industrial wastewater, nanofiltration, nano oxidation membrane and TiO2 based nano-structured /fiber/tube membrane.
(Please see his full profile here)

ARTICLES Philanthropy

NEWRICOMM (LIEN ENVIRONMENTAL FELLOWSHIPS)

Contributed by: Josephine Chow, Moses Chung, Dr Santosh Pathak

NEWRI Community Development has awarded four new Lien Environmental Fellowships in 2023 following its latest Call for Proposals. Collectively, the projects encompass several aspects of environmental engineering including water analysis, water/ wastewater treatment design, potable water disinfection, solids waste management and resource recovery.

The four selected proposals are:

1. **Liveable Maningning Creek Community Program** – at this current stage, a feasibility study executed in conjunction with the University of Philippines to analyse water and air qualities pertaining to Maningning Creek/ Taytay River (Manila) and its adjacent communities, with additional discussions concerning solid waste management. Results and conclusions obtained in this phase are crucial for the design and implementation of sustainable solutions moving forward.
2. **Safe Water Access through Automatic Chlorination and Online Monitoring (ACOM) of Overhead Tanks in Telangana, India** – this is a collaboration with Safe Water Network to provide automated chlorine disinfection to potable water for residents in rural India, specifically in the state of Telagana.
3. **Clean and Healthy Village Development Programme at Vallipuram, India** – this project potentially covers solid waste management, wastewater treatment and the purification of river water for potable purposes. NEWRIComm is working with the Indian Institute of Technology Madras (IIT Madras) to help explore, design and build the above facilities for the village of Vallipuram, located near Chennai, India.
4. **Application of Fluidized Bed Crystallization for the Recovery of Nitrogen, Phosphorus from Swine Wastewater** – this is a feasibility study conducted by Central Institute for Natural Resources and Environmental Studies, Vietnam National University, located in Hanoi. The objective is to develop a fluidized bed crystallization process that can remove/ recover nitrogen and phosphorus from swine wastewater and potentially re-use it as crop fertilizer.


Maningning Creek/ Taytay Creek in Rizal, Philippines


Telagana, India


village of Vallipuram,(Chennai), India


Central Institute for Natural Resources and Environmental Studies, Vietnam National University


Prof Cayetano presenting findings to Prof Richard Webster, Prof Shane Snyder and Ms Josephine Chow


Prof Cayetano and the NEWRI Analytics team in discussion

In addition, Professor Mylene Cayetano from the University of Philippines visited NEWRI in August for a two-week period to work with NEWRI's researchers and lab analysts for the "Liveable Maningning Creek" project, for which Prof. Cayetano is the principal investigator. This is exemplary of NEWRIComm's unique programme, which allows for a sponsored visit to Singapore to facilitate cross-disciplinary learning opportunities and interaction between the LEF and the NEWRI family.

The programme presented Prof. Cayetano with the opportunity to conduct water and air sample analysis using NEWRI's state-of-the-art laboratory equipment and instruments. The analysis was to be conducted on numerous samples collected from several sites along Maningning Creek/ Taytay River and its adjacent communities, prior to her visit to Singapore. With technical advice and guided assistance from NEWRI's team of dedicated research experts, Prof. Cayetano was able to identify and quantify more evidence on the extent of water quality depreciation due to domestic pollution in Taytay River.


Professor Mylene Cayetano (centre) with NEWRI scientists Mr Sim Kok Chen (left) and Ms Tan Kuan Yi (right)

Also, as part of the Lien Environmental Fellowship programme, a related expert from NEWRI/ NTU faculty will be appointed as guide and mentor to the awarded LEF Fellow. In this case, Associate Professor Richard D. Webster provided the support and guidance, allowing Prof. Cayetano to utilize the air sample analysis equipment in his laboratory at the Division of Chemistry and Biological Chemistry (School of Physical and Mathematical Sciences. Consequently, the analysis was conducted with the assistance from Prof Webster's visiting PhD student from IIT Madras India, Mr Shoumick Mitra. Through this collaboration, NEWRI saw various cross disciplinary interaction and exchange of best practices and ideas across NEWRI, NTU Faculty and University of Philippines, bringing an exciting synergy to the community project.

The outcome of Prof. Cayetano's visit and the continued communication after her return to the Philippines is an ideal example of NEWRIComm's vision of providing an international platform for the building of relations and the bridging of ideas and solutions by tapping on NEWRI's experts, technology and resources to develop a viable, comprehensive solution for the impacted community.

In Prof Cayetano's own words: "The Taytay River community is grateful for the support of the Lien Foundation, through NEWRIComm and NTU. We are hopeful that the rehabilitation efforts started 10 years ago may be sustained and upgraded to incorporate technologies available for the treatment of waterways."

For more information on how to join as an LEF fellow, please visit https://www.ntu.edu.sg/newri/programmes/newri-community-development-(newricomm) or email us at: newricomm@ntu.edu.sg.

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PUBLICATIONS Highlights

Polymer Additives to Go? Occurrence of the Rubber Additive 1,3-Diphenylguanidine (DPG) in Bottled Water

Mauricius Marques dos Santos, and Shane Allen Snyder

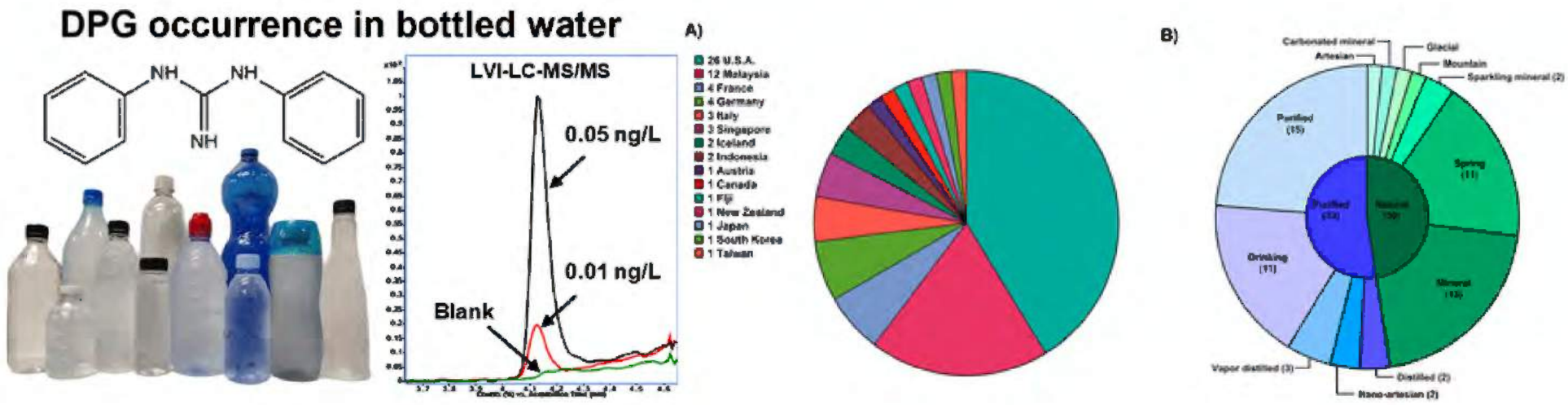

Figure 1. (A) Distribution of bottled water samples by country of origin as per sample label. (B) Distribution of bottled water samples by water type.

ABSTRACT:
The occurrence of polymer additives such as 1,3- diphenylguanidine (DPG) has been recently reported in different human samples, including urine and plasma. It has also been widely reported in many sources of drinking water and tap water. Here, we present the first comprehensive assessment of the occurrence of DPG in bottled water samples.

A large-volume direct injection LC-MS/MS method was used for the analysis of polymer additives (DPG, DTG, and 6PPD) and six transformation products in different bottled water samples. The use of a 100 μL direct injection LC-MS/MS method enabled detection and quantification limits as low as 0.01 and 0.05 ng/L, respectively, with no interference of potential contaminants from materials commonly used in the laboratory. Out of 63 different samples from 15 different countries, DPG had a detection frequency of 40%, with samples above the limit of quantification having a median concentration of 0.76 ng/L (maximum of 7.4 ng/L).

Although the contribution to human exposure from drinking bottled water could explain little of the observed urine concentrations previously reported, the impact from bottled water consumption cannot be neglected and was estimated to be on the same order of magnitude as that of drinking tap water.

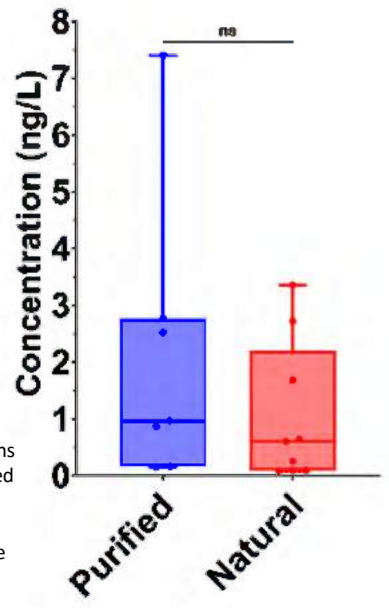

Figure 2. Detectable concentrations of DPG in bottled water for purified and natural water sample groups. ns denotes a not statistically significant difference between the groups (unpaired t test).

HIGHLIGHTS

- Analyzed the occurrence of three common polymer additives (DPG, DTG, and 6PPD) and six transformation products (6PPD-quinone, CC04, CC05, CC11, CC15, and VD03) using our developed method

Keywords: Polymer additives, 1,3-diphenylguanidine, drinking water, bottled water, rubber additive, human exposure, 6PPD quinone

Available at ACS Publications :
https://pubs.acs.org/doi/10.1021/acs.estlett.3c00602

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Please refer to the link for the other references

PUBLICATIONS Highlights

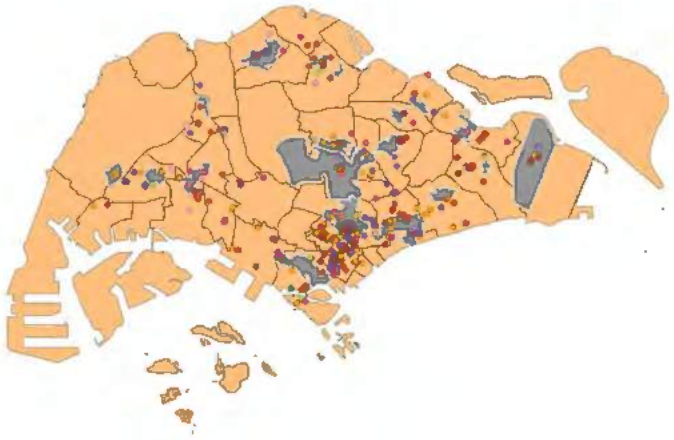
Our series highlights a few (from the numerous) NEWRI publications because we do not forget our foundation of deep scientific research. NEWRI's researchers and professors from our various Centres of Excellence publish frequently in journals, conferences and keynotes.

Evaluation of wastewater-based epidemiology of COVID-19 approaches in Singapore's 'closed-system' scenario: A long-term country-wide assessment

Mauricius Marques dos Santos, Li Caixia, Shane Allen Snyder

ABSTRACT

With the COVID-19 pandemic the use of WBE to track diseases spread has rapidly evolved into a widely applied strategy worldwide. However, many of the current studies lack the necessary systematic approach and supporting quality of epidemiological data to fully evaluate the effectiveness and usefulness of such methods. Use of WBE in a very low disease prevalence setting and for long-term monitoring has yet to be validated and it is critical for its intended use as an early warning system. In this study we seek to evaluate the sensitivity of WBE approaches under low prevalence of disease and ability to provide early warning. Two monitoring scenarios were used: (i) city wide monitoring (population 5,700,000) and (ii) community/localized monitoring (population 24,000 to 240,000). Prediction of active cases by WBE using multiple linear regression shows that a multiplexed qPCR approach with three gene targets has a significant advantage over single-gene monitoring approaches, with R2 =0.832 (RMSE 0.053) for an analysis using N, ORF1ab and S genes (R2 =0.677 to 0.793 for single gene strategies). A predicted disease prevalence of 0.001% (1 in 100,000) for a city-wide monitoring was estimated by the multiplexed RT-qPCR approach and was corroborated by epidemiological data evidence in three 'waves'. Localized monitoring setting shows an estimated detectable disease prevalence of ~0.002% (1 in 56,000) and is supported by the geospatial distribution of active cases and local population dynamics data. Data analysis also shows that this approach has a limitation in sensitivity, or hit rate, of 62.5 % and an associated high miss rate (false negative rate) of 37.5 % when compared to available epidemiological data. Nevertheless, our study shows that, with enough sampling resolution, WBE at a community level can achieve high precision and accuracies for case detection (96 % and 95 %, respectively) with low false omission rate (4.5 %) even at low disease prevalence levels.



Sampling boundaries for community level/point-of-source WBE analysis (grey areas) and visited places by active COVID-19 cases, different colors represent a different week in the 28 weeks monitoring period.

Available at Sciencedirect:
https://www.sciencedirect.com/science/article/pii/S0043135423008424?via%3Dihub

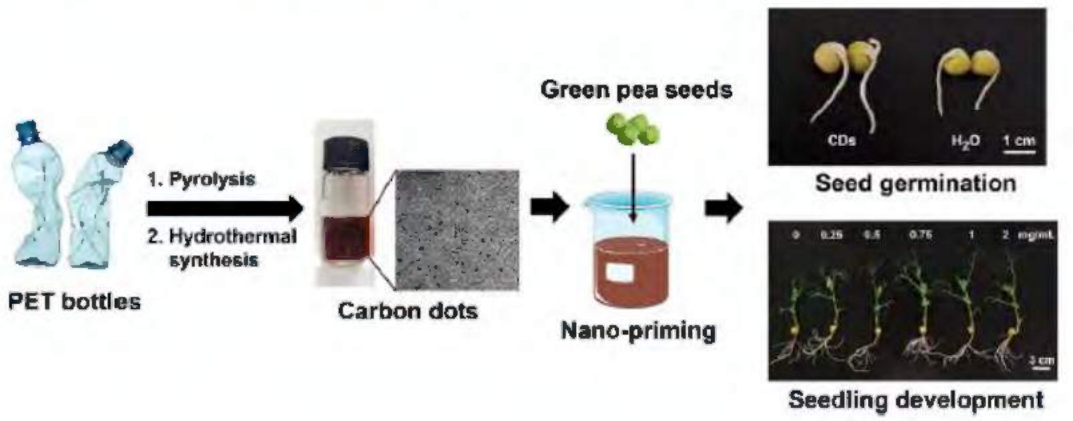
Keywords: Wastewater-based epidemiology (WBE) COVID-19 Multiplexed RT-qPCR SARS-CoV-2 Wastewater monitoring Pathogen detection

Effects of plastic-derived carbon dots on germination and growth of pea (*Pisum sativum*) via seed nano-priming

Lili Liang, Siew Cheong Wong, Grzegorz Lisak

ABSTRACT

Seed nano-priming is a promising technology employed in the agronomic field to promote seed germination and plant growth. However, the effects of carbon dots (CDs) on plant development via seed nano-priming remain unclear. In the present study, CDs synthesized from non-biodegradable plastic wastes were adopted as a nano-priming agent for pea (*Pisum sativum*) seed treatment. The results demonstrated positive effects of seed priming at all CD concentrations (0.25–2 mg/mL), including accelerated seed germination rate, increased shoot and root elongation, biomass accumulation, and root moisture level compared to the control groups. Surface erosion of seed coat was observed after CD priming, which effectively promoted seed imbibition capability. CD penetration, internalization, and translocation were confirmed using transmission electron microscopy. Furthermore, the CD-plant interaction significantly enhanced seed antioxidant enzyme activity, as well as augmented root vigor, chlorophyll content, and carbohydrate content. These findings exhibit great potential of waste-derived CDs as nano-priming agents for seed germination and seedling development in a cost-effective and sustainable manner.



Available at Sciencedirect:
https://www.sciencedirect.com/science/article/abs/pii/S0045653523001340?via%3Dihub

Keywords: Waste Polyethylene terephthalate, Carbon dot, Seed nano-priming, Pea, Seed germination, Seedling growth

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INTERVIEW WITH ANALYTICS CLUSTER NEWEST MEMBER: MS AGPOON KATHERINE JALANDO ON, ASST MANAGER, TECHNICAL DEVELOPMENT

What is your professional background? Tell us more about yourself.

Hi everyone, I am Katherine Agpoon. People who are close to me call me Kate. My technical background is BSc in Chemical Engineering and Chemistry (double degree). I had my Master of Science in Chemical Sciences & Instrumentation from NTU School of Chemistry, Chemical Engineering and Biotechnology (CCEB).

My interest and skills are in line with analytical instruments and method development. I was a Process Engineer for 4 years in a resin manufacturing plant overseeing the production of alkyd and emulsion resins. Developing reprocess batch mixes, in-process testing and quality control of resin for paint applications. My laboratory experience outweighs my interests in production and so I eventually focused my skills on analytical instruments. Now, I have been with 2 multinational analytical testing laboratories in Singapore. My 12 years of experience in a testing laboratory honed my skills in analytical instruments, method development, training junior chemists, communicating with clients and technical auditors in the areas of drinking water, environmental monitoring, industrial hygiene and trace analysis.

How was your experience in NEWRI?

Pleasant environment and professional atmosphere, that is NEWRI to me. I am glad to join this organization and met new people with the same interests. It has an endless quest for knowledge and every research is a challenge that I, myself, is also challenged with the day-to-day troubleshooting and technical advice that I get from inquisitive minds from different disciplines.

What are the challenges that you face when you first joined NEWRI?

I must adjust with the workflow and understand how the organization works. My mindset must be aligned to the vision of the organization. I have bigger scope this time and so I must capture the new knowledge I am getting from the trainings and align to my experience as quick as possible.

Did NEWRI fulfill your expectation? Do you face any challenges switching from analytical lab to research institute?

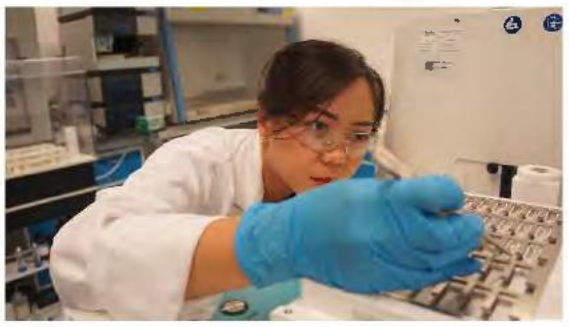
Yes, it did. In NEWRI, we have advance instruments that can analyze variety of samples beyond analytical lab's capabilities. We have LC-MSMS, LC-QToF, LC-IM-QToF for targeted and non-targeted analysis. With competent researchers and advanced analytical instruments, difficult matrices like Dioxins and Furans and even Perfluoroalkylsulfonates (PFAS) can be analyzed. We also have GC-QQQ, GC-QToF, TD-GCMS, Purge and Trap GCMS and gas chromatographs of most detectors. This means that we can also do PBDE's, PCBs, SCCP and Pesticides, especially those with very low specification that a single quadrupole detector is unable to achieve. Not only that, in lieu with sustainability, there are significant increase in interest in-line with sustainability-related testing, with our Py-GCMS and LDIR, we can support sample microplastics analysis and upcycling-related characterization.

We have multiple ICP-OES, ICP-MS and ICP-QQQ units. Our researchers are experts in overcoming spectral interferences using different reaction modes if necessary. We have hyphenated instruments like GC-ICP-QQQ and LC-ICP-QQQ that are used in speciation analysis like speciation of organic arsenic and As(III) and As(V). Our LCs and GPCs are equipped with different detectors and can support even biomolecules. Most of our systems is supported with PAL System with SPME and static headspace capability. Of course, to complete the chromatographic analysis, we also have ion chromatographs and combustion ion chromatograph for the analysis of ions of most type of matrices.

What are your roles and responsibilities as Assistant Manager (Technical Development)?

Instrument manager is my main role and instruments that I handle are chromatography and mass spectroscopy equipment. I provide analytical equipment training and technical understanding to researchers to support their research needs. I am in-charge of liquid chromatography and gas chromatography with QQQ and QToF detectors, ICP-MS and GC/LC -ICP-QQQ, combustion IC and µFTIR. Of course, part of it is to perform method development and/or assist researchers in their method optimisation.

Working on liquid samples for analysis of anions using ion chromatograph (conductivity detector).



Sample preparation of solid samples for combustion ion chromatography.

Changing gripper to syringe for analysis of liquid samples using combustion ion chromatography.

Changing LC mobile phase for LC-ICP-MS arsenic speciation.

Complete set-up of GC/LC-ICP-QQQ for speciation studies.

ARTICLES Safety

by Satish Kumar

In our ongoing commitment to safety, we're dedicating this section to a topic that concerns us all - "**Fire Safety**." It's a subject that often taken for granted, it's essential to remind ourselves of the simple yet effective ways we can ensure our safety in the event of fire.

Fire safety is not something to be taken lightly. It's a collective responsibility that requires everyone's cooperation and vigilance. By practicing these simple tips and encouraging those around us to do the same, we can create a safer environment for all. Remember, **safety is our priority**. Let's continue working together to ensure that we are well-prepared and informed, making our homes and workplaces safer for everyone. Stay safe, and never underestimate the power of prevention.

BE PREPARED, STAY SAFE

Fire safety starts with being prepared. Take a moment to locate the nearest fire exits and familiarize yourself with the building's evacuation plan. In the event of a fire, having a clear escape route can make all the difference.

FIRE SAFETY EQUIPMENT

Ensure that fire safety equipment, such as fire extinguishers, smoke detectors, and sprinkler systems, are properly maintained. If you notice any equipment that needs attention, please report it promptly.

FIRE DRILLS

Regular fire drills help to ensure that everyone knows what to do in an emergency. Pay attention to announcements about upcoming drills and participate actively.

ELECTRICAL SAFETY

Overloading electrical circuits is a common cause of house fires. Avoid using extension cords for long-term solutions and unplug devices when not in use.

OPEN FLAMES

Candles, cigarettes, and open flames can pose fire hazards. Always use candles with caution and extinguish them before leaving the room. If you smoke, do so in designated areas and ensure cigarette butts are properly extinguished.

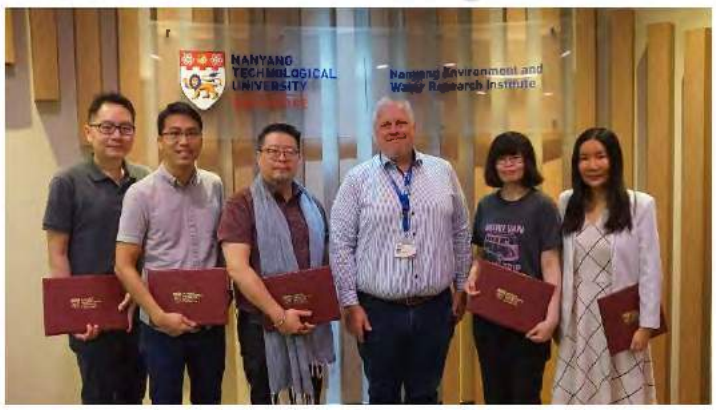
REPORTING SAFETY CONCERNS

If you notice any fire safety concerns in your workplace, please don't hesitate to report them to the appropriate authorities or your supervisor.

STAY INFORMED

Stay updated on fire safety tips, local fire safety regulations, and emergency contacts. Knowledge is power when it comes to fire safety.

AWARDS 15/10 Year Long Service Awards



Congratulations to Dr Goh Kunli - 15years (*left*), Mr Joseph Kwan Zheng Xin – 10years (*left),* Mr Alvin Goh Chee Keong - 10years (3rd *form left),* Ms Ong Qian Mei – 10years (2nd *from right*), and Dr Ge Liya – 10years (*right)*. Pictured here with Prof Shane Snyder (Executive Director, *middle*)

Congratulations also go to Dr Benjamin Moy Yan Pui – 10 years (*right*), whom have also achieved their 10 Year Long Service Award. Pictured here with Mr Anthony The (Senior Asst Director, NEWRI)

AWARDS Special mentions

PhD student MUHAMMAD NAEEM BIN MUHAMMAD NADZRI is part of a team of 20 young people under **Singapore's Inaugural Climate Youth Development Programme** who will be heading to COP28 in Dubai.
(Nov 2023)

Tweak in Puzzle: Tailoring Membrane Chemistry and Structure toward Targeted Removal of Organic Micropollutants for Water Reuse
Hao Guo, Ruobin Dai, Ming Xie, Lu Elfa Peng, Zhikan Yao, Zhe Yang, Long D. Nghiem, Shane A. Snyder, Zhiwei Wang, and Chuyang Y. Tang
Research article selected as one of seven 2022 Environmental Science and Technology Letters Best Paper Award by Environmental Science and Technology Letters (ES&T)

Polymer Additives to Go? Occurrence of the Rubber Additive 1,3-Diphenylguanidine (DPG) in Bottled Water
Mauricius Marques dos Santos and Shane Allen Snyder
ACS Editors' Choice Article Publication

Process intensification in hybrid oxidation-filtration process via catalytic ceramic membrane for micropollutant removal

PhD student ARVIN LIANGDY awarded the **Best Oral Presentation Award at the 10th International Water Association Membrane Technology Conference (IWA-MTC)**, held at Washington University in St. Louis
(July 2023)