15th INTERNATIONAL FORUM ON ECO-TECHNOLOGY

ECO NEXUS 2025

Conference Proceedings of the Technical Sessions

27th & 28th October 2025

Uva Wellassa University, Sri Lanka

ABSTRACTS

15th International Forum on Eco - Technology
Eco Nexus 2025

Proceedings of the Technical Sessions

"*Eco-Technology for Sustainable Development*"

27th & 28th October 2025

At the
Uva Wellassa University, Badulla, Sri Lanka

ABSTRACTS

Joint Editors

Prof. Amila Sandaruwan Ratnayake
Dr. A.M.A.N.B. Attanayake
Prof. Masamoto Tafu

15th International Forum on Eco - Technology
Eco Nexus 2025

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Proceedings of the Technical Sessions of the 15th International Forum on Eco-Technology ECO-NEXUS 2025

"Eco-Technology for Sustainable Development"

Responsibilities for the content of the abstracts included in this publication remain with the respective authors.

ISBN 978-624-6685-21-8

Published by:

Faculty of Applied Sciences
Uva Wellassa University of Sri Lanka
Badulla, Sri Lanka
Tel: (94) 55-2226673
https://www.uwu.ac.lk/ifet/

15th International Forum on Eco - Technology
Eco Nexus 2025

Date: 27th October 2025
Venue: Auditorium of Technological Building, Uva Wellassa University, Badulla.

PROGRAMME

Registration

12.15 Onwards	Registration of Participants

Inauguration Session

13.00 – 13.15	Arrival of Chief Guest, Guest of Honour and Special Invitees
13.15 – 13.25	Lighting of the Traditional Oil Lamp
13.25 – 13.30	University Anthem
13.30 – 13.35	Welcome Address by Dr. A.A.G.D. Amarasooriya (Coordinator/Sri Lanka)
13.35 – 13.45	Opening Speech by Prof. Tomonori Kawakami (Coordinator/Japan)
13.45 – 13.50	Address by the Chief Guest, Senior Prof. Kolitha B. Wijesekara (Vice Chancellor/Uva Wellassa University of Sri Lanka)
13.50 – 14.05	Keynote address by Prof. Masamoto Tafu Advisor to the President (Promotion and Advancement of Research), Director, Center for Promotion and Advancement of Research, Professor, Dept. Ind. Chem. & Chem. Eng., National Institute of Technology (KOSEN), Toyama College, Japan
14.05 – 14.20	Keynote address by Dr. S.K. Weragoda PhD, C Eng, Fellow (NASSL), MIESL, MIWA, Visiting Fellow - ANSO, China, WSP EXPERT - WHO
14.20 – 14.25	Handing over Conference Materials to the Special Invitees
14.25 – 14.30	Vote of thanks by Dr. Nimila Dushyantha (Conference Secretary)
14.30 – 14.35	National Anthem
14.35 – 15.00	Refreshments

Technical Sessions

15.00 – 17.00	Technical Session I

Gathering

17.00 – 17.30	Discussion on Memorandum of Understanding (MoU)
17.30	End of Day I

15th International Forum on Eco - Technology
Eco Nexus 2025

Date: 28th October 2025
Venue: Auditorium of Technological Building, Uva Wellassa University, Badulla.

PROGRAMME

Registration

08.30 Onwards	Registration of Participants (Desk will be kept open till noon)

Technical Sessions

08.45 – 10.45	Technical Session II
10.45 – 11.30	Refreshments
11.30 – 13.45	Technical Session III
13.45 – 15.15	Lunch

Visits

15.15 – 16.30	Ceremony for Obtaining Donated Laboratory Equipment to Uva Wellassa University of Sri Lanka
16.30	Closing Remarks and Site Visit (Uva Wellassa University)

15th International Forum on Eco-Technology - ECO-NEXUS 2025
27th October 2025

Technical Session I

Chairperson **:** Dr. S.K. Weragoda

15.00 – 15.20 CHALLENGE TO LOW-CARBON ECOTECHNOLOGY FOR CALCIUM RESOURCES

M. Tafu, T. Fukumura

15.20 – 15.35 SYNERGISTIC ENHANCEMENT OF TEXTILE DYE WASTEWATER TREATMENT VIA ELECTROCOAGULATION COUPLED WITH *Tamarindus indica* NATURAL POLYMER

B.Y. Tennakoon, U.S. Liyanarachchi, N.A.P.M. Nishshanka, Thilini Jayasinghe, Gayan Amarasooriya

15.35 – 15.50 DEVELOPMENT OF AN EFFICIENT PASSIVE SEISMIC ISOLATION SYSTEM FOR SUSTAINABLE STRUCTURAL RESILIENCE

W.A.K.C.R. Pathmakumara, W.A.P.P. Christopher

15.50 – 16.05 REGIONAL AND GRADE-SPECIFIC EVALUATION OF FLUORIDE IN SRI LANKAN BLACK TEA INFUSIONS FROM UVA AND NUWARA ELIYA

Harshi Jayasingha, N.A.P.M. Nishshanka, Kolitha B. Wijesekara

16.05 – 17.00 CHARACTERIZATION OF RESPONSIBLE LIME OBTAINED FROM GYPSUM POWDER AND ALKALINE CLEANING DRAINAGE

S. Mukaibayashi, M. Tafu, T. Nakashima, T. Tobe, N. Tobe

16.05 – 17.00 ADSORPTION PHENOMENA OF AMMONIA GAS ON DICALCIUM PHOSPHATES (DCP) PARTICLES

M. Shimada, M. Tafu, T. Toshima

16.05 – 17.00 CHARACTERIZATION OF NANO-SCALE PARTICLE DERIVED FROM DICALCIUM PHOSPHATE (DCPD) AND LEAD ION

E. Ishida, M. Tafu, T. Toshima, Y. Amemiya, T. Sekino

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Technical Session II

Chairperson **:** Dr. A.M.A.N.B. Attanayake

08.45 – 09.00	SOCIOECONOMIC AND ENVIRONMENTAL DIMENSIONS OF SAND MINING IN BADULU OYA, SRI LANKA: A QUALITATIVE AND GIS-BASED STUDY Sithumini Gunawardhana, Nimila Dushyantha, Gimhani Nipunika, Sandunika Rathnayake, Gayithri Niluka Kuruppu, W.A.P. Weerakoon[1], Titus Cooray
09.00 – 09.15	PHYTOREMEDIATION OF GROUNDWATER HARDNESS USING *Camellia sinensis* IN A HYDROPONIC SYSTEM R.D.D.S. Sewwandi, Gayan Amarasooriya, S.N. Dissanayaka, N.A.P.M. Nishshanka, Thilini Jayasinghe, Harshi Jayasingha, Tomanoori Kawakami, M. Tafu, Lalantha Senevirathna
09.15 – 09.30	ATMOSPHERIC MERCURY CONCENTRATION VARIATIONS AT SYOWA STATION, LÜTZOW-HOLM BAY, EAST ANTARCTICA Nakazawa Koyomi, Nagafuchi Osamu, Kawakami Tomonori
09.30 – 09.45	CALIBRATION AND PERFORMANCE OPTIMIZATION OF pH AND TURBIDITY SENSORS FOR EMBEDDED WATER SYSTEMS S.N. Dissanayaka, R.D.D.S. Sewwandi, Thilini Jayasinghe, W.A.M. Weerasinghe, Gayan Amarasooriya
09.45 – 10.00	ELECTROCOAGULATION-BASED REMOVAL OF COD AND HEAVY METALS FROM MUNICIPAL SOLID WASTE LEACHATE: A CASE STUDY FROM BADULLA, SRI LANKA W.C. Lakshitha, Thilini Jayasinghe, Gayan Amarasooriya
10.00 – 10.15	DEVELOPMENT OF A REAL-TIME WEED DETECTION SYSTEM USING SMART GLASSES E. Hirao, Y. Hata, M. Tafu, R. Matoba
10.15 – 10.30	ASSESSMENT OF THE IMPACT OF SOIL FLUORINE CONTAMINATION ON MAIZE GROWTH AND VERIFICATION OF THE POSSIBILITY OF REDUCING PLANT F TOXICITY THROUGH THE ADDITION OF CALCIUM HYDROGEN PHOSPHATE (DCP) TO THE SOIL Akagi, N. Chishaki, M. Tafu
10.30 – 10.45	OPTIMIZING CARBON SOURCES AND HYDRAULIC RETENTION TIME FOR NITRATE REMOVAL IN WOODCHIP DENITRIFICATION BEDS H.M.I. Thilakarathna, D.T. Udagedara

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Technical Session III

Chairperson **:** Prof. Masamoto Tafu

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11.45 – 12.00	SYNTHESIZED HYDROXYAPATITE FROM SEASHELLS AS A SUSTAINABLE ADSORBENT FOR CR(VI) REMEDIATION M.P.H. Perera, H.M.S.K. Haputhenna, Gayan Amarasooriya, S.I. Ratnayake, Nimila Dushyantha
12.00 – 12.15	MITIGATING COASTAL HAZARDS: A COMPREHENSIVE REVIEW OF NATURAL DISASTER MANAGEMENT APPROACHES G.I.S. Lakmal, A.S. Ratnayake
12.15 – 12.30	PROVENANCE OF THE TABBOWA AND ANDIGAMA SEDIMENTS: HYPOTHESIZED AS BACKISHWATER FLUVIO-DELTAIC CONDITIONS W.A.P. Weerakoon, H.A.H. Jayasena, Rohana Chandrajith, Deepthi Yakandawala
12.30 – 12.45	INVESTIGATION OF A PVC DISCRIMINATION SYSTEM USING NEAR-INFRARED LIGHT H. Yokohori, S. Mori, M. Tafu, R. Matoba
12.45 – 13.00	A SUSTAINABLE APPROACH TO SUGARCANE IRRIGATION: MACHINE LEARNING BASED AUTOMATED SOLAR POWERED WATER PUMPING SYSTEMS AS AN ALTERNATIVE TO DIESEL/KEROSENE PUMPS R.D.A.U. Pallegama, J.M.N.D. Jayasinghe, S.M.S.H. Senevirathna
13.00 – 13.15	RELIABILITY OF WEATHER PREDICTIONS IN TROPICAL REGIONS - A CASE STUDY OF GALLE, SRI LANKA M. Sivaneshwaran, N.P. Premachandra
13.15 – 13.30	INVESTIGATING THE SUITABILITY OF *Paramecium sp*. AS A FIRST FEED FOR *Betta splendens* LARVAE W.A.N. Tahana, K.M.S.A.K. Dehideniya, A.M.A.N. Adikari, K.L.W.T. Maduka
13.30 – 13.45	SCREENING RICE VARIETIES FOR SUBMERGENCE TOLERANCE IN KILINOCHCHI DISTRICT (DRY ZONE) OF SRI LANKA S. Jeevana, C. Nayanakantha, N. Bamithra

---END OF TECHNICAL SESSIONS---

https://doi.org/10.5281/zenodo.17519524

Abstract No: (IFET/EN/2025/001)

CHALLENGE TO LOW-CARBON ECOTECHNOLOGY FOR CALCIUM RESOURCES

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Calcium-based materials represent a critical industrial resource, particularly for the cement and steel manufacturing sectors, as well as for the development of various functional materials. The primary constituents of these resources are calcium oxide and calcium hydroxide—collectively referred to as lime—which are conventionally produced through the thermal decomposition of limestone (calcium carbonate). This calcination process typically requires temperatures around 1000 °C and relies heavily on fossil fuels such as heavy oil, resulting in substantial carbon dioxide (CO_2) emissions. In the context of advancing toward a low-carbon society—a key objective for sustainable development—the environmental impact of lime production has emerged as a significant challenge. Our investigation into the carbon footprint (CFP) of lime production at a small-scale industrial facility in Japan revealed that approximately 1.2 metric tons of CO_2 are emitted per ton of lime produced. Notably, 60% of these emissions originate from the decomposition of the limestone itself. These findings underscore the necessity of reducing reliance on natural limestone to mitigate carbon emissions in the lime industry. To address this issue, we have explored innovative technologies aimed at producing lime with reduced carbon emissions. One such approach involves mechanochemical reactions, which utilize frictional energy generated between milling media and the vessel wall in a rotating system. This high-energy environment enables chemical transformations at ambient temperature. Our research has focused on converting underutilized calcium-containing waste materials into valuable lime products. For instance, we successfully transformed calcium scale—obtained from water softening processes—into calcium hydroxide ($Ca(OH)_2$). Another promising strategy involves leveraging water treatment processes for low-carbon lime production. Specifically, we examined wastewater from the cleaning of returnable glass bottles, which contains a few percent sodium hydroxide (NaOH). As a calcium source, we selected gypsum (calcium sulfate dihydrate) recovered from building demolition waste. Our experiments demonstrated that gypsum can be effectively converted into $Ca(OH)_2$ in aqueous solutions with low NaOH concentrations. Our research integrates both academic inquiry and industrial collaboration, with the goal of scaling up the production of low-carbon lime. We anticipate that these technologies will contribute to the commercial availability of environmentally sustainable lime products in the near future.

Keywords: Calcium compounds, Low-carbon technology, Unused resources

https://doi.org/10.5281/zenodo.17519771

Abstract No: (IFET/EN/2025/002)

SYNERGISTIC ENHANCEMENT OF TEXTILE DYE WASTEWATER TREATMENT VIA ELECTROCOAGULATION COUPLED WITH *Tamarindus indica* NATURAL POLYMER

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This study evaluates the synergistic treatment of textile dye wastewater using electrocoagulation (EC) integrated with a locally available natural polymer, *Tamarindus indica* seed powder. Industrial dye wastewater with an initial Chemical Oxygen Demand (COD) of 2097 mg/L, pH 7.12, and electrical conductivity of 7.88 mS/cm (color concentration assumed as 1000 ppm for evaluation) was used to assess performance. Electrocoagulation was performed using aluminium (Al), ductile iron (Fe), and stainless steel (SS) electrodes. Among these, the aluminium anode and stainless-steel cathode (Al/SS) configuration achieved the best performance, with 72.4% COD and 92.8% color removal at an optimal charge loading of 800 C/L. The process increased pH from 7.12 to 8.29 and reduced conductivity from 7.88 to 6.81 mS/cm, indicating effective coagulation and pollutant destabilization. Further enhancement in COD and color removal was achieved by coupling the optimized EC system with *Tamarindus indica* seed powder (10 mg/L). Compared to EC alone, COD reduction improved from 72.4% to 88.3% and color removal from 92.8% to 98.8%. The final pH decreased to 6.4, reflecting the mild acidity of the polymer that enhanced floc formation. This hybrid EC-polymer process is cost-effective as it reduces chemical consumption, sludge generation, and overall operational costs through the use of locally available, biodegradable coagulants. The developed method demonstrates strong potential for sustainable, economical, and environmentally friendly industrial-scale dye wastewater treatment.

Keywords: Textile dye wastewater, Electrocoagulation, Tamarindus indica, Aluminium electrode, Natural polymer

https://doi.org/10.5281/zenodo.17520964

Abstract No: (IFET/EN/2025/003)

DEVELOPMENT OF AN EFFICIENT PASSIVE SEISMIC ISOLATION SYSTEM FOR SUSTAINABLE STRUCTURAL RESILIENCE

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Seismic base isolation systems are important in reducing structural damage by decoupling ground motion from superstructures. However, their inherent limitations in energy dissipation and self-centering, especially under near fault earthquakes, particularly without active control, restrict their overall effectiveness. This research introduces a sustainable modification to the conventional isolation system by integrating a secondary passive damping mechanism inspired by dual-stage automotive shock absorbers. The proposed concept, termed "damping the damper," seeks to enhance seismic resilience through a multi stage/layered frictional damping strategy while maintaining structural simplicity. The experimental setup comprises a square base representing the Earth's crust with two superimposed sliding units. The lower unit functions as the primary isolator, and the upper unit represents the proposed secondary isolator. Both units were mounted on low-friction rails inclined 2° toward the center, enabling controlled energy dissipation. Weighted oscillations (1–4.5 kg) were applied to simulate seismic motion, and system performance was assessed based on damping ratio, stabilization time, and self-centering capacity. Results demonstrated a notable improvement in damping ratio (7.6%) over the conventional system (4.67%), accompanied by superior re-centering and reduced residual displacement. The study underscores the potential of multi-stage passive damping systems as an efficient and scalable advancement in seismic protection. This innovation aligns with eco technological principles by promoting sustainable, resilient, and adaptive infrastructure for earthquake-prone regions.

Keywords: Base isolation, Passive damping, Seismic resilience, Energy dissipation

https://doi.org/10.5281/zenodo.17521208

Abstract No: (IFET/EN/2025/004)

REGIONAL AND GRADE-SPECIFIC EVALUATION OF FLUORIDE IN SRI LANKAN BLACK TEA INFUSIONS FROM UVA AND NUWARA ELIYA

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Fluoride (F^-) levels in black tea are an often-overlooked public health and environmental concern, mainly due to the possibility of cumulative exposure through daily consumption. This study assessed the fluoride content in black tea infusions collected from the Uva and Nuwara Eliya regions of Sri Lanka, with special attention to regional and grade-related differences. F^- concentrations of 35 tea samples from Uva (17) and Nuwara Eliya (18) regions were determined using an ion-selective electrode method. The results indicated clear variations between regions and across tea grades. The highest concentration recorded was 2.30 mg/L in Nuwara Eliya (FBOP1 grade), while Uva showed a maximum of 2.02 mg/L (BOPSP grade). The lowest value, 1.41 mg/L, was noted for the OPA grade from Nuwara Eliya. These differences are potentially influenced by environmental and agronomic factors such as soil pH, rainfall, and cultivation intensity typical of high-grown teas. The study also confirmed that finer grades, including FBOP1 and BOPSP, tend to accumulate more F^- compared to larger-leaf varieties like OPA. Although the observed levels were below the World Health Organization's guideline of 4.0 mg/L for drinking water, the regular intake of tea, together with other dietary sources of fluoride, may contribute to excessive exposure in sensitive populations. The findings highlight the need for region-specific cultivation and processing strategies, as well as better management of soil conditions, to help reduce F^- content and ensure consumer safety.

Keywords: Fluoride, Black tea, Sri Lanka, Tea grade

https://doi.org/10.5281/zenodo.17521457

Abstract No: (IFET/EN/2025/005)

CHARACTERIZATION OF RESPONSIBLE LIME OBTAINED FROM GYPSUM POWDER AND ALKALINE CLEANING DRAINAGE

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Lime is extensively utilized in the cement and steel industries, traditionally produced by calcining limestone at approximately 1000°C—a process that demands substantial energy input. Recent advancements have explored the synthesis of slaked lime at ambient temperature via the reaction of gypsum and limestone with concentrated sodium hydroxide (NaOH) solutions. However, this method presents a significant carbon footprint (CFP) due to the electricity required for hydroxide formation. In this study, we propose an alternative approach to synthesize slaked lime using reagent-grade gypsum and NaOH solution, with a focus on optimizing reaction conditions through the evaluation of the physical properties of the resulting lime. Specifically, we investigate the feasibility of producing environmentally responsible lime by utilizing low-concentration alkaline wastewater—such as cleaning drainage—in combination with gypsum. The experimental procedure involved the addition of gypsum reagent to an aqueous NaOH solution, followed by stirring under degassed conditions using nitrogen gas. The reaction temperature was regulated via a water bath, and pH changes were monitored continuously. Post-reaction, the solid phase was isolated through suction filtration, dried, and subsequently characterized using X-ray diffraction (XRD), scanning electron microscopy (SEM), and thermogravimetric-differential thermal analysis (TG-DTA). Parallel experiments were conducted using waste gypsum powder sourced from demolition activities. The pH profile obtained from reactions with reagent-grade gypsum suggests a critical threshold of pH 12.8 for successful slaked lime synthesis; synthesis was not observed below this value. Furthermore, the specific surface area of the synthesized lime was found to be governed solely by the pH of the reaction medium, independent of the solid-liquid ratio. Notably, lime synthesized from waste gypsum exhibited a specific surface area approximately twice that of lime derived from reagent-grade gypsum under identical conditions. This enhancement is attributed to differences in crystal morphology between the reagent and recycled gypsum materials.

Keywords: Sustainable lime, Gypsum recycling, Alkaline wastewater

https://doi.org/10.5281/zenodo.17523166

Abstract No: (IFET/EN/2025/006)

ADSORPTION PHENOMENA OF AMMONIA GAS ON DICALCIUM PHOSPHATES (DCP) PARTICLES

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Ammonia emissions originating from livestock facilities represent a major contributor to malodorous environmental conditions, necessitating effective mitigation strategies for environmental enhancement. Prior investigations conducted in our laboratory have demonstrated that dicalcium phosphate dihydrate (DCPD, $CaHPO_4 \cdot 2H_2O$) exhibits ammonia adsorption capabilities and can be repurposed as an agricultural fertilizer. This study proposes a sustainable approach to ammonia recovery and reuse by employing DCPD derived as a by-product from bovine bone processing during gelatin production—material that is typically discarded. The objective is to facilitate both odor abatement and CO_2 emission reduction, thereby contributing to the advancement of a decarbonized society. Experimental procedures involved introducing ammonia gas at a concentration of 10 ppm into polyvinyl fluoride (Tedlar) bag, followed by exposure to various DCPD samples under controlled environmental conditions. Ammonia adsorption efficiency was quantified by measuring the concentration decrease within the bags. The DCPD samples evaluated included reagent-grade, dehydrated reagent-grade, washed bone-derived, and washed/dehydrated bone-derived variants. Dehydration was achieved by thermal treatment at 190°C for 72 hours. Specific surface areas of the samples were determined via nitrogen gas adsorption analysis, and ammonia uptake per unit surface area was subsequently calculated. Among the tested samples, the washed and dehydrated bone-derived DCPD exhibited the highest ammonia adsorption capacity. X-ray diffraction (XRD) analysis revealed that the dehydration process induced a phase transition from DCPD to dicalcium phosphate anhydrate (DCPA, $CaHPO_4$), suggesting that this structural modification may be responsible for the observed enhancement in adsorption performance.

Keywords: Ammonia adsorption, DCPD, Resource circulation, Sustainable agriculture

Acknowledgement: *A part of this study was supported by research grants from the Takahashi Industrial and Economic Research Foundation, Japan (FY2025).*

https://doi.org/10.5281/zenodo.17523245

Abstract No: (IFET/EN/2025/007)

CHARACTERIZATION OF NANO-SCALE PARTICLE DERIVED FROM DICALCIUM PHOSPHATE (DCPD) AND LEAD ION

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Dicalcium phosphate dihydrate (DCPD, $CaHPO_4 \cdot 2H_2O$) has been recognized for its ability to react with fluoride ions to form stable fluorapatite (FAp, $Ca_{10}(PO_4)_6F_2$), suggesting its potential to stabilize hazardous elements in the environment. Lead immobilization by apatite systems is typically explained by the substitution of calcium ions in hydroxyapatite (HAp) with lead ions, forming lead-substituted hydroxyapatite (Pb-HAp, $Ca_{10-x}Pb_x(PO_4)_6(OH)_2$). This study aimed to investigate whether DCPD can stabilize Pb^{2+} through similar mechanisms. Aqueous solutions with varying Pb^{2+} concentrations were prepared and reacted with DCPD under shaking (80 rpm, 24 h). The resulting solids were collected via membrane filtration (0.45 μm) and analyzed using X-ray diffraction (XRD), field-emission scanning electron microscopy (FE-SEM), energy-dispersive X-ray spectroscopy (EDS), and inductively coupled plasma atomic emission spectroscopy (ICP-AES). The results showed that DCPD effectively reduced Pb^{2+} concentrations in solution. Two types of needle-like morphologies were observed in the solid phase. EDS analysis indicated that these particles contained no calcium, suggesting the formation of hydroxypyromorphite (HPY, $Pb_{10}(PO_4)_6(OH)_2$), rather than Pb-HAp. Under low Pb^{2+} conditions, minor phases of HAp and octacalcium phosphate (OCP, $Ca_8H_2(PO_4)_6 \cdot 5H_2O$) were also detected, likely precipitated from calcium and phosphate ions released from DCPD in acidic conditions. These findings suggest that DCPD participates in phase transformations involving Pb^{2+} and may contribute to lead immobilization. The formation of HPY highlights a promising pathway for further investigation into DCPD-based remediation strategies.

Keywords: Calcium phosphate, Apatite, Lead, Nano-hybridization

Acknowledgement: *A part of this study was supported by research grants from the Takahashi Industrial and Economic Research Foundation, Japan (FY2025), and the Cooperative Research Program of "Network Joint Research Center for Materials and Devices (MEXT).*

https://doi.org/10.5281/zenodo.17523455

Abstract No: (IFET/EN/2025/008)

SOCIOECONOMIC AND ENVIRONMENTAL DIMENSIONS OF SAND MINING IN BADULU OYA, SRI LANKA: A QUALITATIVE AND GIS-BASED STUDY

Sithumini Gunawardhana[1], Nimila Dushyantha[1]*, Gimhani Nipunika[1], Sandunika Rathnayake[2], Gayithri Niluka Kuruppu[3], W.A.P. Weerakoon[1], Titus Cooray[1]

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Sand mining is a crucial livelihood activity in rural Sri Lanka, especially in the Badulu Oya area, providing essential income for local communities. However, unregulated mining has led to significant environmental harm and institutional challenges. This study aims to examine the socioeconomic, financial, and environmental aspects of sand mining using a qualitative approach complemented by GIS-based land use and land cover (LULC) analysis from 2016 to 2024. The research reveals that while sand mining remains a lucrative but unstable source of income—affected by seasonal changes, delays in licensing, and scarce alternative jobs—workers also face health risks from polluted water. Gender-specific labor roles and bureaucratic obstacles limit fair participation. Financially, despite high returns compared to other rural options, increasing costs and regulatory issues reduce profitability. Environmentally, sand mining has intensified riverbank erosion, reduced biodiversity, and caused land degradation. Governance is fragmented, with weak enforcement, limited public involvement, and insufficient data-based resource management. Based on stakeholder input and environmental change analysis, the study proposes a six-point strategy for sustainable sand mining in rural settings. It further reframes sand mining as a rural governance issue, connecting informal labor, environmental vulnerability, and institutional gaps. These findings offer valuable methodological and conceptual insights relevant to other regions. The study highlights the urgent need for integrated rural governance approaches that balance environmental protection with socioeconomic stability.

Keywords: Sand mining, Rural livelihoods, Environmental degradation, Governance

https://doi.org/10.5281/zenodo.17523618

Abstract No: (IFET/EN/2025/009)

PHYTOREMEDIATION OF GROUNDWATER HARDNESS USING *Camellia sinensis* IN A HYDROPONIC SYSTEM

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Groundwater hardness, primarily caused by elevated concentrations of calcium (Ca^{2+}) and magnesium (Mg^{2+}), poses significant challenges to water quality and palatability. This study investigates the efficacy of *Camellia sinensis* (tea plant) for the phytoremediation of hardness ions from groundwater using a hydroponic system. Over a 16-day experimental period, the removal efficiency of Ca^{2+} and Mg^{2+} was evaluated using single-plant and four-plant configurations, with control setups to account for abiotic adsorption by the coconut coir growth medium. The concentrations of Ca^{2+} and Mg^{2+} in water samples were monitored using atomic absorption spectroscopy (AAS). For tissue analysis, plant samples were digested with concentrated nitric acid (HNO_3) prior to AAS, confirming bioaccumulation. A clear plant density-dependent removal efficiency was observed, with the four-plant system demonstrating optimal performance, achieving a 72% reduction in Ca^{2+} (from 45.35 mg/L to 12.8 mg/L) and a 56% reduction in Mg^{2+} (from 74 mg/L to 33.6 mg/L). Tissue-specific accumulation revealed Mg^{2+} was predominantly stored in leaves, whereas Ca^{2+} uptake exhibited signs of physiological regulation and translocation constraints. An observed decline in Mg^{2+} accumulation efficiency at higher external concentrations, despite an absence of visible phytotoxicity, indicates a defined operational threshold for the system, with the effects of extreme hardness remaining uncharacterized. The system-maintained pH stability within acceptable drinking water standards (7.6–8.1). These results confirm the active uptake of hardness ions by *Camellia sinensis* and underscore the critical influence of plant density. While promising, the observed physiological limitations indicate the need for optimized loading rates, establishing this method as a potentially sustainable and scalable plant-based strategy for decentralized groundwater softening.

Keywords: Phytoremediation, Water hardness, Hydroponics, Groundwater treatment

https://doi.org/10.5281/zenodo.17523720

Abstract No: (IFET/EN/2025/010)

ATMOSPHERIC MERCURY CONCENTRATION VARIATIONS AT SYOWA STATION, LÜTZOW-HOLM BAY, EAST ANTARCTICA

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In January 2022, gaseous elemental Hg (GEM) concentrations were continuously monitored at Syowa Station on East Ongul Island, located ~4 km from the continent on the eastern coast of Lützow-Holm Bay, to clarify atmospheric Hg concentrations during the summer in the southeastern Antarctic region. Atmospheric GEM ranged from 0.36 to 1.83 ng/m³ (average value: 1.01 ± 0.21 ng/m³) and increased during the day and decreased at night[1]). While maintaining these diurnal variations, GEM concentrations increased to 1.99 and 1.55 ng/m³ on January 2–3 and 17–20, 2022, respectively (Fig. 1). During both events, the low-pressure system approached the Syowa Station, and the 72-hour backward trajectory analysis revealed that the air mass originated from open water surfaces, implying that Hg evasion from the sea surface increased the atmospheric GEM concentration. To investigate the causes of diurnal variation causes—excluding these two events mentioned—Hg concentrations in the soil [n = 102, 2.61 ± 3.16 (0.14–19.0) ng/g], snow, glacier, and ice sheet around Syowa Station (n = 19, 0.45–5.60 ng/L), as well as in the atmosphere on the fast ice around the station (0.54–1.10 ng/m³), were measured. The results revealed that sources such as ornithogenic soil from the penguin rookery around the station, open water surfaces, and the gaseous oxidized Hg transported inland by katabatic winds did not contribute to the daytime GEM concentration increases. The cause of the summer diurnal variation at Syowa Station was unidentified and warrants further investigation.

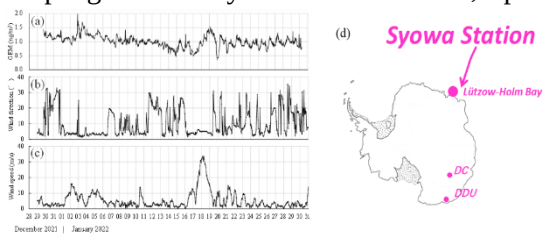

Fig.1 GEM concentration, wind direction, and wind speed observed at Syowa Station, Antarctica during Dec 2021 to Jan 2022. (a) GEM concentration, (b) wind direction, (c) wind speed, (d) Location of observation site (Syowa station) [1)].

1) Nakazawa et al., Atmospheric mercury concentration variations at Syowa Station, Lützow-Holm Bay, East Antarctica and contributing factors, Environmental Science: Advances, 2025, 4, 172-179.

Keywords: Gaseous Elemental Mercury (GEM), Antarctica, Syowa station, Snow, Soil

https://doi.org/10.5281/zenodo.17523808

Abstract No: (IFET/EN/2025/011)

CALIBRATION AND PERFORMANCE OPTIMIZATION OF pH AND TURBIDITY SENSORS FOR EMBEDDED WATER SYSTEMS

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Accurate calibration of pH and turbidity sensors is vital for maintaining the precision and reliability of low-cost, automated water treatment systems. However, open-source sensors commonly suffer from nonlinear response, signal drift, and environmental sensitivity, which limit their long-term measurement stability. This study presents a systematic calibration and validation approach for gravity analog pH and turbidity sensors integrated within an Arduino-driven water system. The calibration mechanism was designed as a button-triggered, five-step routine that activates under user command. The process involves three successive button presses to record analog voltage outputs in standard reference solutions pH 4.00, 7.00, and 10.00, for pH calibration, and Formazin standards of 25, 100, and 200 NTU for turbidity calibration, followed by automatic generation of a linear regression model to determine calibration coefficients. A fourth step saves these coefficients temporarily in the Arduino Nano's memory, while a fifth step initiates real-time readings updated every 20 seconds. A dedicated reset button allows recalibration when drift or measurement deviation is detected, ensuring continuous accuracy. The regression models demonstrated strong linearity. When compared with commercial reference meters, the calibrated sensors achieved mean percentage errors of 4.13% for pH and 2.85% for turbidity, both within the accepted analytical tolerance of ± 5%. Multi-cycle testing confirmed minimal signal variation and stable sensor performance. Moreover, the proposed methodology is broadly applicable to other analog-output water quality sensors, such as ORP, conductivity, dissolved oxygen, and total dissolved solids probes, where parameter voltage relationships can be expressed through linear or polynomial regression. This adaptability positions the framework as a generalized calibration strategy for improving accuracy, stability, and long-term reliability in embedded environmental monitoring and automated water systems.

Keywords: Sensor calibration, Linear regression, Arduino Microcontroller, pH and turbidity sensors, Measurement accuracy

https://doi.org/10.5281/zenodo.17523889

Abstract No: (IFET/EN/2025/012)

ELECTROCOAGULATION-BASED REMOVAL OF COD AND HEAVY METALS FROM MUNICIPAL SOLID WASTE LEACHATE: A CASE STUDY FROM BADULLA, SRI LANKA

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Landfill leachate is a major environmental concern worldwide due to its high concentration of organic matter, color, turbidity, and heavy metals. Untreated leachate can cause serious environmental and health issues. In Sri Lanka, leachate from the Badulla municipal dumping site exhibits similar hazardous characteristics, emphasizing the need for effective treatment. Electrocoagulation (EC) is widely applied globally for wastewater treatment, especially for removing Chemical Oxygen Demand (COD) removal. However, its application in Sri Lanka for simultaneous removal of COD and metal ions has not been explored. This study evaluated the performance of EC on natural leachate collected from the Badulla site. Initial tests compared Fe (Ductile iron)/SS and Al/SS electrodes, with Fe/SS showing the highest removal efficiency at 3375 C/L, and it was selected for further experiments. Five samples (A–E) were collected, analyzed for COD, pH, turbidity, and metal ions, and combined into a composite sample (F). Only manganese (Mn) and iron (Fe) were detected; chromium (Cr) and cadmium (Cd) were absent. Experiments were conducted at various charge loadings (2025– 4050 C/L) to evaluate removal efficiency. Electrocoagulation of sample F at 2250 C/L achieved 66.35% COD and 36.04% Mn removal, while Fe/SS treatment of the discharge sample reached 81.82% COD and 100% Mn removal at 3375 C/L. Additional tests using Poly-aluminium Chloride (PAC) combined with EC showed that PAC alone did not remove COD, but adding PAC simultaneously during EC optimized COD removal to 54.44%. Minimal pH variation confirmed stable operating conditions. Minimal pH variation confirmed stable operating conditions. The study concludes that EC using Fe/SS electrodes, especially combined with PAC, offers an effective and sustainable approach for simultaneous removal of COD and metal (Mn and Fe) ions from landfill leachate.

Keywords: Electrocoagulation, Leachate treatment, COD removal, Manganese, Iron, PAC

https://doi.org/10.5281/zenodo.17523968

Abstract No: (IFET/EN/2025/013)

DEVELOPMENT OF A REAL-TIME WEED DETECTION SYSTEM USING SMART GLASSES

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Kurapia (improved *Lippia nodiflora*), a ground-cover plant, is environmentally friendly and widely used in parks and gardens. However, weeds that grow in shaded areas can hinder its growth, requiring continuous removal. Manually distinguishing Krapia from weeds is difficult, and visual inspection alone has limitations. In our previous study, we developed a smartphone application that identifies weeds from images using YOLOv5 and displays bounding boxes around them. This research aims to implement the same functionality on smart glasses to enable real-time detection and provide visual assistance for efficient weeding operations. The smart glasses used in this study were VUZIX M400, and the system was developed using Android Studio. The YOLOv5 model trained for 200 epochs was employed for weed detection. When the built-in camera captures an image, it is converted into a JPEG byte array and sent to the server via a POST request. The server performs detection using YOLOv5 and returns a result image URL in JSON format. The smart glasses then display the result image through a WebView interface. A continuous execution program was implemented to achieve real-time visual feedback resembling video output. Experimental results showed that the system successfully detected weeds from images containing both Krapia and weeds, with bounding boxes displayed correctly. Each processing cycle required approximately 250 ms, equivalent to 4 fps. Some visual lag was observed, mainly caused by data transmission between the device and the server. In future work, we plan to optimise image resolution and detection accuracy to shorten communication time. This improvement is expected to enhance real-time performance and usability in practical weeding environments, and the system also has potential applications for detecting other plant species.

Keywords: Smart glasses, Weed detection, YOLOv5, Image processing, Real-time system

Acknowledgement: *This study was supported by grants from The First Bank of Toyama, Ltd., and the Consortium of universities in Toyama.*

https://doi.org/10.5281/zenodo.17524065

Abstract No: (IFET/EN/2025/014)

ASSESSMENT OF THE IMPACT OF SOIL FLUORINE CONTAMINATION ON MAIZE GROWTH AND VERIFICATION OF THE POSSIBILITY OF REDUCING PLANT F TOXICITY THROUGH THE ADDITION OF CALCIUM HYDROGEN PHOSPHATE (DCP) TO THE SOIL

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Soil contamination by fluorine (F) is known to inhibit plant growth. However, knowledge of the impact of soil F contamination on crop production remains limited. We assessed the impact of soil F contamination on maize (*Zea mays*) growth, whilst also verified the possibility of reducing plant F toxicity through the addition of calcium hydrogen phosphate (DCP), a recently focused F immobiliser, to the soil. In experiment number 1, soils were prepared by adding 10, 30, and 50 moles of F per 1 m^3 of soil, respectively (F-10, F-30, F-50). These soils were filled into Wagner pots, and maize was cultivated. In experiment number 2, soil containing 50 mol of F per 1 m^3 of soil was prepared. DCP was added to this F-contaminated soil at concentrations of 250 mol, 500 mol, and 1,000 mol per 1 m^3 of soil (DCP-250, DCP-500, DCP-1,000). These soils were placed in Wagner pots, and maize was cultivated. For experiment number 1, the F-30 and F-50 showed clear growth inhibition 14 days after initiation (DAI). At the end of the cultivation (55 DAI), the dry matter yield of the F-30 and F-50 decreased by 70% and 84%, respectively, compared to the control without F addition. Thus, when the concentration of F added to the soil exceeded 30 mol/m^3, maize growth was severely inhibited. For experiment number 2, treatment not mixed with DCP (negative control), growth was significantly inhibited due to F toxicity. In contrast, DCP-250, DCP-500, and DCP-1,000 all showed growth equivalent to the positive control (F-uncontaminated soil). At the end of cultivation (21 DAI), dry matter production in the DCP-250, DCP-500, and DCP-1,000 showed no statistically significant difference compared to the positive control. These results demonstrate that adding DCP to the soil can reduce the growth inhibition of plants in fluoride-contaminated soils.

Keywords: Calcium hydrogen phosphate (DCP), Fluorine toxicity to maize, Soil fluorine contamination, Plant growth test

https://doi.org/10.5281/zenodo.17524142

Abstract No: (IFET/EN/2025/015)

OPTIMIZING CARBON SOURCES AND HYDRAULIC RETENTION TIME FOR NITRATE REMOVAL IN WOODCHIP DENITRIFICATION BEDS

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Excess nitrate (NO_3^-) from agricultural runoff is a major cause of water pollution, leading to eutrophication, poor water quality, and risks to aquatic life and human health. Addressing this issue is essential for sustainable water management and environmentally responsible farming. This study investigates how different carbon sources, concentrations, and hydraulic retention times (HRT) influence nitrate removal efficiency in woodchip denitrification beds (WDBs). Batch experiments were conducted using a laboratory-scale column system filled with woodchips and supplemented with three external carbon sources as glucose ($C_6H_{12}O_6$), acetic acid (CH_3COOH), and ethanol (C_2H_5OH) at two concentrations (5 ppm and 10 ppm) under two HRTs (24 h and 48 h). NO_3^- removal performance was evaluated by monitoring the NO_3^- and dissolved oxygen (DO) in influent and effluent samples. Results showed that C_2H_5OH provided the highest NO_3^- removal rates among all treatments. At 24 h HRT, C_2H_5OH achieved an average NO_3^- removal efficiency of 98.62% at 5 ppm and 94.25% at 10 ppm, compared to CH_3COOH (95.77%) and $C_6H_{12}O_6$ (96.33%). DO concentration decreased steadily during denitrification, creating favorable conditions for microbial activity. These findings demonstrate that C_2H_5OH is an effective carbon source for enhancing NO_3^- removal in WDBs, especially at shorter HRTs. The results provide practical guidance for improving denitrification performance, supporting sustainable agricultural water treatment and contributing to cleaner, climate-resilient water management systems.

Keywords: Denitrification, Woodchip bioreactor, Nitrate removal, Agricultural water, Hydraulic retention time

https://doi.org/10.5281/zenodo.17524185

Abstract No: (IFET/EN/2025/016)

DEVELOPMENT OF A SYSTEM WITH A CUMULATIVE TEMPERATURE NOTIFICATION FUNCTION FOR SOIL SOLARIZATION

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In Okinawa, Japan, marine pollution caused by red soil runoff has become a serious and long-term environmental problem. To mitigate this issue, ground cover plants such as Kurapia (improved *Lippia nodiflora*) have been introduced to stabilize the soil surface. However, in some areas, their growth remains limited due to poor soil structure and fertility. For such soil conditions, soil solarization based on the BLOF theory can be highly effective. This method utilizes solar radiation to increase cumulative soil temperature, suppress harmful pathogens, and improve soil aggregation in an environmentally friendly manner. This study aims to develop an automated monitoring and notification system to efficiently manage the soil solarization process. The proposed system measures multiple environmental parameters and issues alerts when the cumulative temperature reaches a specified threshold. A web-based application built using FastAPI enables real-time visualization of temperature changes and cumulative temperature trends. The system is based on a Raspberry Pi Model B and uses DS18B20 and DHT22 sensors to measure soil temperature, ambient humidity, and CPU temperature. When the threshold value of 900°C proposed in the BLOF theory is exceeded, the system automatically sends notifications to users via Gmail. Field experiments were conducted outdoors using a mobile battery and router to evaluate long-term data acquisition performance under different conditions. The results showed stable operation at night, while significant increases in internal and CPU temperatures were observed during the day. These findings indicate that improving ventilation and thermal insulation are essential for stable operation under high-temperature conditions. Future work will focus on integrating a solar power module to achieve complete energy autonomy and incorporating machine learning algorithms to predict cumulative temperature trends and estimate the curing completion time. This system aims to contribute to sustainable agricultural practices by providing a low-cost, data-driven solution for soil health management.

Keywords: Soil solarization, Raspberry Pi, Soil monitoring, BLOF theory

Acknowledgement: *This study was supported by grants from The First Bank of Toyama, Ltd., and the Consortium of universities in Toyama.*

https://doi.org/10.5281/zenodo.17524618

Abstract No: (IFET/EN/2025/017)

SYNTHESIZED HYDROXYAPATITE FROM SEASHELLS AS A SUSTAINABLE ADSORBENT FOR CR(VI) REMEDIATION

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Chromium is extensively used in various industrial processes, including metal plating, stainless steel manufacturing, and leather tanning. Due to the high toxicity of hexavalent chromium (Cr(VI)), it presents substantial hazards to human health and environmental ecosystems. The study investigates the removal of Cr(VI) ions from aqueous solutions using seashell-synthesized hydroxyapatite (SSHA) as a cost-effective adsorbent, addressing a gap in previous research. Cr(VI) removal was investigated by isotherm experiments and was analyzed with an Atomic Absorption Spectrophotometer. The characteristics of SSHA were analyzed using Fourier Transform Infrared spectroscopy (FTIR) and X-ray Diffraction (XRD) techniques. Other parameters, such as pH, adsorbent dosage, and contact time in relation to the initial Cr(VI) concentration, were systematically evaluated. Experimental results revealed that SSHA achieved a maximum removal efficiency of 39.51% at an optimal dose of 1 g, at pH 7, for an initial 10 mg/L Cr(VI) concentration with particle sizes ranging from 0.125 mm to 0.5 mm. Adsorption studies conducted across initial Cr(VI) concentrations of 5–25 mg/L (at pH 7.0 and 27°C) indicated that the adsorption behavior was better described by the Freundlich isotherm model, with correlation coefficients R^2 = 0.9555 and R^2 = 0.8334 for 5 mg/L and 25 mg/L, respectively. It suggests adsorption on a heterogeneous surface with possible multilayer formation. The Freundlich isotherm model constant (K_F) was found 7.406 mg/g and 7.702 mg/g, respectively, for initial 5 and 25 mg/L Cr(VI), while the Langmuir model yielded negative values for both 5 and 25 mg/L initial Cr(VI), indicating an unfavorable monolayer adsorption process. The FTIR and XRD analyses of Cr(VI)-adsorbed SSHA confirmed that Cr(VI) was not incorporated structurally within the hydroxyapatite lattice but was rather adsorbed onto the surface of SSHA.

Keywords: Seashells, Hydroxyapatite, Adsorption, Adsorption isotherm, Chromium removal

https://doi.org/10.5281/zenodo.17524748

Abstract No: (IFET/EN/2025/018)

MITIGATING COASTAL HAZARDS: A COMPREHENSIVE REVIEW OF NATURAL DISASTER MANAGEMENT APPROACHES

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Coastal hazards, including storm surges, tsunamis, erosion, and sea level rise, increasingly threaten ecosystems, infrastructure, and communities across the world. This comprehensive narrative review documents global efforts to prevent coastal disasters, focusing especially on Nature-Based Solutions (NBS), policy instruments, community-based approaches to resilience, and cases from advanced and developing countries. Through case studies from developed nations (Japan, USA, Portugal, Netherlands) and developing regions (Bangladesh, Indonesia), this paper analyzes the effectiveness of structural (seawalls, levees), non-structural (zoning laws, early warnings), and hybrid (mangrove restoration, living shorelines) approaches. The community based coastal hazard mitigation, preparedness and response, policy and governance structure related to coastal hazards and climate change mitigation and adaptation strategies in coastal areas. Our main findings are that integrated coastal zone management, climate-adapted infrastructure development, and institutional locale capacities are important to effectively minimize disasters. Challenges persist despite considerable experience, including institutional fragmentation, inadequate funding, and social inequality. The study highlights the importance of adaptive policy formulation, interplay, and monitoring with advanced technologies like AI, drones, and satellites to manage coastal hazards exacerbated through climate change. By synthesizing past lessons from main disasters like Hurricane Katrina (2005) and the Indian Ocean Tsunami 2024. Finally, this paper provides actionable insights for policymakers and regulatory bodies to enhance coastal resilience through science-based planning, equitable recovery, and ecosystem-based adaptation , which helps in the planning and decision-making process.

Keywords: Coastal hazards, Nature-based solutions, Disaster risk reduction, Early warning

https://doi.org/10.5281/zenodo.17524815

Abstract No: (IFET/EN/2025/019)

PROVENANCE OF THE TABBOWA AND ANDIGAMA SEDIMENTS: HYPOTHESIZED AS BACKISHWATER FLUVIO-DELTAIC CONDITIONS

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Undisturbed core samples from the Tabbowa (24.9 m) and Andigama (43.6 m) basins in northwestern Sri Lanka were analyzed using core logging, scanning electron microscopy, and palynomorph analysis (palynological and palynofacies). These techniques were applied to each stratigraphic layer to determine the provenance, sedimentation history, and paleoclimatic conditions. The extracted pollen suggests a paleoclimate characterized by low temperatures and humid conditions. Organic matter trapped in the sediments indicates that deposition primarily involved suspended load settling in a weakly oxygenated environment, suggesting dysoxic to anoxic conditions within a fluvio-deltaic setting. Textural features of arkosic sandstones, feldspathic sandstones, and carbonaceous sandstones reveal evidence of slow, steady, and periodic low-energy flows, which eventually led to the formation of swamps within the basin. Moreover, tidal deposits are interpreted to have formed under brackish water fluvio-deltaic conditions, with bay-head deltaic systems gradually migrating coastward. The presence of thin beds of nodular limestone indicates a rhythmic phase within the sedimentary sequence, likely formed during rapid subsidence in a brackish water environment. The sedimentological signatures strongly support the paleoenvironmental interpretations derived from palynofacies analysis. In conclusion, the sedimentation occurred under terrestrial conditions within a fluvio-deltaic environment during the Jurassic (Callovian-Kimmeridgian) and Late Jurassic to Early Cretaceous (Tithonia-Berriasian) periods.

Keywords: Tabbowa, Andigama, Fluvio-deltaic system, Jurassic, Brackish water

https://doi.org/10.5281/zenodo.17525005

Abstract No: (IFET/EN/2025/020)

INVESTIGATION OF A PVC DISCRIMINATION SYSTEM USING NEAR-INFRARED LIGHT

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In many waste disposal plants, it is difficult to accurately sort polyvinyl chloride (PVC) from other plastics. PVC is widely used in pipes and vinyl sheets, but generates harmful substances during combustion and cannot be recycled together with other resins. Therefore, efficient separation of PVC from mixed waste is essential for sustainable waste management and for reducing environmental pollution. Manual sorting is labor-intensive and inconsistent, highlighting the need for an automated and reliable discrimination method. This study aims to develop an automated discrimination system using near-infrared (NIR) spectroscopy to identify PVC quickly and accurately. NIR spectroscopy irradiates the sample with near-infrared light and analyzes the reflected spectrum to determine material characteristics. Previous studies have shown that the reflection spectra vary depending on the plastic type, allowing for material-specific identification. In this research, reflected light in the wavelength range considered effective for PVC discrimination was collected from several plastic samples. Experiments using white plastic specimens confirmed a distinct reflectance characteristic of PVC in the 1000–1150 nm wavelength range, consistent with known absorption features of chlorine-containing polymers. Further experiments investigated the effect of color on reflectance characteristics by irradiating ten colored PVC samples and measuring reflected intensity with a photodiode. The results revealed that while reflectance patterns were similar for light-colored PVC (e.g., white and lemonade), color variation caused noticeable differences in the 1000–1150 nm range. In contrast, transmittance measurements showed almost identical spectral behavior regardless of color, suggesting that transmittance characteristics are largely color-independent and may provide a more stable basis for discrimination. These findings indicate that color influences reflectance-based discrimination and must be considered in system design. Future work will focus on compensating for color effects, optimizing illumination and detection conditions, and exploring transmittance-based discrimination methods combined with machine learning to improve overall identification accuracy and robustness.

Keywords: PVC sorting, Near-infrared spectroscopy, Plastic sorting, Waste management

Acknowledgement: *The authors gratefully acknowledge the support and collaboration of Toko Metal Co., Ltd., whose technical expertise and experimental resources were invaluable to this study.*

https://doi.org/10.5281/zenodo.17525123

Abstract No: (IFET/EN/2025/021)

A SUSTAINABLE APPROACH TO SUGARCANE IRRIGATION: MACHINE LEARNING BASED AUTOMATED SOLAR POWERED WATER PUMPING SYSTEMS AS AN ALTERNATIVE TO DIESEL/KEROSENE PUMPS

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This study presents the development and evaluation of a prototype machine learning based automated solar powered irrigation system as a sustainable alternative to conventional fuel pumps in large scale sugarcane cultivation. The research was conducted over four acres in the dryland area of Pelwatte Sugar Factory, Buttala, Sri Lanka, comparing a 3 HP kerosene pump operated three to four times weekly during dry seasons with a network of four 1 HP solar powered irrigation units. The system aimed to assess environmental performance, water use efficiency, and sustainability as an eco-technology for climate resilient agriculture. The prototype employed an ESP32 microcontroller integrated with a capacitive soil moisture sensor and solar irradiation sensor to monitor soil and sunlight conditions. The ESP32 operated within an analog voltage range of 2.3–2.8 V (12-bit ADC = 2730–3475) under dry soil conditions, with a minimum moisture threshold of 2.2 V (ADC ≈ 2854). Sensor data formed the training dataset for an Artificial Neural Network (ANN) model trained to predict irrigation requirements based on real time soil parameters. The trained ANN was connected with the ESP32 and tested through a battery connected solar panel system that automatically activated pumps when soil moisture dropped below the threshold. Performance testing showed each 1 HP solar pump discharged 25–30 L min^{-1}, delivering approximately 9,000–10,800 liters per day per unit over 6–8 hours of sunlight. Moisture recovery time averaged 30–40 minutes, with ANN response within seconds and overall system accuracy of 90%, maintaining soil moisture between 22–28%. Theoretical analyses indicated a 22% improvement in water-use efficiency and a reduction of approximately 285 kg CO_2 per month. The findings confirm that integrating sensing, solar energy, and machine learning provides a scalable, climate smart irrigation solution for sustainable sugarcane cultivation in Sri Lanka's dry zones.

Keywords: Irrigation, Sugarcane cultivation, Solar Powered water pump, Automation system, Sustainability

https://doi.org/10.5281/zenodo.17525181

Abstract No: (IFET/EN/2025/022)

RELIABILITY OF WEATHER PREDICTIONS IN TROPICAL REGIONS - A CASE STUDY OF GALLE, SRI LANKA

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Accurate weather forecasting is essential for climate-sensitive sectors such as agriculture, tourism, transportation, and disaster management. In tropical regions, however, forecasting remains particularly challenging due to high atmospheric variability, complex monsoonal dynamics, and limited observational data. This study evaluates the weather prediction reliability of four widely accessible weather platforms – AccuWeather (AW), The Weather Channel (WC), WeatherBug (WB), and Google Weather (GW) – for Galle, Sri Lanka, over a six-month period (23 November 2024 – 23 May 2025). Daily forecasts with lead-times of 10 (AW, WC), 9 (WB), and 7 (GW) days were collected via web harvesting and compared against observed meteorological data using the Root Mean Squared Error (RMSE) metric. Using Microsoft Excel, five key parameters were analyzed: precipitation probability, relative humidity, maximum temperature, minimum temperature, and wind speed. Graphical results indicate a consistent decline in forecast accuracy with increasing lead time across all parameters. Notably, nighttime (NT) precipitation forecasts were more reliable than daytime (DT) predictions, with WC offering the most accurate estimates for precipitation probability (Average RMSE of 0-7 day lead-times for AW DT, AW NT, WC DT, WC NT, WB DT, WB NT, GW: 48, 46, 43, 42, 52, 49, 47%). Additionally, WC provided the most precise daytime forecasts for relative humidity (Average RMSE of 0-7 day lead-times for AW DT, AW NT, WC DT, WC NT, WB DT, WB NT, GW: 7, 5, 4, 8, 5, 5, 5%) and wind speed (Average RMSE of 0-7 day lead-times for AW DT, AW NT, WC DT, WC NT, WB DT, WB NT, GW: 7, 6, 4, 6, 9, 10, 5 km/h). GW outperformed other platforms in predicting both maximum (Average RMSE of 0-7 day lead-times for AW, WC, WB, GW: 2.2, 1.1, 1.4, 1 °C) and minimum (Average RMSE of 0-7 day lead-times for AW, WC, WB, GW: 1.2, 1.2, 1.7, 0.9 °C) temperatures. These findings highlight the relatively greater reliability of short-term forecasts and underscore the limitations of depending on a single platform for comprehensive weather prediction.

Keywords: Weather forecast accuracy, Tropical climate variability, Multi-platform comparison

https://doi.org/10.5281/zenodo.17525226

Abstract No: (IFET/EN/2025/023)

INVESTIGATING THE SUITABILITY OF *Paramecium sp.* AS A FIRST FEED FOR *Betta splendens* LARVAE

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Traditional feeding methods for rearing fish larvae have limitations in efficiency and cost-effectiveness. Artemia, the most common live feed, is expensive and requires specific hatching conditions, limiting its use by many farmers. As a result, egg yolk is often used as a cheaper alternative, though it provides lower nutritional value and growth. This study aimed to investigate the suitability of *Paramecium sp.* as a more efficient and cost-effective feed for fish larvae. Three days post fertilization (dpf), *Betta splendens* larvae were fed with 3 different diets, *Artemia sp.* (Control 1), egg yolk (Control 2), and *Paramecium sp.* (Treatment 1), 3 times a day for 10 days. Each treatment was triplicated. Initially, pH, temperature, Dissolved oxygen, ammonia, and nitrate were recorded to assess the influence of water quality parameters on larval fish survival and growth rates. Furthermore, the larval length and weight were measured using a ruler and an analytical balance, respectively. Final mean percentage survival rate $\pm$ SE was 54.17 $\pm$ 3.63 (Control 1), 5.83 $\pm$ 0.83 (Control 2), and 7.50 $\pm$ 1.44 (Treatment 1). The mean final TL (mm) $\pm$ SE was 6.29 $\pm$ 0.10 (*Artemia sp.*), 5.79 $\pm$ 0.21 (egg yolk), and 5.89 $\pm$ 0.20 (Treatment 1). The final mean weight (mg) $\pm$ SE was 0.03 $\pm$ 0.00 (Control 1), 0.01 $\pm$ 0.00 (Control 2), and 0.01 $\pm$ 0.00 (Treatment 1). One-way ANOVA with Tukey's HSD test showed no significant difference ($p > 0.05$) in the mean values of water quality parameters, final total length, and final weight among treatments. However, a significant difference ($p < 0.05$) was observed in the final mean percentage survival rate of the *Betta splendens* larvae ($p < 0.05$). The present study demonstrated that *Paramecium sp.* could serve as a supplementary feeding option in low-cost larviculture systems of *Betta splendens*.

Keywords: *Betta splendens*, Growth performance, Larviculture, *Paramecium sp.*, Survival rate

https://doi.org/10.5281/zenodo.17525390

Abstract No: (IFET/EN/2025/024)

SCREENING RICE VARIETIES FOR SUBMERGENCE TOLERANCE IN KILINOCHCHI DISTRICT (DRY ZONE) OF SRI LANKA

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Paddy cultivation in the Dry Zone of Sri Lanka, particularly the Kilinochchi district, faces severe limitations in productivity due to frequent flash floods during the Maha season. Flooding is one of the major causes of crop failure, decreasing average yield, as most locally cultivated varieties have a survival period limited to approximately seven days. In the Kilinochchi region, Farmers lack suitable rice varieties that survive under stress conditions, and 36 Ha of paddy was fully damaged, and 220 ha of paddy was partially damaged during the Maha 2024/2025 season. The study addresses this practical issue by screening local and known tolerant varieties to identify superior germplasm suitable for the region. The main objective was to evaluate the submerge tolerance level of selected rice varieties under controlled conditions and recommend promising rice varieties. Fifteen rice varieties, including twelve commonly cultivated local types and three known tolerant checks (Bg 455, Bg 379-2, Bw 14-7-5), were screened as three-week-old seedlings under controlled 7-day (mild) and 14-day (severe) complete submergence at the Rice Research Station, Paranthan. Under 7-day submergence, the overall mean survival was 79.00%. Tolerant varieties (90.10% survival) exhibited a quiescence strategy with moderate elongation (8.99 cm), whereas susceptible varieties (82.98% survival) employed an escape strategy marked by significantly higher elongation (14.33 cm). For many commonly cultivated varieties in Kilinochchi, survival was limited to ~7 days of submergence. Under 14-day submergence, the overall survival rate dropped drastically to 20.94%. However, the variety Bw14-7-5 demonstrated the highest tolerance across both stress levels, recording a 94.12% survival rate at 7 days and a superior 39.04% survival rate at 14 days. Based on its consistent and superior performance under both mild and severe submergence stress, Bw14-7-5 is recommended as the most suitable variety for enhancing rice productivity and resilience in the flood-affected areas of the Kilinochchi district.

Keywords: Rice (*Oryza sativa L.*), Submergence tolerance, Kilinochchi, Flash flood stress, Dry zone, Climate-resilient agriculture

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ISBN 978-624-6685-21-8