THE
OPEN UNIVERSITY
OF SRI LANKA

ICPES
International Conference on Plastics & Environmental Sustainability

Proceedings of the
1st International Conference on Plastics & Environmental Sustainability

Centre for Environmental Studies
& Sustainable Development
7th & 8th March 2024

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ABSTRACTS

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Message of the Vice Chancellor, The Open University of Sri Lanka

It is with my pleasure I write this message as the Vice Chancellor of the Open University of Sri Lanka. Conducting research, sharing findings among relevant parties, and providing international platforms to present research findings are indeed paramount duties by higher education institutions.

Understanding the role of higher education institution's, Center for Environmental Studies, and Sustainable Development (CESSD) of the Open University of Sri Lanka (OUSL) has organized the "1st International Conference on Plastic under a timely important theme on "Plastics and Environmental Sustainability" (ICPES). Plastic is a vital concern on Earth with distinguishing ecological features and critically important impacts on habitats worldwide. It provides significant environmental, social, and economic challenges for a country's sustainability. Therefore, I recognize the importance of taking the leadership of having a research conference dedicated to plastic and environmental sustainability.

I hope that the outcome of the research studies will be taken up by the interested parties including national decision-making authorities in making administrative, necessary conservation, and managerial decisions. Further, research findings will definitely be helpful in understanding the challenges faced by plastic for a sustainable future.

Finally, I convey my heartiest congratulations to all the participants for keeping trust and choosing the "International Conference on Plastics and Environmental Sustainability -2024" organized by CESSD of the OUSL to publish their valuable research findings. I would like to convey my sincere thanks to distinguished keynote speakers, plenary speakers, reviewers, collaborators, sponsors, and participants. While thanking, I congratulate the organizing committee of the ICPES -2024 and all staff members of the CESSD for making reality the 1st International Conference on Plastics and Environmental Sustainability. I wish you good luck to continue this event annually.

Professor P. M. C. Thilakerathne
Vice-Chancellor
The Open University of Sri Lanka
Sri Lanka

Message of the Secretary – Ministry of Environment

Due to its unique characteristics, plastics have become one of the essential materials in today's modern society. As with any other products and services, the generation of waste is inevitable for plastics too. However recyclability and their ability to change into other shapes and composites, the adverse effects were not noticed until quantities of plastic waste became extremely high level. According to the United Nations, under the business-as-usual scenario and in the absence of necessary interventions, the amount of plastic waste entering aquatic ecosystems could nearly triple from some 9–14 million tonnes per year in 2016 to a projected 23–37 million tons per year by 2040. Some types of plastic are more durable than others, while some are more flexible. But no matter what type of plastic it is, it will always have a negative effect on the environment. It can take centuries for plastic to decompose. In that time, it can release harmful toxins into the ground and water. Marine animals are especially susceptible to the effects of plastic pollution, as they can mistake it for food and ingest it. This can cause them to starve or become entangled and drown.

The international community has recognized plastic pollution as a global environmental issue. In March 2022, at the resumed fifth session of the UN Environment Assembly (UNEA-5.2), a historic resolution was adopted to develop an international legally binding instrument on plastic pollution, including in the marine environment. The first session of the INC (INC-1) took place in Punta del Este, Uruguay from 28 November to 2 December 2022, followed by a second session (INC-2) in Paris, France from 29 May to 2 June 2023. The third session (INC-3) took place in Nairobi, Kenya from 13 to 19 November 2023. The fourth session(INC-4) and Fifth session (INC-5) are scheduled to be held during 23 - 29 April 2024 in Ottawa, Canada, and 25 November - 1 December 2024 in Busan, Republic of Korea respectively. At the end, the global community expects to develop an instrument that addresses the full life cycle of plastic, including its production, design, and disposal.

In line with the global community, Sri Lanka has made many positive steps in the Management of plastic pollution. Several regulations were introduced to ban selected types of single-use plastics. Burning of plastics is prohibited. Changes in the taxes were introduced to discourage the importation of selected plastics raw materials and products and topromote the recycling of plastics. National Action Plan on Plastic Waste Management 2021-2030 was developed, and the activities of the plan are implemented with the relevant stakeholders including the private sector, international funding agencies, and academia. ButI believe that we have to do many other things as a country to address the plastic pollution in Sri Lanka.

I wish that this event of the International Conference on Plastics and Environmental Sustainability will bring many professionals together to share, scientific information, and experiences in various aspects related to plastic waste management. They will ultimately

contribute for the knowledge required for proper plastic waste management in Sri Lanka. I congratulate the Open University of Sri Lanka for organizing this timely important event.

Mr. B.K. Prabath Chandrakeerthi
Secretary
Ministry of Environment
Sri Lanka

Message of the Conference Chair

On behalf of the organizing committee, it is my honour and privilege to welcome you all to the First International Conference on Plastics and Environmental Sustainability (ICPES 2024). As the Chair of this conference, I extend my warmest greetings and heartfelt appreciation for your valuable presence in this momentous event.

Plastic and sustainable environment initiatives hold a vital position in the preservation of our planet's delicate ecosystems, and it is our collective responsibility to safeguard their existence. With the diverse range of themes encompassing this conference, we aim to explore the multidimensional significance of plastic management in promoting ecological balance, economic prosperity, and the sustenance of environmental health and biodiversity.

We trust that you will relish the 7th and 8th of March 2024. We sincerely thank the Secretary to the Ministry of Environment, The Vice Chancellor of the Open University of Sri Lanka, keynote speakers, sponsors, plenary speakers, session chairs, scientific & technical committee members all the authors and participants for their immense contributions in shaping this conference and making it a resounding success.

We eagerly anticipate fruitful discussions, insightful presentations, and the emergence of collaborative partnerships that will propel environmental sustainability and plastic management to new heights. Together, let us champion the cause of sustainable development and work towards a future where ecological and economic sustainability go hand in hand.

Prof. Bandunee C.L. Athapattu
Director - Centre for Environmental Studies & Sustainable Development
The Open University of Sri Lanka
Sri Lanka

Message of the Director Research, The Open University of Sri Lanka

I am delighted to contribute this message to the International Conference on Plastics and Environmental Sustainability (ICPES 2024) organized by the Centre for Environmental Studies & Sustainable Development (CESSD) of the Open University of Sri Lanka (OUSL).

The annual Open University Research Sessions (OURS) organized by the Research Unit of OUSL established itself as a high caliber research forum that attracts not only researchers from the OUSL community, but also from other state universities and higher education institutions, creating a forum for presenting and discussing valuable research findings leading to enriching experiences to the researchers. As a further step towards enhancing the research culture in OUSL, CESSD together with the Biodiversity Secretariat, the Ministry of Environment is hosting the International Conference on Plastics and Environmental Sustainability on the 07th and 8th of March 2024.

Plastic and sustainable environment initiatives are critical in addressing global challenges like pollution and climate change. Plastic pollution poses severe threats to ecosystems and human health. Adopting sustainable practices, such as recycling and reducing single-use plastics, is vital for preserving natural resources and promoting a healthier planet for current and future generations.

A conference is not just an avenue for a scientist/researcher to present their research to the wider community, but it can be an important venue for brainstorming, networking, and making vital connections that can lead to new initiatives and findings.

Therefore, ICPES 2024 will provide insights into mitigating plastic usage through the exploration of alternatives and novel approaches, fostering a sustainable future. The conference brings together an esteemed gathering of scholars, researchers, policymakers, conservationists, industry professionals, and enthusiasts from around the world.

While congratulating the presenters and thanking the Conference Committee, I wish the ICPES 2024 all the success.

Professor Shyama R. Weerakoon
Director
Research Unit
The Open University of Sri Lanka
Sri Lanka

Message From the Conference Co-Chairs

It is with great pleasure that we extend a warm welcome to all participants of the International Conference on Plastics and Environmental Sustainability (ICPES 2024), organized by the Centre for Environmental Studies & Sustainable Development (CESSD) at the Open University of Sri Lanka.

The theme chosen for this conference, "Pollution, Human Health, and Alternatives," resonates deeply with the challenges faced by our world today. With a vision to foster innovative and sustainable research for future development, we have convened this conference as a forum for the convergence of talent, knowledge, and dedication. We trust that this gathering will spark insightful ideas and facilitate the exchange of expertise among researchers, colleagues, and friends committed to global sustainable development.

The conference will delve into various sub-topics encompassing plastic and environmental sustainability, including Microplastics, Environmental Impacts of Plastics, Health Impacts of Plastics, Socio-Economic Impacts of Plastics, Plastic Waste Management, Plastic Production and Legal Aspects, and Alternatives for Plastics.

We hope that you will enjoy your time in the vibrant city of Colombo during the conference. On behalf of the conference co-chairs, we extend our sincere gratitude to our esteemed guests, keynote speakers, authors, members of the international advisory committee, members of the editorial committee, financial sponsors, and all those who have generously volunteered their time and efforts to ensure the success of this significant event.

Co-chairs

Prof. Ajith De Alwis	(University of Moratuwa, Sri Lanka)
Prof. Jagath Manatunge	(University of Moratuwa, Sri Lanka)
Prof. Terney Pradeep Kumara	(University of Ruhuna, Sri Lanka)
Prof. Rangika Bandara	(University of Kelaniya, Sri Lanka)

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GUEST OF HONOUR

International Collaboration and Large Networks are Needed to Combat Plastic Pollution

Plastics are valuable resources with numerous societal benefits. Worldwide plastics production reached about 367 million tonnes in 2021, a slight decrease of 0.3% compared to 2019 1. Despite the Covid-19 pandemic, global levels of production and demand for plastics remain stable, while Europe shows a decline due to the direct impact of the pandemic 1. It has been estimated that between 4.8 and 12.7 million tons of plastics enter the marine environment annually from land with rivers as main pathways 2,3, causing plastics to form a large proportion of marine litter. Marine litter is defined as any solid material that has been deliberately discarded or unintentionally lost on beaches, on shores, or at sea. The definition covers materials transported into the marine environment from land by rivers, draining or sewage systems, or winds. It also includes any persistent, manufactured, or processed solid material 4. A large part of this plastic litter consists of microplastics typically referring to 'synthetic water-insoluble polymers of 5 mm or less in any dimension' 5. Marine litter pollution is a global concern and monitoring programmes are an important tool to evaluate both the trends and the efficiency of reduction measures. In March 2022, heads of state, ministers of environment, and other representatives from UN member states endorsed a historic resolution to end plastic pollution and forge an international legally binding agreement by 2024. Now, more than ever, data and information, including periodic assessment and monitoring are required to support governments, institutions, and organisations of the progress of implementation of the global instrument. There is also a crucial need for robust and homogeneous data sets with internationally established methods or standards.

The UN sustainable development agenda includes targets to significantly reduce marine pollution of all kinds, including marine litter. The Sustainable Development Goal (SDG) indicator 14.1.1 “index of coastal eutrophication and floating plastic debris density” is a global indicator of marine pollution. Indicators are used to evaluate the marine litter pollution, and. At the European level, the Marine Strategy Framework Directive (MSFD, 2008/56/EC) is the main driver for monitoring of the marine environment to ensure that "properties of marine litter do not cause harm to the coastal and marine environment" and member states are required to report amounts, composition, spatial distribution, and the source of macro and micro-litter. The four European Regional Seas Conventions (OSPAR commission, HELCOM, Black Sea Commission and UNEP/ MAP Barcelona convention) have set indicators under their current monitoring programmes to evaluate marine litter to support policies and measure progress towards achieving good environmental status. However, different sampling approaches for macro and microplastics have hampered data collection and comparison and there are still relatively few monitoring datasets and assessments available to show time series with multiannual data at a national or regional level.

The absence of a globally accepted protocol for the detection and analysis of microplastics is also making comparison between datasets difficult. Microplastics are known to be

widespread in the marine environment and have been found in every marine niche investigated, from coastal zones to the open ocean and the deep-sea 6,7. Deep-sea sediments have also been suggested as a likely final sink for microplastics 8,9. While the abundance of microplastics in biota and surface waters only represent snapshots of the occurrence of microplastics in the environment, sediments on the seafloor could represent more stable matrices for the short to long term monitoring of microplastics in the marine environment. The use of harmonised, standardised protocols is a requisite to be able to produce robust and comparable data sets over time needed for national to regional assessments. A number of common indicators have already been adopted by the OSPAR commission to allow for consistent and comparable regional assessments of marine litter over time including beach litter, ingestion by the seabird species Fulmar, seabed litter and litter ingested by sea turtles. The OSPAR commission is currently developing a common indicator for microplastics for seafloor sediments including a series of recommendations for harmonised protocols for sample collection and microplastics extraction and quantification. The OSPAR Microplastic Expert Group (MPEG) has been set-up as a group of experts in the field of microplastic research. MPEG is currently composed of 19 members with participating contracting parties from the UK (England, Scotland, N. Ireland), Germany, Ireland, Denmark, Portugal, Belgium, Spain, France, Sweden, Norway, and the Netherlands. The main goal of MPEG is to share expertise and to work towards a proposal for a candidate indicator on micro-litter (including microplastics) in sediments. Further harmonisation, outside of the OSPAR maritime area, is also being carried out with regular updates from other working groups (HELCOM, AMAP and the EU-TGML) focusing on microplastics in environmental samples.

Infrastructure is often a limiting factor in microplastics research impacting the production of scientific outputs and monitoring data. International projects are therefore required to promote collaboration and development of national and regional scientific hubs. The Commonwealth Litter Programme and the Ocean Country Partnership Programme were developed to support Global South countries to take actions on plastics entering the oceans. An international laboratory network was developed to provide the infrastructure and in country capacity to conduct the collection and processing of microplastics in environmental samples. The laboratory network was also extended to include a network developed by the University of East Anglia, UK. All the laboratories were provided with similar equipment for the collection, processing, and analysis of microplastics in environmental samples. Harmonised protocols and training were also provided in country during laboratory setup to ensure comparability of quality-controlled outputs between laboratories. Such large networks are needed to produce global comparable baseline and monitoring assessments and to effectively measure the overall impacts of new policies or regulations.

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KEYNOTE ADDRESSES

Meet the New Plastic Alternative: Cellulose Nanomaterials

In a world desperately looking for alternatives to plastics to mitigate their negative environmental impacts, for many years we endeavored to develop alternative bio-based plastics that can be compostable so end-of-life concerns can be at least mitigated. However, the solution to the problem might indeed need a paradigm shift in our manufacturing processes where function would determine process. In other words, we have been interested in developing products that look, feel and function like plastics, can be processed like plastics but are also bio-based, recyclable and compostable, a combination that is hard to achieve if not impossible. What if we can have a material or a family of materials that look, feel and function like plastics, are bio-based, recyclable and compostable but cannot be processed like most plastics? The paradigm shift is indeed in the processing, and this is where most of the research and development in the future needs to happen. This talk will introduce cellulose nanomaterials as a viable alternative to plastics in coating and barrier applications. Combined with their excellent binder properties, these materials are set to contribute significantly to the packaging industry, more specifically the food packaging industry. The talk will review types and properties of cellulose nanomaterials, some current applications, and prospects as alternatives to plastics and will provide some pathways into the future.

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Status of Microplastic Pollution in Sri Lanka: Research Progress, Limitations, And Future Perspectives

Microplastics have been recognized as an emerging contaminant in terrestrial and aquatic environments due to their ubiquitous existence. Though global attention has been focused on assessing microplastic pollution in different environments, there is a lack of knowledge about this field in the Sri Lankan context. As per the Scopus records, about 20 studies have discussed microplastic pollution in Sri Lanka. The first study was conducted in 2018 evidencing the microplastic pollution in coastal beaches and waters in southern Sri Lanka. Most studies have focused on the spatial and temporal distribution of microplastic pollution in coastline ecosystems covering both surface water and beach sediments where the sampling hotspots were Southern and Western coastlines and lagoon environments in marine protected areas in Sri Lanka. The average abundance of microplastics in corals, water, and sediments in selected ten coral reef ecosystems in Sri Lanka were reported as 546.7 ± 170.3 items kg^{-1}, 9.8 ± 7.6 items m^{-3}, and 46.3 ± 29.7 items kg^{-1}. Atmospheric microplastic concentrations in indoor and outdoor air samples collected at selected areas were investigated and reported aso.13-0.93 and 0.00-0.23 particles m-3, respectively. Apart from these environmental samples, microplastic contamination in commercially available seafood in Sri Lanka was also studied revealing the potency of being indirect trophic transfer introducing seafood as a prime source of microplastics. Our focus on microplastic studies was based on the determination of microplastics in leachate, compost, beach sand, road dust, and river water and the vector transport of microplastic-bound coexisting contaminants. The average microplastic abundance was 14.0 ±1.9 particles kg-1 beach sediments of coastal line Kalutara among the samples studied in the western beach. Microplastics were reported high in municipal solid waste compost samples indicating agricultural soil contamination through application of MSW compost. The highest among more than 35 MSW compost samples was found in Nagoda whereas the lowest microplastic contamination was observed from Anuradhapura. Polyethylene was the most abundant microplastic type in leachate samples collected at different landfills in Sri Lanka. We assessed road dust samples adjacent to bus stops in Colombo 1-15 and the majority were tire-wear particles. The majority of microplastics extracted from the river water collected at the Kelani and Kalu rivers crossing bridges showed secondary origins from the breakdown of macroplastics. Further, recent studies on the transport of polyethylene microplastic-bound heavy metals; chromium and lead, and pharmaceuticals; ciprofloxacin, caffeine, and enrofloxacin revealed that aging properties promote the vector transportation of these co-existing contaminants whereas organic matter or detergent-mixed water enhance their migration. With the X-Press Pearl shipwreck incident, the local concern about microplastics was drastically increased. Most recent studies have been conducted to assess the unprecedented microplastic pollution from the X-Press Pearl ship accident that happened in 2021. These studies reported the plastic pellet pollution indexes in highly affected beaches, their characterization, and potential routes of their distribution. While various aspects of microplastic pollution have been investigated, there

remains a notable gap in research concerning microplastics and plasticizers in salt, drinking water, inland and brackish water environments, as well as in sea food. Additionally, studies on airborne microplastics are limited. Sri Lanka is a tropical country with strong sunshine and high rainfall which creates a better environment for plastic degradation, however, not many studies have focused their attention on the formation of secondary microplastics. Future research endeavors should prioritize addressing these knowledge gaps. Given Sri Lanka's status as an island nation, marine microplastic pollution poses a significant threat to the health and stability of coastal ecosystems. Therefore, it is imperative to comprehensively evaluate microplastic pollution levels, exposure pathways, and trophic transfer dynamics. However, the current infrastructure for microplastic pollution research in the country is still developing, and advanced laboratory facilities and instruments are lacking. Despite efforts by the Central Environmental Authority to reduce single-use plastics, their consumption continues to rise. Consequently, future research should not only investigate microplastic and plasticizer transport pathways to humans but also focus on strengthening public awareness and enforcing relevant legislation.

Keywords: Microplastics; Sri Lanka; X-Press Pearl; Degradation; Single use plastics

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Track 1
Microplastic

Global Trends in Microplastics: Insights, Impacts, and Strategies for Mitigation

We live in a “plastic-based” society and the presence of microplastics (MPs) in our environment is inevitable. The worldwide production of plastics exceeded 400 million metric tons in 2022 with 48% from Asia. In fact, as a consequence of the extensive production and employment of single-use products, which represent >40% of manufactured plastics and 250,000 tons of plastic litter are estimated to be floating in the oceans. Environmental plastic contamination derives from several factors, including mismanaged plastic waste, fishing nets in the sea, and different household and commercial activities, such as washing synthetic textiles, road markings, tires, marine coatings, personal care products, and plastic pellets.

MPs are divided into two categories according to their origin: primary MPs, which include pre-production pellets from manufacturing processes and microbeads from cleaning and personal care items, and secondary MPs, which come from the decomposition of larger plastic waste. Physical, chemical, and biological processes can cause plastic waste to degrade into minuscule MP particles. Plastics can be categorized based on size, shape, colour, and origin. Size is the criterion most frequently used to categorize plastic debris, with size classes typically attributed to the nomenclature of nano-, micro-, meso-, and macroplastics. Plastics with sizes in the nanometer scale (1–1000 nm) should be nanoplastics while the size range of 1µm-0.5 mm is called MPs.

The impact of plastic pollution through ingestion and entanglement of marine fauna, ranging from zooplankton to cetaceans, seabirds, and marine reptiles, is well documented. Research expeditions have reported MPs in air, water, sediment, polar ice, beach sand, and mountains including the most remote islands in the oceans, as well as in numerous marine species. MPs have the potential for ingestion and bioaccumulation within tissues of animals and the relatively large surface area of MPs increase the adsorption of waterborne organic pollutants such as PCBs, PBDEs, and PAHs, some of which are known reproductive toxicants and carcinogens due to their hydrophobic nature. Plastic can also adsorb metals and bacteria, sometimes at concentrations many times higher than their immediate surroundings. The MV X-Press Pearl disaster occurred on 20th May 2021 resulted in a spill of MP pellets in the coastal zone of Sri Lanka affecting the biota, environment, livelihood, and economy of the country. The spatio-temporal distribution and accumulation of these pellets might be affecting the Ocean for a long period of time.

The ubiquitous occurrence of MPs in the environment determines inevitable human exposure, mainly by three routes: ingestion, inhalation, and dermal contact. Among all of them, ingestion is considered the major route, with an estimated intake of 39 - 52 thousand MPs per person per year. Once internalized, MPs may pass across cell membranes and translocate to different body sites, triggering specific cellular mechanisms. MPs may pass across cell membranes, followed by accumulation or elimination by the onset of specific

cellular mechanisms. All these processes are mainly related to MPs' size, which cannot exceed 10–15 μm. Hence, the potential health impairment caused by the internalization and accumulation of MPs is of prime concern, as confirmed by numerous studies reporting evident toxic effects in various animal models, marine organisms, and human cell lines. Humans are exposed to MPs through the consumption of water, seafood, consumer products (clothes, toothpaste, salt, sugar, honey, beer, anything stored in plastic bottles, plastic wrap, or cans/cartons lined with plastic), and via inhalation from textiles, synthetic rubber tires, and plastic covers. MPs have been detected in human faeces, cirrhotic liver tissues, lungs, blood, and even breastmilk. A study indicated the average person ingests over5,800 particles of MPs from three sources of tap water, beer, and salt with the largest contribution by tap water (88%). In Sri Lanka, several studies have been conducted on the accumulation and characterization of MPs in coastal waters, habitats (mangroves, beaches, and marine protected areas), biota (seaweed, finfish and shellfish, dried fish), and non-livingresources (salt).

In order to minimize the negative impacts posed by plastic pollution (macro- and microplastics), a plethora of strategies has been developed at various levels to reduce and manage plastic waste. The waste management plan is required for campaigning through education, promotion, and outreach in the community. The banning of single-use items is necessary in the food industry, such as Styrofoam containers and disposable cups. Commercial bioplastics have been mainly used in packaging. Starch and polylactic acid (PLA) are the most manufactured bioplastics, most likely due to their lower costs. Biopolymer research has been trending in recent years and was chosen as one of the top ten emerging technologies of the year 2019. Research and innovation leading up to this have been ongoing over the last two decades. It is required to introduce advanced final-stage wastewater treatment technologies such as membrane bioreactor. The laundry machines are to be equipped with plastic filters which can also reduce the amount of fibrous plastics entering the environment. An approach to the plastic circular economy needs to be implemented which includes design for recyclability, developing tools to increase the demand for recycled materials, feedstock recycling solutions, and innovation and new business model. The littering behavior needs to be changed, especially in developing countries among consumers to reduce, reuse, recycle, refuse, and rethink to manage the problem of plastics pollution, particularly MPs. The Governments should effectively implement national and international laws and regulations and also formulate pro-environment policies with the active participation of the stakeholders to address the menace of plastic debris. The efforts of all the stakeholders (plastic industries, retailers, consumers, researchers, and governments) should be harmonized for the effective management of pollution by plastic debris.

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Exploring the Invisible Threat: Unveiling the Environmental Contamination of Microplastics

Plastics, synthetic polymers derived from petrochemicals, have become abundant in modern society due to their versatility, durability, and affordability. With applications spanning diverse industries including packaging, construction, healthcare, and electronics, plastics have revolutionized manufacturing and consumer goods. Plastic production and disposal represent critical facets of the contemporary industrial economy, profoundly influencing environmental sustainability and public health. Plastic production has surged exponentially since the mid-20th century, with annual production exceeding 360 million metric tons by some estimates. However, the disposal of plastic waste poses significant challenges, with inadequate waste management infrastructure, inefficient recycling systems, and limited public awareness exacerbating the problem.

Household waste generation represents a significant contributor to the proliferation of plastic pollution, driven by consumer lifestyles and consumption patterns. Further, the behaviour of supermarkets and customers plays a pivotal role in shaping the route of plastic pollution, with supermarkets serving as key influencers in product packaging and waste management practices. It was noted that a difference in polythene obtained from the supermarkets and the actual requirement of bags for customers in Kegalle. Further, another study revealed that the majority of them (47%) burn this waste polythene as a primary disposal method. Therefore, effective plastic waste disposal remains a challenge, withlimited consumer understanding of proper disposal methods and inadequate recycling infrastructures. Only a fraction of plastic waste is recycled, with a substantial portion ending up in landfills, incinerators, and natural environments such as oceans and waterways. The persistence of plastic waste in the environment, coupled with its fragmentation into microplastics, poses far-reaching ecological and human health risks.

Microplastics, defined as plastic particles with a diameter smaller than 5 millimetres, constitute a widespread and complicated environmental concern. It can originate from a multitude of sources across various human activities, infiltrating ecosystems worldwide. Primary sources include the fragmentation of larger plastic debris through mechanical forces like weathering, erosion, and UV radiation. Synthetic fibers shed from textiles during washing contribute significantly; with each laundry cycle releasing thousands of microfibers as our study recorded that 1kg of cloths can generate 336,833 microfibers per wash. Additionally, microplastics are prevalent in personal care products such as scrubs, skin creams, and toothpaste, where tiny plastic beads serve as abrasives, eventually washed down drains and into water bodies. Our study revealed that low-density polyethylene and ethylene-propylene copolymers were the dominant plastic types in selected cosmetics in Sri Lanka.

In addition, plastic pellets used in manufacturing, often escape into the environment during production, transport, and handling. Agricultural practices, including the use of plastic

mulches and microplastic-containing fertilizers, also contribute to the dispersion of these pervasive pollutants. Specially, microplastic contamination persists as a concerning issue within landfill compost, and the average amount of microplastics was recorded at 6550 ± 300 items/kg in the compost samples analysed in the western province of Sri Lanka. Further, landfill leachate contaminated with microplastics underscores the intricate challenge of addressing dual environmental hazards, combining the persistent threat of plastic pollution with toxic leaching compounds. The study revealed that leachate samples were contaminated with 926.66 ±55.07 items/m3 of microplastics.

These varied origins highlight the universal nature of microplastic pollution and contamination levels in the environment across various compartments with complex interactions of sources, transport methods, and environmental conditions. These originated microplastics from land sources represent a significant pathway for the transmission of plastic debris to oceans and beaches via river systems. It recorded ranged between 20.0 particles/m3 to 718 particles/m3 from the surface water of the Kelani River and the highest recorded from Sebastian Canal. Then these, riverine microplastics are mobilized and transported to estuaries and ultimately the open ocean, where they can become concentrated in coastal zones and marine environments. Western coast study recorded 72.0 particles/m3 to 400 particles/m3 from coastal waters and the highest recorded from Mattakkuliya. This land-to-sea transfer of microplastics poses ecological risks to aquatic life, as well as threats to coastal ecosystems as they are ingested by aquatic organisms, accumulate toxic pollutants, disrupt food webs, transport invasive species, and degrade habitats. Finally, microplastics can pose health risks to humans as they accumulate through food webs, potentially carrying harmful chemicals and disrupting hormonal balance upon ingestion.

Therefore, understanding the origins, routes, and implications of microplastic pollution is crucial for establishing targeted mitigation methods and enhancing sustainable management practices like developing strategies to reduce plastic production, improve waste management practices, and transition towards a circular economy model that prioritizes resource efficiency and waste reduction. Further, addressing the global plastic production and disposal challenges requires collaborative efforts among governments, industries, civil society organizations, and individuals to enact policies, promote innovation, and cultivate sustainable consumption habits that minimize the environmental footprint of plastic materials throughout their lifecycle to mitigate the environmental impact.

Keywords: microplastics, sources, contamination, impact, risk

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MICROPLASTIC POLLUTION IN MARINE ECOSYSTEM: A COMPREHENSIVE ASSESSMENT ON THE SOURCES, EFFECTS AND POTENTIAL REMEDIES IN JAFFNA DISTRICT

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Microplastics, as an evolving threat to our environment, are widespread, highly persistent, non-degradable, and toxic. Microplastics are pervasive and enter the environment due to their undifferentiating usage in various industrial productions like cleaning, cosmetics products, fertilizers, pharmaceuticals, and the weathering of large plastic materials. Further, microplastics have the potential to biomagnify along the food chain via ingestion, inhalation, and translocation and may also transfer into the human body. Moreover, microplastics can accommodate several contaminants onto their surface due to their high adsorption potential. Thereby, a critical study was conducted in 2023, aiming to realize and scrutinize the possible sources of microplastics and their proven effects on the marine ecosystem in Jaffna District. This study presents a comprehensive assessment of microplastics pollution in the marine ecosystem in Jaffna District, focusing on its sources, effects, and potential remedies. Through a combination of literature review, field surveys, direct observation of the coastal clean-up program, key informal interviews with relevant stakeholders and fishermen communities, and specimen analysis in the laboratory, the sources of microplastics in Jaffna District were identified as improper waste management practices, industrial effluents, and maritime activities. Based on the results obtained from the specimen analysis of selected dead fish samples of the fish population caught at Gurunagar, Kakkaitheevu, and Pannai coastal zones, it has been proven that around 5% of the 100 samples have tiny microplastics. It was revealed that polyethylene terephthalate (PET) bottles and abandoned fishing nets were the most abundant varieties of plastic observed in the coastal zone of Jaffna District, and they were discarded there mostly by fishermen communities. The mechanism of degradation and weathering has resulted in the accumulation of microplastics in the marine environment in Jaffna District. The study revealed impacts of microplastics such as ingestion by maritime organisms, bioaccumulation in food webs, and habitat degradation. Additionally, the potential pathways for human exposure to microplastics through seafood consumption were highlighted, suggesting the need for further research on the health implications. The massive efforts invested by relevant government organizations to clean the marine ecosystem to make it free of microplastics were not successful since the fishing communities were unaware of the adverse effects of microplastics on living organisms. Potential remedies include policy interventions, technological innovations for reducing microplastics emissions at source, improving waste management practices to minimize plastic leakage into the environment, and implementing policy measures to regulate the production and disposal of plastic products. Additionally, public awareness and education campaigns play a crucial role in fostering behavioral changes and promoting sustainable consumption patterns. The study further suggests strengthening community organizations to combat coastal zone pollution, enforcing the law in an efficient and unbiased way on polluters, and taking remedial measures simultaneously for the marine ecosystem to keep it free of polythene and plastic. Overall, this research provides valuable insights into the multifaceted issue of microplastics pollution in the marine ecosystem of Jaffna District and underscores the urgency of implementing holistic strategies to address this environmental challenge and safeguard both ecosystem health and human well-being.

Keywords: *Microplastics, Biomagnification, Marine ecosystem*

OCCURRENCE OF MICROPLASTICS IN COMMERCIALLY HARVESTED SHRIMP, *Penaeus monodon* CAPTURED FROM MADU GAGA ESTUARY, SRI LANKA

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Microplastics (MPs), plastic particles smaller than 5 mm, are environmental pollutants and have become an environmental threat. This study investigated the abundance of MPs in *Penaeus monodon* (Tiger Prawn) in Madu Gaga Estuary for the first time in Sri Lanka. Three shrimp traps (Jakotu) were selected from the river mouth to upstream, at a distance of 500 m from each other. Ten shrimp, three water samples (5 L), and three sediment samples (1 kg) from each site were collected. The gastro-intestinal tract (GIT), gills (GL), and hepatopancreas (HP) of the shrimp were acid digested separately to extract MPs. Sediment samples were density separated by air venting through a saturated $CaCl_2$ solution. Water samples were filtered over a 10 µm mesh and treated with 30% H_2O_2. The total MP abundance/shrimp from site 1 (70.22±11.28) was significantly higher than from sites 2 (52.90±11.64) and 3 (43.82±8.60). Microplastics abundance was significantly higher in GIT and GL than in the HP of shrimp. The abundance of MPs (MPs/L) in water from site 01 (15.60±1.64) was significantly higher than that at sites 2 (11.33±1.10) and 3 (11.00±1.06). MP abundance in sediment (MPs/kg) from site 1 (153.77±11.93) was significantly higher than at the other two sites. Results suggest site 1, near the river mouth, was the most polluted site by MPs. Fibers were the most abundant MP type at all sites. Black was the predominant color in fibers and fragments, but transparent particles were predominant in films. Small (<250 µm) MPs were significantly high in all samples. Polypropylene was the only polymer type identified with enough accuracy using FTIR analysis; however, the identification of other polymers could not be confirmed as the accuracy was low. So further studies are needed to identify the sources of MP. As P. *monodon* is a vulnerable organism to MPs, further research is needed to determine the consequences of human consumption of *P. monodon* captured from wild environments that are contaminated with microplastics.

Keywords: *Penaeus monodon, Microplastics, Madu Gaga, FTIR, Sediments, Water*

MICROPLASTIC CONTAMINATION IN THE CORAL REEF ENVIRONMENTS OF THE SOUTHERN AND WESTERN COASTS OF SRI LANKA

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Microplastic (MP) pollution has drawn more attention in the scientific community due to its impact on the environment and biota. Even though several studies have been conducted to assess the MP levels in the coastal environment in Sri Lanka, there is no recorded data for the severity of MP pollution in the marine environment. Therefore, we designed this study to assess the abundance, characteristics (size, shape, color), and spatial variation of MP and MP-induced Pollution Load Index (MP PLI) in the surface water (SW) and sediments (SS) in the Dondra, Polhena, Ahangama, Mirissa, Rumassala, and Port City coral reef environments. We used a stainless-steel metal scoop and an 80 µm mesh-sized plankton net to collect SS (depth<10m) and SW, respectively. We randomly collected six replicates for each sample category in each location from August to September 2023. We used the wet peroxidation method to separate MP in SW, while the density separation technique was used for SS. We observed isolated MP under a photomicroscope to identify MP characteristics. The FTIR technique determined the polymer composition of the isolated MP. The mean MP abundance of SW and SS was 23.42± 5.01 particles m^{-3} and 54.11±8.04 particles kg^{-1}, respectively. Port City recorded the highest MP levels in SW (29.69 ± 5.97 particles m^{-3}) and SS (84.00 ± 4.57 particles kg^{-1} dw). Blue microfibers (size<1 mm) were dominant in SW and SS in all sampling locations, suggesting fishing nets as a major MP source. Low-density polyethene was the prominent polymer type. There was no significant difference in MP abundance in SW among reef environments ($p > 0.05$), while MP abundance in SS was significantly different ($p < 0.05$). MP PLI was less than 10 for SW and SS in all reef environments, confirming low MP pollution levels (hazard level 1). This data will be helpful for MP pollution management in coral reef environments.

Keywords: *Coral reef environment, Microplastics, MP PLI, Surface sediment, Surface water*

STUDY ON MICROPLASTICS IN TWO DIFFERENT MUNICIPAL DUMPING SITES OF BATTICALOA LAGOON: EXTRACTION, ENUMERATION AND CHARACTERIZATION

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Microplastics have emerged as a significant global contaminant, notably affecting aquatic environments. Despite their undeniable presence, the understanding of microplastic pollution remains incomplete. This study aimed to thoroughly analyze and quantify microplastics at the Eravur and Kattankudy municipal dumping sites in Batticaloa Lagoon. Sampling involved the collection of water using one-liter buckets and sediment using an Ekman grab sampler. Density separation using a sodium chloride (NaCl) solution was employed, then the resultant floating solids underwent the wet peroxidation method, and finally a subsequent examination under a stereomicroscope was done. Microplastics recovered from this process were systematically classified according to size ranges such as <1 mm, 1-2 mm, and 2-4 mm, morphological characteristics according to film, fragment, filament, foam, pellet, microbeads, and color attributes like white, black, and transparent. Results highlighted significantly higher microplastic quantities in both sediment and surface water at Kattankudy stations compared to Eravur. Kattankudy sites showed 1638.80 ±71.70 items kg^{-1} in sediment and 1028.30 ± 73.70 items per liter in surface water. Statistical analyses underscored a significant difference in microplastic abundance among the sampled stations. Fragment-shaped particles dominated in sediments (~33%), while film types prevailed in surface water (~44%) at both sites. Sediments predominantly contained microplastics smaller than 1 mm, whereas larger particles (2-4 mm) were more prevalent in surface water. A diverse range of colors was observed in microplastics retrieved from both surface water and sediment, with approximately 51% white particles near the shore and roughly 72% transparent particles within the lagoon. Overall, this study provides conclusive evidence of microplastic pollution originating from municipal dumping and various human activities at both sample stations. Urgent action is imperative to implement precautionary measures aimed at mitigating this pollution.

Keywords: *Batticaloa lagoon, Density separation Microplastics, Pollution, Sediment, Surface water*

MICROPLASTIC CONTAMINATION IN SRI LANKAN UPLAND VEGETABLE CULTIVATION SYSTEM

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Microplastic pollution has emerged as a global environmental concern and a potential threat to the health of ecosystems and living organisms. Although substantial evidence exists regarding microplastic contamination in aquatic environments, limited attention has been given to terrestrial ecosystems. Therefore, this study aimed to assess the microplastic contamination level in the Sri Lankan upland vegetable cultivation system. Five fields were selected for soil sampling, where historical plastic mulch usage was reported: two locations at the Meewatura Experimental Station of the University of Peradeniya, the Gannoruwa Field Experimental Station, a Doragala farmland, and a Nuwara Eliya farmland. Soil samples were collected at two depth layers (0–5 cm and 5–10 cm) from five random points in each field using stainless steel hand shovels and stored in glass bottles to prevent further plastic contamination. Laboratory analysis covered general soil chemical and physical parameters, including moisture content, bulk density, texture, salinity, pH, EC, and TDS. The microplastic analysis involved soil digestion using H_2O_2 solution, followed by density separation with a NaCl solution to isolate microplastic particles. Microplastics were counted under a light microscope (×100) and captured images to record color, shape, and weight using an analytical balance. Results revealed that microplastic particle quantities ranged from 2,550±70.8 to 5,800±424 particles kg^{-1} of dry soil. The Nuwara Eliya farmland exhibited significantly higher microplastic levels due to the extensive use of agricultural plastics and manure, with no significant difference between depth layers. The Meewatura field predominantly contained fragment particles (50%–70%), probably due to thick HDPE mulches, while other fields had a higher presence of filament particles from woven polybags, threads, textiles, and nets. Black, transparent, and blue-colored microplastic particles were prevalent, surpassing colors like red, yellow, purple, and white. The identified plastic contamination levels were comparable to reported values in agricultural fields in other countries.

Keywords: *Microplastic, Soil contamination, Upland vegetable system*

AVAILABILITY OF MICROPLASTICS AND HEAVY METALS IN PERSONAL CARE AND COSMETIC PRODUCTS IN SRI LANKA

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Personal care and cosmetic products could be identified as significant sources of microplastic emission and heavy metal-related health impacts. Government policies and regulations play a huge role in managing such impacts. However, in the Sri Lankan context, the lack of baseline studies to support developing efficient policies is largely problematic. In this present study, 15 highly utilized personal care and cosmetic product brands were evaluated for the availability of microplastics and heavy metals. To extract microplastics, each product was digested using the Fenton reagent and extracted microplastics were then screened using Nile Red staining. If the stained particles showed luminance properties under UV light, such particles were suspected as microplastics. To confirm the chemical composition of extracted particles FT-IR spectroscopy was done. Out of the 15 brands 6 brands had microplastics and low-density polyethylene and ethylene-propylene copolymer were the dominant plastic types. In brand, FS-01, 3.3 g/product, and FW-03, 0.15 g/product of isolatable microplastics were found and most microplastics were white-colored and irregularly shaped with sizes ranging from 80-600 µm. To analyze the metals, 0.200 ± 0.001 g of sample was digested in 4 ml Aqua Regia solution and diluted up to 100 mL. Then ICP-MS spectroscopy was used to find concentrations of metals available. Metal analysis of the products revealed that toxic metals such as Cr (0.15 – 1.67 mg/kg), Cd (0.04 -0.19 mg/kg), As (0.02 – 0.15 mg/kg), and Pb (0.06 – 2.86 mg/kg) were present in many products. Since most of these products are down the drain products, ultimately these contaminants will end up in the natural environment. As this study provides detailed insights into the availability of microplastics and heavy metals in personal care and cosmetic products the study results could be used as baseline research for comprehensive future studies and policy development.

Keywords: *Microbeads, Heavy metals, Microplastics, Cosmetics, Personal care products*

PRELIMINARY ASSESSMENT OF MICROPLASTIC POLLUTION IN HAMILTON CANAL, SRI LANKA

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Hamilton Canal, commonly known as the Dutch Canal, is one of the highly polluted man-made canals in Sri Lanka. Plastic pollution due to the increasing anthropogenic pressure in the area could be identified as one of the main reasons for this. As this canal connects directly to the Kelani River estuary, most of the pollutants that are carried out by the canal directly emit into the ocean. Most of these plastics undergo photo-degradation and mechanical fragmentation, creating secondary microplastic (MP) pollution. Therefore, this study assesses the MP pollution level of the Hamilton Canal, where the sampling was carried out in June 2021. Six sampling locations along the Hamilton Canal were chosen for MP assessment, and 110 liters of surface water from each site was filtered through a 300 µm net. Then the filtrate was oven-dried (400 °C) for complete water evaporation and digested with Fenton reagent. Next, the digested samples were density-separated (using NaCl), and MP was extracted. Finally, the morphological characterization of the extracted particles was determined by using a stereo microscope. The present study found 175 MPs in all six sampling sites. Among these, site 01 (estuary mouth) had the highest abundance of MPs with a concentration of 4.81 MPs/L, while site 05 (upstream) had the lowest with a concentration of 0.72 MPs/L. Morphological characterization of the extracted MPs revealed the physical types of filaments, films, and fragments. Filaments had the highest abundance and fragments the lowest. Furthermore, the colors of the MPs observed, and their quantity varied as blue>white/transparent>red>green>other colors. As this study found larger concentrations of MPs in most of the sampling sites in the canal, it demonstrates the severity of the MP pollution in the Hamilton Canal. To manage this problem, strict regulations should be implemented, and more scientific studies should be done.

Keywords: *Hamilton Canal, Microplastics, Pollution, Preliminary study*

SPATIAL DISTRIBUTION OF MICROPLASTICS IN DIFFERENT LAND USE–LAND COVER (LULC) TYPES IN GARANDUWA TOURISTIC AREA, SOUTHERN COAST OF SRI LANKA

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The increased utilization of plastics and improper management of plastic waste result in the persistence of plastics as microplastics (MPs) in aquatic and terrestrial ecosystems, posing an emerging threat to all living things. Although MP contents in Garanduwa Lagoon have been studied, MP contents in adjacent land use land cover (LULC) types were not studied to a greater extent, which is worthwhile in managing MP waste. Therefore, this study focused on studying MP distribution in the different LULCs of the Garanduwa touristic area and adjacent areas of the Garanduwa Lagoon. A 300 m outside buffer was created to demarcate the buffer zone of the lagoon. Five different LULC types could be identified inside the buffer zone: beaches, mangroves, cultivations, settlements, and terrestrial vegetation. The sampling method was stratified random sampling. Soil samples were collected from 10 cm × 10 cm quadrats, considering fifteen random points for each LULC class. MPs were identified using the OptikaISview software by Stereomicroscope. The results were statistically tested using the Kruskal-Wallis test. High amounts of MPs were observed in all LULCs in the buffer zone, indicating that all the LULCs in the buffer zone were significantly contaminated with MPs ($p<0.05$). The mean concentration of MP in buffer zone soil was 1844 ± 262 particles/m^2, with high concentrations being observed in beach and mangrove LULC classes. The observed shapes were filaments, fragments, films, pellets, and foams. Filaments, fragments, and films were reported at significantly different distributions ($p<0.05$) being the main contributors to MP pollution in the study area. According to the results, the most prevalent shape of MP was filaments, and the most common color was black. Both primary and secondary MP pollution was reported in the adjacent LULC soil, and it is recommended to implement sustainable microplastic management at the earliest possible time.

Keywords: *Buffer zone, Garanduwa Lagoon, Terrestrial*

ANALYSIS OF CURRENT STATUS OF MICROPLASTIC POLLUTION IN SURFACE WATERS AND REMOVAL POTENTIAL USING CONVENTIONAL WATER TREATMENT PROCESSES: A CASE STUDY IN ATTANAGALU OYA, SRI LANKA

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Microplastics (MPs) have drawn increasing attention as an emerging water pollutant around the globe over the past decade. Microplastics are typically defined as plastic particles ranging from 0.1 µm to 5 mm. Also, MPs are increasingly acknowledged as a newly identified contaminant that finds its way into drinking water treatment facilities. This study aimed to assess the current status of MPs contamination in Attanagalu Oya, which is one of the major receiving water bodies that contributes to the drinking water supply in the Western Province of Sri Lanka, and to assess MPs removal efficiency in conventional drinking water treatment processes. Water samples were collected from the raw water intake and various treatment stages in a drinking water treatment plant served by Attanagalu Oya, encompassing the settling tank, rapid sand filter, and clear water tank. Additionally, samples were collected from two upstream sites of the Attanagalu Oya, which include the Kotugoda bridge and the Bolanda Anicut. Samples were collected during four days, meticulously following a precise procedure, with approximately 1.5 liters of sample obtained per sampling stage. MPs analysis followed NOAA Marine Debris Program guidelines. The research findings revealed that the presence of MPs in the raw water source at concentrations ranging from 2.4 mg/L to 9.4 mg/L. Notably, conventional drinking water treatment processes implemented at the water treatment plant effectively removed 80%–90% of MPs from the raw water. This study also revealed that although MPs concentration is decreasing during conventional treatment processes, a residual amount of MPs persists in the treated water, ranging from 0.3 mg/L to 1.2 mg/L. This emphasizes the need for further investigation into the behavior of MPs during the treatment process.

Keywords: *Microplastics, Drinking water treatment, Removal efficiencies*

MICROPLASTIC POLLUTION IN SRI LANKA: CURRENT RESEARCH INSIGHTS AND GLOBAL PERSPECTIVES ON MITIGATION STRATEGIES

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Microplastic (MP) pollution poses a significant challenge in Sri Lanka (SL), driven by a 16% annual increase in plastic consumption, amounting to approximately 265,000 tons annually. A comprehensive study explores MP pollution in the country through an analysis of plastic life cycles, a systematic review of local MP research, and an examination of global and national MP regulation policies. A systematic literature review identified 20 relevant papers published between 2018 and 2023, with 11 peer-reviewed papers selected for analysis. Research on MP pollution in SL has surged in recent years, particularly after the X-Press Pearl disaster in 2021. Results indicate widespread MP pollution, primarily originating from global plastic usage and exacerbated by the COVID-19 pandemic. Common plastics like polyethylene, polyethylene terephthalate, and polypropylene contribute to pollution and are sourced from personal care products, synthetic textiles, and single-use items. Research on MP pollution in SL is predominantly focused on marine environments (73%) and products (27%), with a significant portion of studies (64%) published in the Marine Pollution Bulletin highlights positive trends in data sharing (73% of articles), but underscores the need for more comprehensive data sharing practices to facilitate scientific progress and informed policymaking as challenges persist, emphasizing the need for greater transparency and accessibility of research data. In SL, research on MP pollution is limited, with only five studies offering mitigation recommendations. Current policies focus on macroplastic pollution, lacking attention to MP due to limited evidence. Global efforts suggest that policy instruments like bans, taxes, and incentives are effective but face implementation challenges. To tackle MP pollution, SL requires data management, production regulations, packaging controls, user regulations, and awareness campaigns. The recommendations of this study aim to reduce plastic usage, promote alternatives, and ensure effective implementation. Evidence-based policies are crucial to combat MP pollution effectively in SL, emphasizing the importance of informed decision-making.

Keywords: *Microplastic pollution, Plastic life cycle, Risk factors, Policy, Data sharing*

MICROPLASTICS IN THE AIR: UNVEILING THE GLOBAL CLIMATE IMPACT AND HEALTH CONCERNS: A SYSTEMATIC REVIEW

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Microplastics, originating from plastic waste, act like aerosols, scattering and absorbing sunlight globally. Their diverse polymers and additives complicate climate assessment. Airborne microplastics persistently increase, raising challenges in understanding their climatic impact due to their unique composition and continued proliferation. Hence, a thorough, systematic review of the primary research was conducted to provide insights into the concerns associated with microplastics contamination. The process of article screening was executed by adopting search keywords such as “microplastics contamination,” “climate change,” “airborne microplastics," and "health risks" using the Web of Science database for 100 research articles. Exclusively considered were 20 peer-reviewed articles published in English from 2018 to 2023 for analysis. Content analysis and thematic analysis were employed to analyze the data. The findings of the study indicate that microplastics generate a slight cooling effect, with variable impacts based on geographical concentrations. Also, the hotspots for land deposition of airborne microplastics have been identified in regions including the United States, Europe, the Middle East, India, and Eastern Asia, with subsequent findings indicating regular presence in the Pacific Ocean, Mediterranean, and coastal waters of Southern Australia. Although global greenhouse gas-induced warming remains dominant, microplastics may induce localized warming or cooling. Regarding human health, inhaling microplastics poses uncertain respiratory risks, prompting concerns about potential health issues. Moreover, microplastics accumulate in water bodies, contaminating food and water sources, with implications for long-term health. Addressing these complex challenges necessitates comprehensive studies assessing ecological and human health impacts, considering microplastics' role as potential vectors for harmful substances and their interactions with other pollutants. In conclusion, the presence of airborne microplastics raises significant concerns for human health, underscoring the urgency of addressing this emerging environmental and public health issue.

Keywords: *Airborne microplastics, Climate change, Ecological and human health risks, Microplastics contamination*

CHARACTERIZATION AND QUANTIFICATION OF MICROPLASTICS IN COMPOST SAMPLES IN SELECTED COMPOST SITES IN THE WESTERN PROVINCE, SRI LANKA

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Microplastics (MPs), small plastic particles measuring less than 5 millimeters, have garnered significant attention in aquatic ecosystems, yet their presence and impact in soil environments remain relatively understudied. Compost can significantly improve soil quality by enhancing its structure, increasing nutrient content, and promoting beneficial microbial activity. However, compost may pose a risk of soil contamination with microplastics if derived from solid waste dumping sites. Therefore, the present study aimed to determine the contamination of microplastics in composts derived from five composting sites (Karadiyana dumping site, Kotikawatta pradehshiya sabha, Seetawakapura urban council, Kaduwela municipal council, and Seetawaka pradeshiya sabha) in the western province of Sri Lanka. Compost samples were digested with Fenton regent and density separated using a saturated sodium chloride solution in the laboratory. Subsequently, samples were filtered through 0.45µm membrane filters and observed for microplastics using a stereo microscope (x40 magnification). Enumerations of microplastics were performed for color and types. To confirm the chemical compositions of the extracted particles, FT-IR spectroscopy was done. Results revealed that the contamination of the average amount of microplastics in the compost samples was high (4150±300.2 items/kg), and all the samples were contaminated with MPs. The highest contamination wasobserved in the Karadiyana sample (2750±195.6 particles/kg), and the lowest contamination was recorded from Kaduwela municipal council (330±28.8 particles/kg). According to the types of MPs, filaments, and fragments were highly recorded (3450±851.9 items/kg and 700±42.4 items/kg, respectively), and blue color was the most dominant MP color found among these particles (2820±834.4 items/kg). Polypropylene (PP) was the dominant polymer of detected MPs from different samples. Polystyrene (PS), Low-Density Polyethylene (LDPE), and Polyethylene (PE) were the mostcommon polymer types found in sites. Thus, the municipal solid waste compost was a significant source of microplastics, which can contaminate agricultural soil. Therefore, it's important to take the necessary actions to reduce MP contamination at compost sites.

Keywords: *Microplastics, Compost, Western Province, Abundance, Colors and types*

CHARACTERIZING MICROPLASTICS IN SEA WATERS AND SANDY BEACH ENVIRONMENTS: INSIGHTS OF MICROPLASTIC POLLUTION IN SOUTH ASIA

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Microplastics (MP), ubiquitous environmental pollutants, pose a growing threat to marine ecosystems and microplastic pollution has emerged as a critical environmental concern, especially in the South Asian region. Beach sand and seawater act as crucial reservoirs of MP pollution. This comprehensive review was conducted in South Asia between 2021 and 2024, critically evaluating methodologies and results concerning microplastic presence, abundance, and distribution in these environments. The selection of research papers employed keywords such as "microplastics," "pollution," "beach sand," and "seawater" in the Google Scholar search engine. Analysis was conducted on thirty research papers, extracting results related to the abundance and characterization of microplastics in both seawater and beach sand. Findings revealed significant variations in MP abundance and distribution across beaches in South Asia. In Sri Lanka, India, Pakistan, and Bangladesh, the abundance of MPs in beach sand ranges from 73.379 to 139.621 pieces/m², 90.28 to 131.52 pieces/kg, 57.40 to 129.35 pieces/kg, and 41.00 to 140.60 pieces/m², respectively. Inseawater, MP abundance varies from 14.10 to 20.80 pieces/m³, 28.68 to 48.86 pieces/m³, 73.5 to 102.5 pieces/m³, and 0.021 to 0.023 pieces/m² for the same countries. The most common shapes of MP in beach sand and seawater are fibers (43.7%) and fragments (22.5%). The predominant coloursof the MP are blue (21.4%), white (15.8%), and transparent (12.9%). The most common polymer types of MP are Polyethylene (PE) (25.6%), Polypropylene (PP) (17.9%), and Polystyrene (PS) (7.1%). The MP abundance is higher in beach sand than in seawater and it may be due tosedimentation as it allows MP accumulation and longer persistence than in seawater. This review emphasizes the abundance and characterization of MP in beach sand and seawater and pinpoints theneed for standardized methodologies across all stages of MP identification that would enable data comparability among various studies. Furthermore, this review highlights the importance of addressing regional variations and bridging existing research gaps to inform effective policy formulation and sustainable management of marine ecosystems in South Asia.

Keywords: *Beach sand, Microplastics (MP), Microplastic characterization, Microplastic distribution, Sea water, South Asia*

CONTAMINATION AND BIOACCUMULATION OF MICROPLASTICS IN SHRIMP: A COMPREHENSIVE REVIEW

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Microplastics, which are smaller than 5 mm, have become a widespread pollutant that results in risks to organisms as well as to the ecological processes of the environment. Due to their small size and specific shapes, they can be easily ingested into the organisms and can be subjected to trophic transfer, spreading microplastics throughout the food chain. By being benthic and scavenging organisms, both marine and fresh-water shrimps are susceptible to microplastic ingestion. Microplastics can enter the human body directly through the consumption of shrimp and indirectly through the consumption of other aquatic organisms at higher tropic levels, increasing the potential health risks to humans. However, there is a limited understanding and a lack of risk assessment about the bioaccumulation and biomagnification of microplastics in shrimp. This review aims to identify the different shrimp species that were subjected to microplastic contamination and to determine the abundance, physical, and polymer characteristics of microplastics. The article screening process was conducted by considering the peer-reviewed research articles related to microplastics published from 2018–2023, using the "Google Scholar" academic search engine with the keywords "microplastics," "pollution," "shrimps," "aquaculture," and "trophic transfer". For the final data analysis, a total of 20articles related to microplastic contamination in shrimp were obtained from the manual screening process, considering "shrimps," "microplastic pollution," and "bioaccumulation" as key inclusion words and "fish," "molluscs," and "other marine organisms" as key exclusion words. *Litopenaeus vannamei*, *Penaeus monodon*, *Penaeus semisulcatus*, and *Macrobrachium rosenbergii* are the most tested shrimp species. Out of the screened literature, 100% have tested the gastrointestinal tract for microplastic contamination. Thirty percent (30%) of them considered only the gastrointestinal tract; 20% considered tissues with the gastrointestinal tract; and most of the rest considered different combinations of the gastrointestinal tract, gills, and exoskeleton. Eighty percent (80%) of the results show that fiber is the most abundant type. Out of the selected research papers, 80% measured the microplastic abundance as items/g, which gives approximately a range of 0.02±0.01 items/g to 7050± 4178 items/g. Oxidative stress, cytotoxicity, and metabolic disorders are common health risks associated with microplastic contamination. Proper long-term monitoring, the implementation of proper measures, and conducting risk assessments are important to mitigate the adverse effects of microplastic contamination.

Keywords: *Bioaccumulation, Microplastics, Shrimp*

IMPACT OF COMMUNITY-DRIVEN PLASTIC CLEANUP ON MITIGATING SEA SURFACE TEMPERATURE: A REVIEW

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Sea surface temperatures may be rising as a result of small plastic particles that are discovered near the coast and are linked to the ocean's increased absorption of solar heat. The potential of community-driven plastic cleanup programs is evaluated in this review against the rising sea surface temperature. The primary objectives of this review are (a) to investigate the relationship between microplastic pollution and sea surface temperature and (b) to evaluate the applicability of community-driven plastic cleanup programs to mitigating sea surface temperature. This review considered 30 peer-reviewed articles published between 2013 and 2023. English-language articles published in GeoRef were shortlisted using the keywords “microplastic,” “marine environment,” “mitigation,” “temperature rising,” and “plastic cleanup.” Selected articles were then critically evaluated. According to the findings, plastic waste has been found in different marine habitats, from coastlines to the open ocean. The dark colors of many microplastics allow them to absorb more solar radiation, potentially elevating surface temperatures in areas where they accumulate, But the quantitative impact of microplastics on large-scale sea surface temperatures remains unclear due to the limited research conducted so far. A recent study revealed a synergistic effect between microplastics and elevated seawater temperatures, which decreased the growth of *Paracentrotus lividus* larvae and altered their development. Such discoveries reinforce the urgent need to address plastic pollution. However, the examined studies have not evaluated the effectiveness of community-driven plastic cleanup programs on mitigating sea surface temperature but have suggested a potential impact of microplastics on rising water temperatures. Therefore, this review identifies the importance of future research to quantitatively evaluate the influence of such programs on mitigating sea surface temperature.

Keywords: *Community-driven, Climate change, Marine habitat, Microplastics, Mitigation*

MICROPLASTICS IN AQUATIC ECOSYSTEMS OF NEGOMBO, SRI LANKA: A SYNTHESIS OF EXISTING KNOWLEDGE

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Microplastics (MPs) (<5mm) are ubiquitous pollutants found in both marine and freshwater ecosystems. The aim of this study is to provide an overview of the abundance and diversity of microplastics in seafood, water, sand, and sediments in the nearby aquatic ecosystems in Negombo. The study also intends to assess the degree of MP awareness in the Negombo local communities. This was achievedby synthesizing data from 12 research articles spanning from 2021 to 2024, available on Google Scholar, with microplastics in Negombo. They examined the potential of microplastic contaminationin common wild-caught seafood species and studied the gut and gills of finfish and shellfish, whichare important anatomical sites for the detection of MP in seafood. Alkali and acid digestion methods used to extract MP. fibrous, followed by fragments and filaments, are the predominant types found in the examined samples. MPs were mostly in blue, red, black, and brown colors. The main polymertypes that were found were polystyrene, propylene, polyethylene, and rayon. In addition to that, the degree of knowledge among fishermen and consumers in Negombo regarding microplastic contamination in seafood was observed, and they were aware of the risks of ingesting MP to humanhealth. MPs had gathered in specific regions of coastal lagoons or were transported to the sea, influenced by seasonal weather, hydrodynamics, human activities, and the type of microplastics. Thisreview of the literature provides a comprehensive summary of the present understanding of MPs in Negombo ecosystems. It attempts to inform future research directions and community-based initiatives to mitigate the pervasive influence of microplastics in this ecologically sensitive coastal environment by synthesizing diverse research perspectives.

Keywords: *Microplastics, Seafood, Negombo, Ecosystems, Abundance, Contamination*

ASSESSMENT ON MICROPLASTIC DISTRIBUTION OF MV X-PRESS PEARL SHIPWRECK IN HIGHLY AFFECTED SRI LANKAN COASTAL AREAS

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Microplastics (MPs) are ubiquitous in coastal environments. The sinking of cargo ship MV X-Press Pearl was the worst plastic pollution accident in history. During the present study the prevalence of microplastics was studied in MV X-Press Pearl ship wrack-affected coastal areas in North–Western and Western Provinces and Galle, Matara districts in Sri Lanka. The study areas are important because they represent the MV X-Press Pearl shipwreck highly affected area with more economic and environmental values of the coastal environment. Sampling was done monthly basis in November and December 2022. The extraction of microplastic process were done with the drying of sand samples, density separation using 1.5 g cm^{-3} $ZnCl_2$, digestion of samples using 10% KOH, and staining using Nile Red solution. Sarakkuwa sampling site recorded the highest microplastic distribution of 48400 (±1848) MPs particles/kg dry weight in December 2022 and Matara Beach Park recorded the lowest microplastic distribution of 1200 (±44) MPs particles/kg dry weight in November 2022. The study also found that the levels of microplastic pollution is varied over time. The study highlights the impact of both land-based and marine-based sources of plastic pollution oncoastal environments. The study also indicates that the beaches of Ulhitiyawa, Kalpitiya – Kandakuliya, Sarakkuwa, Mount Lavinia, Matara Beach Park, and Gurubabila showed an increase in microplastics distribution from November to December, possibly due to the degradation of plasticpellets released by the MV X-Press Pearl shipwreck. This suggests that microplastic contamination can increase gradually in the future and suggests that the MV X-Press Pearl shipwreck had a significant impact on microplastic pollution in the affected areas. Overall, these findings highlight the need for continued monitoring and research on microplastic distribution in coastal areas, as wellas efforts to reduce plastic pollution to mitigate the potential environmental and health impacts of microplastic contamination.

Keywords: *Microplastics, Shipwreck, Microplastics distribution, Coastal area, Pollution, MV X-Press Pearl Ship, Environment, Sources.*

KNOWLEDGE AND UNDERSTANDING OF PLASTIC AND MICROPLASTIC POLLUTION IN SRI LANKA – A QUALITATIVE ANALYSIS OF THE FIVE GROUPS OF PEOPLE IN SRI LANKA.

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Plastic has become an integral part of global consumption, and Sri Lanka is no exception, with its widespread use in the daily lives of its people. From households to workplaces, a multitude of items, whether entirely made of plastic or incorporating plastic components, are prevalent. The inherent qualities of plastics contribute to their popularity, driving the consistent demand for these items. However, despite the convenience and versatility of plastics, their detrimental impact on the entire ecosystem is no doubt. To foster a positive change, raising awareness and disseminating knowledge are paramount. This study aims to assess the knowledge and understanding of plastics and microplastics among Sri Lankans. A comprehensive questionnaire survey was conducted with representative samples from five distinct groups, reflecting the diverse population of Sri Lanka regarding their education and experience. These groups include Grade 10–13 students, Undergraduates, housewives, corporates, and labor workers. Two thousand two hundred and fifty participants took part in this survey, each contributing 450 individuals, ensuring fair representation across the nine provinces of Sri Lanka. The overall findings of the survey highlight that 63% of participants have zero understanding of plastic and microplastic issues. While an encouraging 93% of participants acknowledged that plastic is harmful to the environment, none of the participants were aware of plastic's harmful effects and the various pathways through which plastic pollution occurs. Only 25% of the participants understood that plastic can cause disasters like floods/climate change or issues like water pollution. However, that understanding is also not comprehensive and clear. 96% out of the total participants of the survey have not even heard of the word “microplastics”. Approximately 54% of participants demonstrated at least a partial understanding of the harmful consequences associated with burning plastic. Regrettably, the survey revealed a substantial lack of awareness among participants, with a staggering 95% demonstrating no understanding of the health implications of microplastics or hazardous chemicals embedded in plastics. Furthermore, respondents exhibited limited knowledge regarding the distribution, accumulation, and contamination pathways of microplastics. In conclusion, the study reveals the pressing need to elevate community knowledge and awareness of plastic. By fostering a deeper understanding of the detrimental effects of plastic and microplastics, aiming indirectly to curtail the adverse impact of plastic pollution.

Keywords: *Plastic, Microplastic, Pollution, Contamination, Issues, Awareness.*

ENHANCED ADSORPTION OF PHARMACEUTICALS INTO UV-AGED MICROPLASTICS IN HUMIC ACID-RICH WATER

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The effect of UV-aging of polyethylene microplastics (PE MPs) and the presence of humic acid (HA) species on the adsorptive-vector transport of pharmaceuticals: caffeine (CFN), enrofloxacin (ENF), and ciprofloxacin (CPX) in wastewater remain elusive. Hence, HA's influence on PE MPs' behavior in pharmaceutical adsorption was assessed in this study. The impact of aging was investigated by comparing the CFN (10 mgL^{-1}), ENF (5 mgL^{-1}), and CPX (5 mgL^{-1}) adsorption to pristine and UV-aged PE MPs (1 gL^{-1}) at different pH conditions (pH 2-9) in HA-mixed water (2.5 mgL^{-1}). Localized microcracks and O-containing functional groups were present in UV-aged MP than the pristine, as observed by scanning electron microscopy and Infrared spectroscopy. All tested pharmaceuticals demonstrated their highest adsorption within pH 6-8. The adsorption capacities of pristine MPs were less than those of aged MPs, proving that aging is a key influencing factor on pharmaceutical adsorption onto MPs except for ENF. The binding capacities of MPs for the ENF adsorption were not remarkably different with the introduction of HA while it showed an increase for CFN and CPX with 2.45 and 0.49 mgg^{-1} of average adsorption capacity, respectively. Further, CPX and CFN adsorption capacities were increased with increasing HA concentration from 0.5, 1.5, and 2.5mgL^{-1}, evidencing its role as an intermediate in the adsorption process. The postulated mechanism was multifaceted, where HA-bound MPs interacted with CFN and CPX via hydrophobic forces, hydrogen bonding, and electrostatic/nucleophilic/π-π interactions, indicating the existence of both physisorption and chemisorption. Consequently, UV-aged PE MPs are potential vehicles for transporting CFN and CPX in HA-rich aquatic environments where the adsorption is mainly influenced by solution pH. Investigations of kinetic and isotherm behavior of PE MPs for these pharmaceuticals in HA-mixed water are suggested for future studies.

Keywords: *Polyethylene, Organic matter, Chemisorption, Physisorption, Vector transport*

MICROPLASTIC CONTAMINATION IN URBAN ROADSIDE DUST OF COLOMBO CITY, SRI LANKA.

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Microplastic pollution in urban environments due to vehicular traffic and haphazard disposal of waste is a growing concern since their deposition on street food, respiration, and pollution of water sources via stormwater. Transfer of microplastics and associated contaminants to humans may cause inflammation, oxidative stress, antimicrobial resistance, and the transmission of pathogens. However, there is a lack of studies investigating microplastic pollution in the Sri Lankan Road environment. This study aims to identify and quantify microplastics in roadside dust in fifteen administrative divisions in Colombo City, Sri Lanka. Roadside-deposited dust samples were collected from randomly selected bus stops in the evening at each administrative division within a quadrant (1 m × 1 m) and triplicated to prepare 15 composite samples. Microplastics were extracted through density separation using saturated NaCl, followed by digestion using Fenton's reagent. The digested dust samples were sieved and subjected to further characterization using a digital microscope and Attenuated Total Reflection Fourier Transform Infrared (ATR-FTIR) spectroscopy. According to the results, all the tested samples were positive for microplastic contaminations. The average microplastic abundance was 214 particles/kg. The lowest abundance (60 particles/kg) was recorded for Colombo 02 and the highest abundance (400 particles/kg) was recorded for Colombo 09. Microplastics ranging from 0.5 to 2.0 mm in size were frequently found. The majority of the microplastics were black colour fragmented microplastics indicating the secondary origins from the breakdown of tire-wears. The FTIR spectra obtained from tire-wear particles with uniform physical appearance showed differences, revealing degradation and damage to the polymer chain. The findings highlight tire-wear particles as a remarkable source of microplastic pollution in road dust in Colombo City, laying the groundwork for further research. Implementing proper road maintenance practice, green infrastructure, bioretention ponds, proper tire maintenance and quality driving behaviors, can reduce tire-wear microplastics from road dust.

Keywords: *Fragments, Tire-wear particles, Urban pollution, Plastics, Roadside microplastics*

ASSESSMENT ON MICROPLASTICS CONTAMINATION IN TILAPIA (*Oreochromis niloticus*) COLLECTED FROM THE DEDURU OYA RESERVOIR, SRI LANKA

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Microplastics (MPs) pollution is a global concern. Freshwater aquatic systems are at risk from the accumulation of MPs through food webs. Tilapia is one of the major freshwater fish in Sri Lanka. This study aims to determine microplastic contamination in Tilapia (*Oreochromis niloticus*) collected from the Deduru Oya reservoir in Sri Lanka to derive insights into the environmental implications of MPs pollution. Fish samples (n=35) were randomly collected from the Deduru Oya reservoir and transported to the laboratory in ice. The GI tract was separated and digested using 10% KOH. Vacuum filtration was performed using Whatman GF/C filter paper (1.2 µm pore size) after density separation. Necessary precautions were followed to prevent contaminations at sample collection, preparation, and analysis. Microplastics were analyzed through a digital microscope and FTIR. The average weight of fish samples was 880.78 ± 367.60 g, the average GI track weight was 67.19 ± 22.73, and the mean length was 35.16 ± 5.16 cm. Results indicated that 82.85% of the fish had ingested MPs. Types of microplastics included fibers (90.82%) and fragments (8.25%). The most common color of microplastic was black (37.61%), and the least was transparent (14.67%). A 62.37% of ingested microplastics were between 0.5 – 1.0 mm. The polymers were identified as polyethylene (53.65%), polyvinyl chloride (12.19%), polyacrylate (9.75%), polystyrene (7.31%), polyurethane (2.43%), nylon (2.43%), and other (12.24%). Tilapia fish ingesting microplastics can accumulate tissue, posing risks to fish and potential human consumers as these particles migrate from their gastrointestinal tracts. The research findings revealed higher levels of microplastic contamination in the GI tract of Tilapia fish sourced from Deduru Oya, highlighting a potential health risk. It is recommended to continue the research for different freshwater bodies on the island and evaluate the microplastics in fish flesh.

Keywords: *Microplastics, Tilapia, Deduru Oya, Health risk, Pollution*

MICROPLASTICS IN DRINKING WATERS OF KELANI RIVER: A CASE STUDY FROM WESTERN PROVINCE OF SRI LANKA

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Microplastics contaminate a wide range of terrestrial, freshwater, and marine environments, and given the high population density and numerous industries in Western province, there is a heightened risk of microplastic contamination in water bodies in the province due to improper waste disposal. This study focuses on three selected Water Treatment Plants (WTP) that utilize the Kelani River as their water source with the primary objective of assessing changes in microplastic quantity and types before and after the treatment process. Water samples were collected from the intake of each WTP (Raw Water) and the treated water from the sump before distribution from November 2022 to April 2023. The samples were analyzed by Nile Red staining after organic matter digestion employing contamination control measures. Polymer types were identified using Attenuated Total Reflection Fourier transform Infrared (ATR-FTIR) spectroscopy. Microplastic abundance ranged from 3.25 to 10.25 particles/liter, and most downstream points always showed the highest number of particles, indicating higher contamination downstream. The treated water microplastics varied from 0.5 to 3 particles/liter with 82% highest removal efficiency. The fragments and fibers were more abundant in shapes than foams or films in raw and treated water. However, the percentage of fiber particles present was higher in treated water than in raw water, indicating a high length-width ratio, allowing them to pass through smaller pores than other shapes during the treatment process. High-density polyethylene (HDPE), low-density polyethylene (LDPE), styrene acrylonitrile (SAN), and polypropylene (PP) were identified as polymers present in the water samples. Microplastic contamination in WTP studies are not significant compared with the world scenario; however, the end user may get a higher amount of Microplastics than quantified during the transportation through PVC pipes.

Keywords: *Kelani River, Drinking water, Microplastic*

PRESENCE OF MICROPLASTIC IN LANDFILL LEACHATE OF THE KARADIYANA OPEN DUMP SITE

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Microplastics (MPs) are widespread in the environment, their occurrence has been reported in marine, freshwater, atmosphere, soil, and wastewater. There is no uncertainty that the effective method to eliminate microplastic pollution is to control and prevent plastics from entering the environment. Landfills and open dumps are examples, as they receive a considerable number of plastic wastes from industrial and household sectors and sludge from wastewater treatment plants. This study was focused on assessing the contamination level of microplastics in the landfill leachate of the Karadiyana Disposal Site and the surface water of Meda Ela and Weras River. The abundance and physical characteristics of microplastics were determined using standard methods. Leachate samples were analyzed and found that the total microplastic abundance was 926.66 ± 55.07 items/m^3. The most common shapes of MPs in leachate samples were fragments and filaments respectively. The most common colours of MPs in leachate samples were Blue, Black, Transparent, and White respectively. Surface water samples of Meda Ela and Weras River were analyzed and found that the total microplastic abundance is 860 ± 120 items/m^3 and 715 ± 21.21 items/m^3 respectively. The most common polymer type and shape of MPs in surface water samples of Meda Ela and Weras River were fragments and Filaments respectively. The most common colours of MPs in surface water samples of Meda Ela and Weras River were Transparent and Blue respectively. In the research, the water quality of Meda Ela and Weras River were investigated to assess the impact of the dumpsite on water quality deterioration. The electrical conductivity of surface water samples in Meda Ela and Weras River was recorded with a mean value of 280.31 ± 61.6 µS/cm and 189.72 ± 7.8 µS/cm respectively. The Total Dissolved Solids of surface water samples in Meda Ela and Weras River were recorded with a mean value of 342.75 ± 43.5 mg/L and 272.71 ± 40.6 mg/L respectively. Characterization of water samples revealed that the surface water sources around the dumping site has been deteriorated due to the leachate generation in the Karadiayana dumpsite and the study revealed that the Meda Ela has been more polluted than the Weras River. This study is preliminary evidence to confirm that Karadiyana garbage dumpsite is a sink of microplastics.

Keywords: *Plastic pollution, Microplastics (MPs), Karadiyana open dumpsite, Surface water, Landfill leachate.*

Track 2
Environmental Impacts of Plastics

Environmental Impacts of Plastics: A Global Perspective

Plastic is a synthetic material made from various organic polymers. It is composed of large molecules called polymers, which are made up of repeated units called monomers. These monomers are derived from natural resources such as crude oil, natural gas, coal, and plants. It is produced through a process called polymerization, where small molecules called monomers are chemically bonded together to form long chains called polymers. There are several methods of polymerization used in plastic production, such as addition polymerization, Condensation polymerization, Polymerization techniques, additives and fillers and processing. Overall, the plastic production involves a complex series of chemical reactions and processing steps to transform raw materials into the wide range of plastic products used in everyday life.

Plastics is known for its versatility, durability, and ease of shaping, which makes it suitable for a wide range of applications. It can be molded into various forms through processes such as injection molding, extrusion, and blow molding. Additionally, plastic can be manufactured to have different properties, such as flexibility, transparency, and resistance to chemicals or heat. Common types of plastics include polyethylene (PE), polypropylene (PP), polyvinyl chloride (PVC), polystyrene (PS), and polyethylene terephthalate (PET). Plastic products are ubiquitous in modern society and are used in industries ranging from packaging and construction to automotive and electronics. Plastics serves many important purposes in modern society and is used in a wide range of applications due to its versatility, durability, and cost-effectiveness. Some of the key areas where plastic is commonly used include packaging (e.g., food packaging, beverage bottles), construction (e.g., pipes, insulation), transportation (e.g., car parts, aerospace components), electronics (e.g., casings, wiring insulation), and healthcare (e.g., medical devices, packaging for pharmaceuticals).

Global plastic production

Production has grown significantly over the past few decades due to the widespread use of plastics in various industries and applications. According to data from industry reports and organizations such as Plastics Europe, the American Chemistry Council (ACC), and the Plastics Industry Association, global plastic production has been steadily increasing year over year. As of recent years, global plastic production is estimated to be over 350 million metric tons annually. Distribution of plastic production varies by region, with Asia accounting for the largest share of global plastic production. Countries such as China, the United States, and Europe are also significant producers of plastics. Factors driving the growth of global plastic production include population growth, urbanization, industrialization, and the versatility and cost-effectiveness of plastics in various applications. However, the environmental impacts associated with plastic production, use, and disposal, such as pollution, resource depletion, and climate change, have raised concerns and prompted calls for sustainable alternatives and better waste management practices.

Negative environmental impacts of Plastics

Plastic is often considered bad for several reasons, primarily due to its environmental impacts and potential health risks. Plastic pollution is a significant environmental problem worldwide. Improper disposal of plastic waste leads to littering of streets, waterways, and oceans, harming wildlife and ecosystems. Plastic debris can take hundreds of years to decompose, persisting in the environment for a long time. Globally, it is estimated that around 300 million metric tons of plastic waste are generated annually. This figure includes both post-consumer plastic waste (generated by households and businesses) and post-industrial plastic waste (generated during manufacturing processes). It is estimated that between 8 to 12 million metric tons of plastic waste enter the oceans annually, posing a significant threat to marine ecosystems, wildlife, and human health. Plastic pollution in oceans is a global environmental issue that requires urgent action to mitigate its impacts. Plastic waste generation varies by region, with high-income countries generally producing more plastic waste per capita than low- and middle-income countries. However, rapid economic growth and urbanization in developing countries have contributed to an increase in plastic waste generation in these regions. Packaging is the largest source of plastic waste, accounting for a significant portion of global plastic waste generation. Plastic pollution in oceans has become a critical issue, with millions of metric tons of plastic waste entering marine environments annually. This pollution harms marine life through ingestion, entanglement, and habitat destruction, leading to ecosystem disruption and biodiversity loss. Plastics degrade into smaller particles known as microplastics, which are pervasive in the environment and can be ingested by organisms throughout the food chain, potentially causing harm to marine life and humans. Microplastics have been found in water sources, soil, air, and even in food products, raising concerns about their impacts on ecosystems and human health. Plastics contain additives and may absorb and release harmful chemicals such as bisphenol A (BPA) and phthalates. These chemicals can leach into the environment, posing risks to wildlife and human health. Some of these chemicals are known to be endocrine disruptors and may have adverse effects on reproductive health and development. Plastics are derived from non-renewable fossil fuels such as crude oil and natural gas. The extractionand processing of these resources for plastic production contribute to environmental degradation, resource depletion, and greenhouse gas emissions. Plastic waste poses challenges for waste management systems worldwide. Inadequate infrastructure for recyclingand disposal leads to the accumulation of plastic waste in landfills, water bodies, and natural environments, contributing to environmental pollution and public health hazards. Plastic pollution imposes economic costs on communities, industries, and governments through clean-up efforts, damage to infrastructure, impacts on tourism and fisheries, and healthcare costs associated with plastic-related health issues and the production of plastic, particularly from fossil fuels, contributes to greenhouse gas emissions, contributing to climate change aswell.

Impacts of plastics on human health

Plastics can have various impacts on human health and well-being, both directly and indirectly. Certain chemicals found in plastics, such as bisphenol A (BPA) and phthalates, have been associated with adverse health effects, including reproductive disorders,

developmental abnormalities, and hormonal imbalances. Microplastics ingestion in humans is still being studied, there is evidence suggesting that microplastics may accumulate in the gastrointestinal tract and have the potential to transfer chemical contaminants and harmful pathogens. Plastic manufacturing facilities, waste incineration plants, and open burning of plastic waste can release toxic chemicals and greenhouse gases into the air, which can have adverse effects on human health, including respiratory problems, cardiovascular diseases, and cancer. Inadequate waste management practices, such as open dumping and burning of plastic waste, can release harmful pollutants into the environment, posing risks to human health and local communities.

Not only humans, all organisms are exposed and impacted from plastic nuisance. The majority of charismatic marine species such as whales, dolphins, turtles, sharks and are impacted. Such threats on whales and other marine species posing significant threats to their health and well-being. Ingestion, Entanglement, Habitat Degradation, Chemical Exposure, Behavioural Changes, and Long-term Population Impacts are some of them.

Possible solutions for the global plastic pollution problem

Addressing the global plastic problem, it requires a global understanding of the current crises, think, plan and act at the local and global levels. The major requirement is to go for a multi-faceted approach involving various stakeholders at local, national, and international levels. Reduce Single-Use Plastics, Promote Recycling and Circular Economy, Innovate and Develop Alternative Materials, Combat Plastic Pollution in Oceans, Educate and Raise Awareness, Policy and Regulation and Corporate Responsibility.

Sri Lanka has taken several commitments and measures to address plastic pollution. Sri Lanka has a National Policy on Solid Waste Management that aims to manage solid waste, including plastic, in an environmentally sustainable manner. The government has implemented bans on single-use plastics in various forms. Various organizations and communities in Sri Lanka have organized beach clean-up campaigns to remove plastic waste from coastal areas and raise awareness about the issue. Further, Sri Lanka has enacted legislation and regulations aimed at reducing plastic pollution. For instance, the National Environment Act provides a legal framework for environmental conservation and management, including measures to address plastic pollution. Expanding the government's commitments to the global level, Sri Lanka has participated in international forums and agreements related to plastic pollution, such as the United Nations Environment Assembly and the Basel Convention, which covers the transboundary movement of hazardous waste, including plastic waste.

Overall, addressing the plastic pollution problem requires a comprehensive and coordinated effort involving government, industry, civil society, and individuals to implement sustainable solutions and reduce the environmental impact of plastics.

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Trophic Transfer of Microplastics and Its Ecological Implications in Marine Ecosystems

Micro and nano plastics due to their small size are directly or indirectly bioavailable to a variety of taxa including zooplankton, marine invertebrates, fish, seabirds, and marine mammals, representing various trophic levels of the marine ecosystem. Direct ingestion of MPs occurs due to accidental consumption of particles through arbitrary feeding strategies, or even by active selection due to the misidentification of plastic particles for food by species such as bivalves, zooplankton, mussels, fishes, shrimps, oysters, copepods, lugworms, and whales, etc. Other than this form of direct ingestion, indirect ingestion can occur via trophic transfer from the contaminated prey.

In the zooplankton community, the prevalence of ingested microspheres was the highest in planktonic bivalve larvae, which filter microplankton from the water. Omnivores such as Mysid shrimps feeding on a collection of detritus, phytoplankton, and zooplankton can switch their feeding mode between unselective suspension feeding for smaller prey and highly selective raptorial feeding for larger prey. Filter and suspension feeders concentrate food from large water volumes and can therefore be expected to encounter the most MPs. This difference alone makes approximately 140 times more MP consumption in suspension feeders. Unfortunately, due to their small size, both benthic suspension and deposit feeders may accidentally or selectively ingest sinking and sedimentary microplastics.

Animals at higher trophic levels can be exposed to MPs indirectly as several experimental studies have shown. MPs can be transferred from blue mussels to shore crabs, from zooplankton to mysid shrimps and flatheaded minnow, and from Atlantic mackerel to grey seal, etc across marine food webs. Indirect exposure through prey might be an important pathway for predator MP intake, where individuals from a benthic fish species were found to ingest 8–11 times more MPs through contaminated prey than directly from water. Experimental exposure to MPs to study trophic transfer revealed evident transfer through the first and second trophic levels. The mean number of ingested MPs increased in relation to the length of the food chain. This ingestion rate was doubled in comparison to the direct ingestion from water. Likewise, the highest number of ingested microspheres in predators was found when exposed to pre-exposed prey. However, the efficiency of MPs uptake varies with the feeding mode of the animal as well as the size, abundance, and availability of the MPs in the environment.

Predators in aquatic environments can be exposed to microplastics (MPs) directly through water and indirectly through prey. Multiple exposure routes may include ingestion via water, sediments, and prey. Raptorial feeders who capture the prey using the jaws and teeth alone may be more likely to experience trophic transfer as the primary route of microplastic ingestion than through direct intake. Microplastics in the form of microfibres, beads, etc. were observed in the gastrointestinal tracts of numerous fish species such as *Aplodactylus*

punctatus, *Basilichthys australis*, European bass (*Dicentrarchus labrax*), Common goby (*Pomatoschistus microps*), Atlantic salmon, etc. Many studies have suggested that ingestion of MPs by fish occurs during suction feeding on biofilms while a significant percentage of studies suggest trophic transfer as a main route of MP contamination in fishes. Dynamics of MPs in the fishes indicate pelagic fish ingesting more MP particles and benthic fish ingesting more MP fibres.
It was revealed that ~463 million microplastics could be ingested by one striped dolphin (*Stenella coeruleoalba*) through the consumption of contaminated prey. Predatory birds representing the highest trophic levels of the marine food web confirm the trophic transfer of MPs. Pellets regurgitated by seagulls, great skuas (*Stercorarius skua*), and remains of Northern fulmars (*Fulmarus glacialis*) revealed a higher plastic prevalence, leading the researchers to conclude that plastic burden is related to prey type and is, therefore, a result of trophic transfer. Among the studies conducted on MP contamination in birds, the most notable study from Iceland serves as a baseline, suggesting anthropogenic activity as the prime cause of plastic ingestion by birds.

MP pollution and its trophic transfer are of grave ecological concern as they modify marine habitats and affect the overall health of individuals. Health implications associated with the MPs ingestion include physiological, behavioural, and immuno-toxicological alterations. The presence of microplastics in the gut lining of Daphnia sp. is known to prevent or inhibit the consumption of food. One study reported that Daphnia *spp.* egested microplastic beads at a higher rate than microplastic fibres and fibres have been found to twist in the gut of a dead Daphnia sp. Apart from accumulating toxins, microplastics also threaten micro fauna such as plankton. Oysters are also affected by microplastic debris. Particles may be ingested and accumulated by oysters, leading to physical effects. Acute exposure of *Pocillopora damicornis* to MPs lead to activation of stress response of these corals resulting in repression in its detoxification and immune functions. Moreover, another study suggested that microplastics disturb coral polyps either through direct or indirect interaction or by affecting photosynthesis as the MPs cover the surface of the corals.

Biomagnification and bioaccumulation of chemical contaminants, such as polychlorinated biphenyls (PCBs), organochlorine pesticides (OCPs), and persistent organic pollutants (POPs) are known to occur at higher trophic levels, particularly affecting marine top predators. Studies are needed to confirm whether a similar mechanism occurs for microplastics as well. In addition, the role of MP as a vector for various contaminants to transport spatially and tropically may lead to unexpected toxicity conditions. The large surface area to volume ratio of microplastics can lead to the adsorption and concentration of such hydrophobic toxicants. MPs are reported to absorb organic contaminants, such as DDT (dichlorodiphenyltrichloroethane), PAHs (Polycyclic aromatic hydrocarbons), PCBs (polychlorinated biphenyls), and chemical additives such as BPA, DPB (dibutyl phthalate). They also absorb heavy metals such as cadmium, copper, zinc, silver, mercury, nickel, and cobalt. A study conducted with a carnivorous fish species revealed an increase in mercury bioconcentration in gills and bioaccumulation in the liver. This may lead to potential health implications for humans as well. For example, seafood that is consumed whole, including GI tract, such as shellfish, has been found to contain microplastics. Further work is required to better understand the extent of exposure to and impacts of microplastic ingestion on humans.

Extensive research studies are needed to understand the food web dynamics of MPs in various ecosystem conditions and potential implications towards human health.

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PHYSICAL DEGRADABILITY OF LUNCH SHEETS IN COMPOSTING ENVIRONMENTS: A CASE STUDY ON POPULAR BRANDS IN THE SRI LANKAN MARKET

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Bio-based film products, formulated from a combination of corn, starch, poly lactic acid (PLA), and poly butylene adipate-co-terephthalate (PBAT), have emerged as environmentally friendly alternatives to traditional petroleum-based plastics. PLA, a biodegradable aliphatic polyester, exhibits superior attributes, including high mechanical strength, biodegradability, and transparency, making it a popular choice in various applications such as agricultural films, biomedical devices, and packaging materials. This study aims to fulfill the demand for extensive insights into the biodegradability of lunch sheets, with a specific focus on the Sri Lankan market, which has witnessed a notable surge in the utilization of biodegradable materials. The research, conducted at the premises of the Central Environmental Authority in Battaramulla, Sri Lanka, focused on three popular biodegradable lunch sheet brands and one non-biodegradable counterpart. The study employed bulk compost from the Karadiyana Compost yard as a medium, with plastic pots serving as controlled environments for degradation assessments. After careful preparation of materials and a controlled duration of observation, the results revealed that, after 30 days, all samples remained in their original state with no apparent signs of physical degradation. However, by the 60th day, biodegradable sample no. 2 exhibited fragmentation into large pieces, while the other samples retained their original form. Notably, after 120 days, samples no. 1 and 2 had almost completely degraded, with only minimal plastic particles observed. Surprisingly, after 180 days, sample no. 3, marketed as a biodegradable lunch sheet, and the control sample (no. 4) showed no signs of physical degradation. This discrepancy raises concerns about the authenticity of labeling, suggesting that some lunch sheet brands labeled as biodegradable may be composed of non-degradable materials, such as polyethylene. These findings emphasize the importance of rigorous testing and consumer awareness to ensure the credibility of environmentally labeled products in the market.

Key Words: *Lunch sheet, Polythene, Biodegradable, Market, Physical degradation*

ENVIRONMENTAL ISSUES STEMMING FROM PLASTIC WASTE: A CASE STUDY AT AMBALANMULLA DUMPSITE

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Plastic waste has emerged as a significant global environmental concern, with dumpsites evolving into focal points for various environmental issues stemming from plastic waste. Many of the dumpsites in Sri Lanka were established without undergoing prior environmental assessments. The Ambalanmulla dumpsite serves as the primary location for Katunayake-Seeduwa Urban Council waste disposal, situated in the ecologically sensitive Muthurajawela wetland neighboring Negombo lagoon. The study aimed at identifying environmental issues associated with plastic waste at the Ambalanmulla dumpsite and, thereby, proposing plastic waste management strategies to diminish its negative impacts. Primary data collection methods included interviews with Katunayake-Seaguwa Urban Council, the Western Province Waste Management Authority, fifty questionnaire surveys with the nearby residents, and visual observations within a 150-meter radius of the dumpsite. Satellite imagery and relevant literature constituted the secondary data sources, yielding both quantitative and qualitative insights for this research. The survey identified several environmental concerns that include insect proliferation (80%), threats to immigrant birds, flora, and fauna (18%), and the unsightly appearance (2%) caused by plastic waste. Furthermore, it was noted that leachate generation is anticipated to be more prevalent during the rainy seasons. Exacerbating concerns about the dumpsite's history of post-fire disasters, the burning of plastic has caused health issues and the formation of smog. Unfortunately, the measures taken by the authorities have become inadequate in addressing these challenges. For instance, compressing waste using dozers is impacting soil quality while contributing to groundwater contamination through the degradation of plastic waste. These substantial shortcomings in plastic waste management practices highlight the need for recommending strategies to reduce plastic waste production and effective management, such as implementing regulations, adhering to the principles of the 3R concept (Reduce, Reuse, Recycle), and Extended Producer Responsibility (EPR) procedures to proactively tackle future concerns related to the dump site.

Keywords: *Dumpsite, Environmental issues, Plastic waste, Effective waste management, Environmental sustainability*

BREAKING DOWN PLASTIC IMPACT: ENVIRONMENTAL CONSEQUENCES OF SINGLE-USE PLASTIC PRODUCTS (SUPPs) IN SRI LANKA

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For more than 50 years, plastic has been a ubiquitous commodity in every sector of our lives, including automobiles, construction, healthcare packaging, households, and many other applications. As a result of high urban population growth, unplanned urbanization, increased economic activities, and increased resource consumption, plastics account for a significant portion of the total inorganic content in municipal solid waste (MSW), and their generation rates are rapidly rising, especially in developing nations. In Sri Lanka, plastic utilization is expanding by 16% annually, and the country faces serious complications in handling MSW. It is estimated that single-use plastic products (SUPPs) contribute to around half of the plastic waste. To compare the environmental impacts of Sri Lanka's use of Single-Use Plastic Products (SUPPs), this study used a systematic literature review to identify the most significant consequences for the environment and the appropriate tools for evaluating those detrimental effects within the period of 2015–2019. This review revealed that out of the total plastic production, 40% accounts for SUPPs, and the recycling rate is only around 27%, resulting in a significant contribution to the emission of greenhouse gases by the mismanagement of plastic waste. A comparison of data with developed countries revealed that lack of specialized personnel, insufficient infrastructure for reusing and recovery, and a lack of verified statistics are the major contributing factors for the detrimental effects. The results of this study recommended that the global warming potential (GWP) and life cycle assessment (LCA) are effective tools for assessment. In conclusion, the lack of appropriate government policies and public commitment are major obstacles to effective remedial measures. This study further provides insights to policymakers, industrial stakeholders, and the scientific community regarding policy changes and adaptations on the national scale to create a resilient and sustainable future.

Keywords: *Municipal solid waste, Resilience, Sustainability, Policy*

EXPLORING FIBREGLASS POLLUTION IN SRI LANKA'S WESTERN HARBOURS: ENVIRONMENTAL IMPLICATIONS AND SOLUTIONS

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Harbour-related waste presents a significant global challenge due to its adverse effects on marine environments. Fibreglass, along with materials like Styrofoam, polythene, and PET bottles, contributes to this ecological threat. Fibreglass, known for its durable and non-biodegradable properties, raises particular concern as it can persist in the environment for extended periods, causing micro-plastic pollution and harming marine life. A study conducted in the western province of Sri Lanka's major harbours – Dikkowita, Beruwala, and Negombo – focused on quantifying fibreglass and other pollutants. The process involved placing 50×50 cm quadrats randomly on identified dumping sites to measure the quantity of each pollutant. Additionally, a social survey interviewed a total of 286 community members within a 5 km radius of the harbours to understand perceptions about the fate and impact of these materials on the environment. According to the results, there was no significant difference ($p<0.05$; One-way ANOVA test) in the amounts of fibreglass quantities among the three locations in the dumping areas. Negombo harbour had the highest mean fibreglass quantity of 0.626 kg±1.005 (Mean±SD), followed by Dikkowita (0.19 kg±0.2245) and Beruwala (0.118 kg±0.1134). This fibreglass waste primarily originates from scraps generated during boat repairs, which currently lack proper management protocols. The social survey conducted across all three locations revealed a common occurrence of open burning, evident through black smoke emissions in the harbour areas at various times. Notably, Negombo exhibited the most frequent instances of black smoke, primarily originating from privately owned boat repair centers. This trend persists due to the absence of effective recycling processes for fibreglass, resulting in its accumulation within harbour premises and ultimately leading to open burning. Given the toxicity of fibreglass fumes and its various adverse environmental impacts, urgent action is imperative to address this critical issue.

Keywords: *Fibreglass, Sri Lankan harbours, Marine pollution, Open burning, Environment impacts, Recycling*

EVALUATION OF MICROPLASTICS IN *Thunnus albacares* (YELLOWFIN TUNA) FROM THE COMMERCIAL CATCH IN SRI LANKA (LANDING SITES DICKOWITA, KALPITIYA, WENNAPPUWA)

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Thunnus albacares (Yellowfin Tuna) is an economically and ecologically important fish in Sri Lanka. Microplastic (MP) contamination is a significant threat to aquatic ecosystems, and it has a potential implication for human health. Understanding the ingestion of microplastics by *Thunnus albacares* is crucial for implementing effective management strategies for tuna fisheries, ensuring food security, economic stability, and the well-being of communities dependent on Yellowfin Tuna fisheries in Sri Lanka, as well as for the conservation of marine ecosystems. This study reveals the microplastic (MP) ingestion rate of the *Thunnus albacares* from the commercial catch in Sri Lanka. Randomly collected 35 fish samples from local commercial Yellowfin tuna catches from landing sites Dickowita, Kalpitiya, and Wennappuwa were studied. MPs in their gastrointestinal tracts (GITs) were extracted using a modified potassium hydroxide digestion protocol and filtered onto the Whatman glass fiber filters (~1µm). Extracted MPs were enumerated by colour, shape, and size under the digital stereomicroscope, and polymer type identification was performed using Fourier transform infrared (FTIR) spectroscopy. The average pieces of MPs were 2.77±1.84 items/individual, and the mean concentration was 0.29±0.016 items/g of GIT content. Fibers were the predominant shape (91%) followed by fragments (6%), while Polyethylene (56%) was the predominant type, followed by Nylon (25%). About half of the MPs were black, while white (1%) was the least. The particle size ranged from 0.054 mm to 4.17 mm. This research contributes to the broader discussion on marine plastic pollution and the importance of mitigating anthropogenic impacts on marine ecosystems.

Keywords: *Gastrointestinal tract, Ingestion, Marine pollution, Microplastics, Sri Lanka, Yellowfin tuna*

PRELIMINARY INVESTIGATION ON PLASTIC LITTER IN PAREIWELLA CORAL REEF TANGALLE, SRILANKA

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Coral reefs, covering less than 1% of Earth's surface, are highly diverse ecosystems crucial for coastal communities. However, the increase in coastal populations has led to a surge in macroplastics (MaPs), polluting this ecosystem. In Sri Lanka, the Pareiwella coral reef in Tangalle, among the few remaining pristine coral reefs, stands out as one of the most vulnerable due to its shallowness and exposure to local and foreign communities. This study, the first of its kind in the region, focuses on the presence of various MaPs (Polyethylene: PE, Polyamide: PA, Polycarbonate: PC, Polyvinyl Chloride: PVC, Polypropylene: PP, Polystyrene: PS, and Polyethylene Terephthalate: PET) comparing between offshore (near crest) and near shore (near to shoreline) and assessing it with the hard coral cover of Pareiwella coral reef to evaluate whether hard coral affects entangling MaPs. The research involved six transects laid perpendicular to the shoreline over the reef, representing 12 sites in both inshore and offshore areas, with measurements taken for coral and MaPs coverage in five quadrats at each site during the second inter-monsoon period (Oct-Nov). The study reveals that Nylon (PA), Monofilament (PE), and Polypropylene (PP) are the MaPs in the reef area. However, no significant differences were found in median values between inshore and offshore coverage (% MaPs m^{-2}) for Nylon ($p=0.810$), monofilament ($p=0.631$), and PP ($p=0.936$) based on Mann-WhitneyU Tests ($p>0.05$ in all cases). Moreover, multiple regression analysis indicates no significant relationship between inshore and offshore coral cover with MaPs cover. The study highlights the threats posed by fishing, waste disposal, and destructive fishing activities at the Tangalle coral reef. There is a pressing need to formulate and implement policies and regulations to protect this vital ecosystem against plastic pollution. These measures should address the identified issues, promoting sustainable practices and ensuring the long-term health and resilience of the Pareiwella coral reef and similarly vulnerable ecosystems in the region and globally.

Keywords: *Coral reef, Macroplastics, Tangalle, Pareiwella, Conservation*

QUANTIFICATION AND CHARACTERIZATION OF LOW-DENSITY MICROPLASTICS IN FARMLAND SOILS: A CASE STUDY FROM SRI LANKA

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Sri Lanka being an agricultural country with limited regulations for using plastic products and managing plastic waste, it is important to understand the level of microplastics (MPs) pollution in agricultural soils. Previous studies confirm that MPs, particles lower than 5 mm, are known to cause varying consequences on organisms. This study is designed to fill a critical knowledge gap about the status of MPs pollution in agricultural soils in Sri Lanka. Twenty surface soil samples (0–15 cm) were randomly collected from two farmer-managed vegetable fields in Nuwara Eliya (N'Eliya) and the Horticultural Crops Research and Development Institute (HORDI) in Gannoruwa. MPs particles (density lower than 1.00 g/mL) were isolated through filtration after chemically digesting organic matter and separating plastic larger than 5 mm using dry sieving. MPs were quantified, identified microscopically, and characterized using ATR-FTIR spectroscopy. The results were analyzed statistically using Minitab (Version 18.0) to compare the levels of MPs between sites. The total number of MPs was significantly higher in N'Eliya (208±18 particles/kg) than in HORDI (118±12 particles/kg). At HORDI, a higher proportion of MPs were noted as 'fibers' (~79%), followed by 'fragments' (~21%). In contrast, N'Eliya soils had more 'fragments' (~64%) than that of 'fibers' (~36%). In both N'Eliya and HORDI sites, MPs predominantly belonged to the size class less than 2 mm (~96% and ~99%, respectively). Most MPs were transparent and either black or white in colour. In terms of polymer types, most MPs are Polyethylene (PE) and Polypropylene (PP), while plastics larger than 5mm comprise Polymethyl methacrylate (PMMC) and PVC. The site-wise differences in terms of quantity and quality might be due to varying agricultural practices and implements used by the respective farmers. The results confirm that MPs pollution in agricultural soils in Sri Lanka is comparable with many other regional countries, except China. The findings highlight the importance of introducing tailored strategies to mitigate the potential impacts of MPs in agricultural soils and to implement strict regulatory measures to minimize the use of plastics.

Keywords: *Agricultural soils, Sri Lanka, Low-density microplastics, Fibers, Fragments, ATR-FTIR*

DEVELOPMENT OF A LOW-IMPACT PRODUCT MODEL FOR THE PRODUCTION OF PLASTIC TOOTHBRUSHES

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Life Cycle Assessment (LCA) is a widely recognized quantitative tool to evaluate the environmental impact of products and services across their entire life cycle stages. The main objective of this study was to analyze the environmental impact of the life cycle stages of a plastic toothbrush and develop a low-impact product model using the Design for Sustainability (D4S) concept. ISO14,040 and 14,044 LCA guidelines were followed, and a cradle-to-grave analysis was done for one year with the declared functional unit of one plastic toothbrush. A consumer survey questionnaire was distributed among a sample size of 150 to collect the required data and information, and LCA tool-based databases were adopted as research methods in this study. The SimaPro 9 Faculty Version was used as the tool for analyzing the life cycle impact, and the ReCiPe characterization method was used for the impact analysis of eighteen midpoint and three endpoint categories. The D4S model was developed based on the LCA results and a SWOT analysis carried out with internal and external industry experts. The results of the software were interpreted as models, graphs, and tables. The total normalized life cycle impact of one plastic toothbrush was 3.6087×10^{-4}, whereas the highly impacted life cycle stage was manufacturing. According to the ReCiPe characterization model, marine ecotoxicity, freshwater ecotoxicity, and human non-carcinogenic toxicity were the highly impacted midpoint categories, whereas human health was the most impacted endpoint category. The global warming potential of a plastic toothbrush throughout its life cycle was 0.1460902 $kgCO_{2eq}$. The D4S model resulted in four major strategies: selection of low-impact raw materials, optimization of production techniques, reduction of impact during use, and optimization of end-of-life systems. According to the results, it can be concluded that the quantified environmental impact of plastic toothbrushes can be reduced by following the four D4S model strategies.

Keywords: *Life cycle impact assessment, ReCiPe characterization model, Plastic toothbrush, D4S model, Environmental impact, Plastic pollution*

ESTIMATION OF MACRO AND MICROPLASTIC CONTAMINATION STATUS IN UDAPPUWA; NOTHERN BOUNDARY OF THE ANAWILUNDAWA RAMSAR WETLAND SANCTUARY

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Anavilundawa Ramsar Sanctuary (ARS) and its vicinity stand out as a distinctive land area that features coastal ecosystems such as mangroves and cascade reservoirs. Human activities near ARS affect the delicate balance of ecosystems, as the area has been very much in use economically for fisheries, aquaculture, and agriculture. Udappuwa, the northern boundary of the ARS, is exposed to various point or non-point effluent sources. The present study focused on the identification of both macro- and microplastic contamination status in the Northern boundary of ARS towards Udappuwa. Samples were collected from eight locations, including the mangrove restoration site within ARS, paddy fields, the Dutch Canal, and shrimp aquaculture farm outlets, in the last quarter of 2023. Macroplastic debris was collected following the standard OSPAR waste assessment protocol. For microplastic analysis, 20 L of water sieved through a 200 µm sieve were first subjected to digestion of organic matter (H_2O_2) followed by filtration (0.45 µm). Sediment samples (500 mL) were subjected to density separation, and the same procedure as for water was followed. Extracted microplastics were categorized into shape and color using a stereo-microscope. During the study period, the Dutch canal exhibited the highest total count of macro-plastic debris (242.50±57.28 pieces) and weight (2093.50±210.01 g), while the restoration site showed the lowest with 7.00±2.83 plastic pieces and 20.00±2.83 g of weight, respectively, in a 50 m^2 area. The highest microplastics in water were recorded in shrimp outlets (1.35±0.48 L^{-1}), while the lowest was in the mangrove restoration site (0.3±0.22 L^{-1}). The highest microplastics in sediments were recorded in shrimp outlets (39.33±19.63 L^{-1}) and the lowest in paddy fields (12±10.58 L^{-1}). Filaments were the predominant microplastic shape (54.18%) recorded in both water and sediments, and blue emerged as the most dominant color (34.96%). As this area is both ecologically and economically important for shrimp farming and fisheries, immediate attention should focus on the containment of plastic pollution in the area. Hence, the findings of the present study may serve as the baseline data for strategic interventions.

Keywords: *Mangrove, Microplastic, Macroplastic, OSPAR, Density separation*

LONG-TERM ECOLOGICAL CONSEQUENCES OF MICROPLASTICS: A COMPREHENSIVE REVIEW OF ECOSYSTEM DYNAMICS AND ADAPTATION MECHANISMS

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Plastic pollution, particularly the predominance of microplastics, has emerged as a pressing global environmental challenge with long-term consequences for ecosystems. In response to this concern, this comprehensive review employs the PRISMA methodology, examining 21 English articles published between 2019 and 2023, accessible through Research Gate, Google Scholar, and PubMed databases filtered with pre-selected keywords (Adaptation, Biodiversity, Microplastics) and logic gates (AND, OR). The primary focus is on investigating the complex and long-term ecological impacts of microplastics, identifying key knowledge gaps; proposing avenues for further research. The synthesized results reveal a complex interplay of microplastics within ecosystems, showcasing pronounced biodiversity alterations, major interactions, and ecological processes. The review reveals significant gaps in our understanding of the cumulative and synergistic effects of prolonged exposure to microplastics, with approximately 70% of studies indicating uncertainties in assessing these critical knowledge gaps. This underscores the urgent need for targeted investigations to address these uncertainties. The discussion emphasizes the importance of adopting interdisciplinary approaches, with studies showing a 25% increase in effectiveness when utilizing such strategies to unravel the adaptation mechanisms employed by organisms facing chronic microplastic exposure. The review examines the broader implications of plastic pollution, revealing that approximately 80% of studies highlight marine life impact, 65% emphasize toxicity and bioaccumulation, 50% discuss disruption of food webs, 40% address habitat alteration, and 30% tackle health risks for humans. These findings underscore the necessity for holistic strategies, with a 15% increase in effectiveness when interdisciplinary approaches are integrated, emphasizing the need to transcend disciplinary boundaries for comprehensive solutions. This serves as a call to action, urging collaborative efforts among researchers, policymakers, and industries to address the pervasive environmental consequences of plastic pollution; highlights the urgency for targeted research initiatives and the development of holistic strategies to mitigate the far-reaching effects of microplastics on ecosystems; encapsulates the need for sustained interdisciplinary collaboration to foster innovative solutions, ensuring the long-term health and sustainability of our global ecosystems in the face of this growing trend of environmental challenges.

Keywords: *Adaptation mechanisms, Biodiversity, Ecosystem dynamics, Microplastics, Plastic pollution*

HITCHHIKERS ON FLOATING MARINE DEBRIS ALONG THE COAST OF MANNAR, SRI LANKA

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Hitchhikers on floating marine debris have gained wider attention recently due to their role as vectors for the primary and secondary introduction of non-indigenous species via biofouling. Thus, the present study focused on the community structure and the effect of debris source and composition on the attachment and structure of the fouling community. Samples were collected from three beaches located in the Mannar District, Sri Lanka namely, Talaimannar (L 1), Pesale (L 2), and South Bar (L 3) during March 2023. Debris with attached fouling communities were collected using the line transect laid in the high tide line. Debris type, material composition, surface texture, shape, country of origin, and fouling organisms attached were recorded. A total of 84 (L1: 30, L2: 10, and L3:44) debris samples with attached macrofouling organisms were encountered from which 54.7% were household, 27.9% were industrial and 17.4% were medical wastes. From the fouled debris the majority were of High-Density Polyethylene (HDPE) (55.6%) followed by Polyethylene Terephthalate (PET) (21%) and Glass (9.9%). Biofouling organisms belonging to Phylum Annelida, Arthropoda, Bryozoa, and Mollusca were recorded and among these the abundance of Bryozoans was noteworthy, accounting for 72 occurrences followed by annelids (32), arthropods (12) and mollusks (5) out of 121 total species occurrences from all three sampling locations. However, none of the mollusks were observed from the South Bar location. Considering the composition of debris relevant to the taxa attached, HDPE accounted for the highest occurrence of taxa (40.2%) followed by PET (29.3%), other (14.1%), and Glass (10.9%). Interestingly, out of the fouled debris, 11 pieces were of Indian origin, representing transboundary marine plastics. The findings of the present study demonstrate the effect of debris as a source of dispersion of marine organisms and the contribution of material composition and the source of debris origin to the same. Therefore, raising awareness is a must among the general public about the unforeseen effect of marine debris as a source of dispersion of marine organisms and the magnitude of the impact if potential invasive species are introduced.

Keywords: M*arine biofouling, Transboundary marine plastics, Bryozoa, Medical wastes*

IMPACTS OF NONDEGRADABLE GARBAGE ON WILD ELEPHANT POPULATIONS IN SRI LANKA: A CASE STUDY OF THE BUDDANGALA, AMPARA DISTRICT

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In Sri Lanka, elephants hold an iconic status in both environmental and social contexts; however, they face numerous anthropogenic threats, particularly stemming from plastic pollution. In Ampara district, numerous mismanaged dumping sites pose significant risks to wildlife in the area. This study aimed to understand the attraction of elephants to these sites and to investigate the possible reasons for this mismanagement. Conducted in November 2023, the study focused on a 500 m radius around the Buddangala landfill in Ampara district. Individual Interviews with community members who were residents in the area for more than 10 years and also relevant authorities such as the wildlife department, municipal council, and Buddangala solid waste management facility were done to understand their opinions and observations towards the matter. The community survey, which consisted of 80 participants, confirmed that there was an increase in daily wild elephant sightings and damages after the establishment of the landfill. According to them, the unanimous reason was mismanaged, unsorted waste dumping into the landfill. Surprisingly, only 42% recognized unsorted plastic ingestion as a leading cause of elephant deaths, indicating an awareness gap on improper waste disposal. Interviews with authorities identified that labor and infrastructure shortages as contributors to the matter. Elephants are drawn to the landfill due to the salty flavor of unsorted organic matter, leading to recurring visits. Wildlife data disclosed post-mortem findings of polythene, plastic, and sharp tools in elephant digestive tracts, resulting in polythene-induced starvation, wounds, entanglement, and digestion issues such as internal bleeding, digestive impairment, growth retardation, stress behavior, endocrine changes, circulatory disorders, tumors, etc. This unintentional ingestion of non-degradable items poses immediate and long-term health risks, emphasizing the urgent need for action. Immediate actions focused on effective waste management, community awareness, and policy advocacy should be taken to ensure wildlife protection and harmony in the district.

Keywords: *Wild elephants, Mixed waste, Community survey, Inadvertent ingestion, Policy advocacy*

INLFUENCE OF MANGROVE ROOT SYSTEM ON DEBRIS ACCUMULATION IN KADOLKELE MANGROVE NATURE PARK, SRI LANKA

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Thriving in tropical and subtropical regions, the mangrove ecosystem exhibits lush vegetation and intricate root systems that form an effective network to intercept drifting detritus. This prevents the onward movement of organic matter, mitigating the environmental threat of marine debris to oceans and coastal ecosystems. Recent recognition of the crucial role played by mangrove roots highlights their significance in protecting marine life, ecosystems, and human activities from the detrimental impacts of debris in coastal areas. This study aims to investigate the significance of mangrove roots as natural mechanisms proficient in trapping, accumulating, and stabilizing diverse forms of marine debris, including plastic, glass, and other materials. Debris samples were systematically gathered from three distinct zones, specifically Rhizophoraceae, Avicenniaceae, and Lumnitzeraceae, within the Kadolkele Mangrove Park over a three-month period starting from June to August 2023. Debris quantification was conducted utilizing a 1m x 1m quadrat. The collected debris underwent meticulous categorization and listing. Subsequently, the composition percentages of various debris types were rigorously examined in relation to their respective distribution across the diverse zones within the mangrove ecosystem. The data was analyzed using the Minitab 17 statistical software package. The Rhizophoraceae zones exhibit a prominently developed stilt and prop root system, whereas the Avicenniaceae zones are characterized by the presence of pneumatophores. The Lumnitzeraceae zone, representing the landward region, exhibits a less developed root system, with vegetation displaying a greater resemblance to terrestrial plants in terms of structure and composition. The well-developed root systems within the initial two zones led to the retention of plastic (97%), glass (92%), rubber (93%), polythene (95%), and fabric (97%) during the debris collection process. The data reveals a systematic reduction in debris accumulation proceeding landward ($p<0.05$). This leads to the inference that the roots of mangrove vegetation can serve as efficient collectors of debris within the mangrove ecosystem.

Keywords: *Debris, Mangrove root systems, Kadolkele mangrove park*

Track 3
Health Impacts of Plastics

Plastic Health Hazards: Understanding, Mitigation, and Prevention Strategies

The term plastic is a generic name given for most of the synthetic and semisynthetic organic polymers that are capable of exhibiting plasticity. According to the estimated amounts by the year 2019, approximately 459.75 million tons of plastic waste had been generated throughout the world. Of this huge amount, nearly 20% was recycled or incinerated. In contrast, the remaining 80% was either used in landfills or released without control to natural environments.

Microplastics (MP)/Nano plastics (NP) enter the human body through many pathways. According to scientific literature, the comment pathway of intake of MP /NP into the human body is by inhalation. Through the air we breathe these MP/NP enter to human body through the alveolar capillary membrane. The common type of MP/NP enter through inhalation is microfibers.

Another pathway is via the food chain. The MP/NP that joins the marine environment are ingested by the marine animals. Ingestion of MP/NP can be direct or indirect. Directingestion occurs when animals eat them accidentally. In contrast, indirect ingestion is relatedto the trophic transfer being the result of the consumption of contaminated food. The Zooplankton are at the basic steps of a food chain. The MP /NP ascend in the food chain andgradually undergo bioaccumulation. Humans as the apex predators of the food chain and consume fish/ mussels belonging to various stages of the food chain have a higher risk of bioaccumulation.

The MPs/NPs have been found in table salt, drinking water bottles, and tap water. In 2019, the World Health Organization (WHO) issued a 125-page report (ISBN: 978-92-4-151619-8) confirming the contamination of drinking water by MPs/NPs and its severity.

Finally, it has shown that these MP/NP do enter to human body via damaged skin. Certain cosmetic products in the market do contain MP/NP. When applied on damaged skin it enters the human body.

It is roughly estimated that an average human intake of plastics is around 5g per week via all the routs mentioned above. This figure may change lifestyle patterns and the amount of environmental pollution that a particular person is living in.

The adverse effects of MPs/NPs on the human body can be divided into two main categories. They are the complications caused by the physical properties of the plastics and their chemical constituents. The physical properties of MPs/NPs are defined in terms of size, shape, and concentration. When considering the chemical constituents, it can be divided into two main parts. One is the chemicals used as raw materials used in manufacturing to obtain different physical properties of the plastic product. The other part is chemicals absorb and adsorb to the MPs/NPs from the environment.

In the plastic manufacturing process, it is blended with various chemicals to have colour, transparency, different levels of strength, thermo-tolerance, heat resistance, and malleability, and to keep the finished product intact/non-oxidizing. In the environment, these MP/NP particles absorb various chemical compounds such as carcinogens and heavy metals (Lead, Cadmium, and Mercury).

These plastic molecules, enter to human body have various types of chemical constituents in various concentrations (as a cocktail). These MPs/NPs (especially the NP particles) have the ability to cross through the intestinal and alveolar epithelium to enter the blood circulation and deposit at terminal organs throughout the body. At the tissue level, these chemicals are released to the surrounding tissues via simple diffusion. Certain chemicals have the potential to damage the DNA material in the cell and lead to cancerous lesions.

Pathological changes to the intestine include a reduction in mucus secretion, gut barrier dysfunction intestinal inflammation, and gut microbiota dysbiosis. Liver pathologies include inflammation and lipid accumulation or lipid profile changes and changes in the markers of lipid metabolism.

There is a lack of toxicity data for humans in vivo at the moment. The studies conducted using cell cultures have shown disruption of mitochondrial membrane potential and inhibition of plasma membrane, decreased viability and induced cell cycle arrest, upregulation of transcripts for NF-κB and some pro-inflammatory cytokines, alteration of thecell cycle, and apoptosis-regulation related protein expressions. Most importantly the changes of the gut microbiota dysbiosis have been shown to a directly related to gastrointestinal cancers. Recent studies have shown the NP crosses the placenta and enters the fetal tissues. Also, there is evidence that MP/NP secrets in breast milk. However, the scientific population has very little knowledge about how MPs/NPs cause disease and help totransmit the disease (? COVID-19). Much more research, in terms of both cellular and tissue-level pathological mechanisms, as well as on the long-term effects of tissue/organ accumulation, is needed.

To reduce plastic pollution, the 6 R principle can be followed.

Reducing plastic usage
Reusing and minimizing new purchases
Recycling
Rejecting if it is not necessary
Rethink twice before buying or using
Replace the plastic with innovations

It is our primary responsibility to reduce the usage of plastic and stop plastic from entering into our environment.

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MICROPLASTICS IN ALGAE AND MOLLUSKS REPRESENTING THE DOMINANT TROPHIC LEVELS OF MORAWALA ROCKY SHORE NEGOMBO, SRI LANKA

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Trophic transfer of microplastics (MPs) is a decade's major concern for their potential bioaccumulation in the body tissues of marine inhabitants. The biotic components of the intertidal zone ecosystems, such as rocky shores (RS), are more prone to MPs adsorption and ingestion since they receive inland runoff and contaminants from the open ocean waters. This study investigated the MPs concentrations present in algae as macro primary producers and mollusks as grazers and filter feeders at Morawala RS to ensure the possibility of the MPs trophic transfer. The RS was sampled during May 2022 and November 2023 once a month at low tide, covering the major monsoon seasons (N = 42 per species). A line transect method was employed perpendicular to the shoreline, and randomly placed quadrates were used to collect the biota (n = 6), mainly from the mid- and low-tide zones. The collected green algae (Ulva sp.), brown algae (Sargassum sp.), grazers (Patella sp.), and filter feeders (rock oyster Saccostrea sp.) were stored frozen prior to MPs analysis. Algae samples were subjected to wet peroxidase oxidation with 30% H_2O_2, and the tissue samples of mollusks were subjected to alkaline digestion with 10% KOH, followed by NaCl density separation and fractionation, and finally MPs were visually detected and quantified. The MP colour, MP form, and size were recorded in each of the samples. MP size was manually measured using a graticule scale. The filtered samples were frozen for FTIR analysis for further polymer identification. The mean MP concentration in the green and brown algae samples was 0.101±0.011 items/g WW: wet weight and 0.081±0.028 items/g WW, respectively. In mollusks, the MP concentration was higher in filter feeders (1.453±0.554 items/g WW) than in grazers (1.253±0.271 items/g WW). The mean mollusk tissue MP concentrations were insignificantly high compared to the levels in algae samples ($p > 0.05$) (one-way ANOVA test, $p > 0.05$). Further, based on two years of data, we couldn't observe a significant seasonal variation in the biota trapped MPs during Northeast and Southwest monsoons in the consecutive years 2022 and 2023. However, the mean MP concentration values were insignificantly high in biotic samples during the Northeast and in the inter-monsoon seasons compared to the Southwest monsoon season ($p > 0.05$). Most of the MPs were in the form of threads. Blue, black, red, orange, and white were the colours of the extracted MPs. Algae and mollusks representing the dominant trophic levels at the Morawala RS were contaminated with MPs. Thus, consuming seafood contaminated with MPs will lead to the ingestion of MPs transferring of toxicants along the coastal food chains.

Keywords: *Trophic transfer, Algae, Filter feeders, Rocky shore, Sri Lanka*

PRELIMINARY STUDY OF THE MICROPLASTICS OCCURRENCE IN FARMED WHITE LEG SHRIMPS- *Litopenaeus vannamei* OF PUTTALAM DISTRICT: ASSESSMENT OF THE SYNERGISTIC ACUTE TOXICITY EFFECTS OF COMBINED MICROPLASTICS VIA ZEBRAFISH (*Danio rerio*) MODEL INITIALS

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The widespread presence of microplastics (MPs) in aquatic habitats has made them bioavailable to high amounts of marine organisms, posing risks to seafood safety and human health. The study aimed at analysing the microplastic accumulation in farmed two-month-old *Litopenaeus vannamei* shrimps (6.612±1.02 g) collected via cluster sampling from Aarachchikattuwa, Sri Lanka, and to analyze the possible synergistic acute toxicity of microplastic polymer combinations using a zebrafish embryo model. The exoskeleton and edible-soft tissues of each shrimp underwent analysis for MPs following density separation, alkali digestion, stereomicroscopy, and Raman spectroscopy analysis. An average of 4.99±1.81 MP particles/g were found in all the analyzed specimens containing MPs. The MPs in the size range of 100–250 µm were dominant, raising concerns about tissue translocation, while fibers (96.72%) were prevalent among the observed morphotypes. Blue was the most prominent colour (55.78%) of MPs, likely originated from the breakdown of textiles and fishing gears. The average MP abundance in this study shows elevated microplastic pollution in the culture ponds. Microplastic abundance similarity in exoskeletons and edible-soft tissue raises concern on human exposure through consumption, despite exoskeleton removal. Following the OECD guidelines, in the Fish Embryo Toxicity (FET) assay, zebrafish embryos were exposed to polyethylene (LDPE, <500 µm) with polyamide (Nylon 66,<500 µm) at varying concentration combinations (6.25, 12.5, 25, 50, and 100 mg/L). Polymer types were selected based on prior prevalence reports and Raman spectroscopy results. Lower concentration combinations (Nylon 6.25 mg/L with LDPE 6.25 mg/L, 12.5 mg/L, 25 mg/L) exhibited significant effects on embryo hatching, survival, and heart function, while there were no significant developmental abnormalities. Higher particle dispersal at these concentrations may have facilitated increased MP uptake. The magnitude and characteristics of the findings dependon the MP size, concentration, surface chemistry, and polymer interactions. While the tested microplastic levels showed low acute toxicity, long-term accumulation may raise health concerns, stressing the need for further research.

Keywords: *Microplastics, Farmed shrimps, Zebrafish, FET assay, Polymer combinations, Synergistic acute toxicity*

ANALYSIS OF MICROPLASTICS, PRESENT IN FARMED BLACK TIGER SHRIMPS (*Penaeus monodon*) AND ASSESSMENT OF SYNERGISTIC ACUTE TOXICITY EFFECTS OF COMBINED MICROPLASTICS VIA ZEBRAFISH (*Danio rerio*) MODEL [CS1]

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Microplastic pollution is a major environmental concern, especially in aquatic ecosystems. Sri Lankan lagoon farms are highly contaminated with MPs, which may impact the safety of seafood. However, MP detection in the Sri Lankan farmed shrimp species is in its initial phase. This study focused on MP detection in commercially harvested four-month-old (16.69±3.62 g) *Penaeus monodon* (Black tiger shrimps), which was collected from the cluster farm at the Udappuwa area near Puttalam lagoon, and zebrafish was used as a model organism to assess the possible synergistic effects of the two most abundant combined MPs polymers found in shrimp samples. Alkali digestion, density separation, stereomicroscopic, and Raman spectroscopic observation were conducted to identify MPs within the exoskeleton and edible-soft tissues of the collected samples. A total of 614 MPs were found in all 20 samples collected, averaging 30.75±9.06 particles per individual, indicating that the shrimp farms were highly contaminated with MPs. MPs with a size range of 500–1000 µm were most abundant in the exoskeleton, while 1000 µm< were in the edible portion. Among morphotypes and colors, fibers and blue color were dominant, respectively. In the Fish Embryo Toxicity (FET) assay, according to the OECD guidelines, Zebrafish embryos were exposed to combinations of polystyrene (PS) with polyethylene terephthalate (PET) of varying concentration combinations (6.25,12.5, 25, 50, and 100 mgL^{-1}) based on Raman spectroscopic results and past literature. The survival rate, hatch rate, heart rate, and developmental deformities were evaluated at 24 hpf, 48 hpf, 54 hpf, 72 hpf, and 96 hpf time points, and the findings revealed that PET and PS combinations had no significant effects on the evaluated parameters. None of the developmental abnormalities were significantly associated ($p \geq 0.05$) with MP levels. Analyzed MP concentrations showed minute levels of acute toxicity. Thus, the prolonged accumulation of these microplastics could raise health implications, emphasizing the need for further research.

Keywords: *Microplastics, Penaeus monodon, Zebrafish, FET assay, PET, PS*

USE OF LAMINATED PAPER CUPS (LPC); A CASE STUDY AT THE UNIVERSITY OF MORATUWA

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Laminated Paper Cups (LPC) are integral to takeaway culture and are valued for their convenience, portability, and beverage suitability. Consisting of a hydrophobic film interior and often polyethylene-based, this lamination enhances structural integrity and prevents moisture absorption, allowing for one-time use. Research at the University of Moratuwa delves into LPC usage, disposal methods, and awareness levels. It also explores student perceptions regarding alternative applications, highlighting the imperative for sustainable practices in balancing convenience with environmental responsibility and health consciousness. Data was collected through an online questionnaire survey in January 2024 at the university premises. A simple random sampling method was employed to select the equivalent sample size. The purpose was to assess awareness across various fields of education regarding the environmental and health hazards associated with LPC. For the study, a total of 234 university students were selected. Of the respondents, 93.2% reported using LPC, with 64.1% using about 3 to 5 cups per week. Regarding disposal techniques, the majority (67.8%) preferred to dispose of LPC as garbage. 56.8% of respondents were unaware of the health hazards, and 50.8% of respondents were also unaware of the environmental hazards associated with LPC. A significant portion (61.9%) were unaware that paper cups may contain laminated plastic film (hydrophobic) and possibly microplastics when used with hot beverages, posing ingestion risks to the human body. Notably, 89% of respondents expressed willingness to use alternatives if LPC were banned at the university. In this study, a notable finding emerged as a significant proportion of respondents indicated a lack of awareness regarding the health impact of LPC. Regular consumption of hot beverages, such as tea and coffee, from LPC may lead to the ingestion of microplastics and heavy metals. Therefore, this study revealed the need for strict regulation and necessary actions to enhance awareness of the advisable impact of polythene and plastic-related products.

Keywords: *Awareness, Health impact, Laminated paper cups, User perception, Microplastics*

PUBLIC HEALTH IMPACTS OF PLASTICS: AN OVERVIEW

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Plastics have become an essential part of our modern society, bringing immense convenience to our daily lives. However, with this convenience comes a growing concern about the potential negative impact of plastics on our health. This study delves into the complex connection between plastic usage and health, covering every step of the plastic life cycle from creation to disposal. The Scopus database was used to obtain forty relevant publications on the impact of plastics on human health published between 2012 and 2023. The results revealed that during the production process, various chemicals are used to create plastics, some of which have been identified as potential health hazards in 45% of the articles. Workers in the plastic manufacturing industry are particularly vulnerable to these substances, putting them at risk for respiratory problems, skin irritations, and other occupational health issues. Plastics in everyday consumer products introduce the possibility of harmful chemicals leaching into our environment, which is highlighted in 27% of the articles. 16% of the articles indicated that endocrine disruptors such as phthalates and bisphenol A are commonly found in plastic materials and have been linked to severe health concerns. Furthermore, transferring these chemicals from plastic packaging to food and beverages presents a continuous danger of ingestion for individuals. Proper disposal of plastic products is essential to prevent the release of toxic substances into our surroundings. The presence of microplastics, which are formed when larger plastic objects break down, has been confirmed in the air, water, and soil, which is highlighted in 20% of the articles. This has sparked concerns about their ability to accumulate in the food chain and potentially harm human health. In order to address the negative effects of plastics on our well-being, a multifaceted approach is necessary. This includes implementing regulations, finding alternatives for harmful chemicals used in plastic production, improving recycling methods, and promoting responsible plastic consumption through public education campaigns. A deep understanding of the complex relationship between plastic exposure and health outcomes is imperative to creating effective policies and ensuring a sustainable environment for current and future generations.

Keywords: *Pollution, Health hazard, Microplastics*

Track 4
Socio-Economic Impacts of Plastics

From Consumption to Consequences: Understanding the Economic Cost of Plastic Pollution

Plastic production is a profitable business as shown by its rapid growth over time. The primary plastics sector of polymers and additives accounts for around USD 600 - 700 billion per year in revenues. The profitability of the business prevails since the external costs it generates have been shifted to others and into the future. The industry incurs a severe burden on human health and environmental degradation, leading to large intragenerational and intergenerational inequity. The poorest segments in the society face the highest impact though their contribution to plastic waste is only minimal. The persistent nature of the plastics implies a heavy burden on the many future generations to come.

The current economy related to plastics is operating mostly in a linear economy. The materials are extracted, produced, used, and disposed to the environment. Only a very small percentage is cycled back yet at the expense of energy and matter. Some of the main issues related to this non-circularity include structural flaws, for example, nearly 95 percent of plastic packaging is lost after a single use. Waste is often being dumped in poor developing countries, due to the weak governance in transboundary movements. Collection of waste is grossly underfunded, and incentives are lacking to encourage the adoption of new solutions. Natural capital in the terrestrial and marine environments will be affected negatively by plastic pollution. Especially marine ecosystems provide a large variety of ecosystem services including provisional services, regulatory services, cultural services, and primary ecosystem services. Plastic pollution affects the whole range of ecosystem services and thereby brings a threat to the well-being of humans across the globe. The plastics can bring a wide range of ecological impacts over a wide range of biota which will subsequently result in negative impacts on ecosystem services. For example, marine plastic will reduce the fish productivity and affect commercial fisheries and aquaculture. The plastic material can be a source of pathogens, additives, and persistent organic pollutants. Large marine mammals and reptiles are sources of cultural ecosystem services including recreational values and nonuse values. Marine plastic pollution may result in a widespread negative impact on such charismatic species leading to loss of human wellbeing.

Plastic pollution of soil is a relatively neglected topic but adverse effects of microplastics in soils is highly possible due to the dumping of disused or abandoned plastic, municipal wastewater effluent, landfilling with sewage sludge, and plastic used in agricultural activities. Earthworms ingest small-sized plastics and generate secondary microplastics which are transported in the soil due to their burrowing activities. In addition, microplastics can be bioaccumulated in earthworm bodies and can bring about sub-lethal effects on the reproduction and immune system response of earthworms. The impacts of plastics on terrestrial wild animals have also been widely documented.

Plastic can exert a heavy toll on human health. For example, microplastics have been found in breast milk and inside vital organs of human bodies. The proven health effects include causing cancer or changing hormone activity (known as endocrine disruption), which can lead to reproductive, growth, and cognitive impairment. In addition, many other impacts can be identified along the plastic value chain. Examples include pollution at extraction sites, exposure to chemicals, air pollution from waste incineration, and water and soil contamination. Vulnerable marginal groups especially poor communities are over-exposed to such contaminants thus raising concerns of intragenerational inequity. Plastics could emit19 per cent of global greenhouse gas emissions also leading to many disastrous consequences.The current linear plastics economy is estimated to generate annual social and environmentalcosts ranging between USD 300-600 billion per year, with some estimates above USD 1.5 trillion per year. The upper estimates are much higher than the revenues of the plastic industry implying the non-profitability of the plastic industry when the environmental and social costs are being internalized. It is important to calculate a per ton external cost for eachuse of plastic in a range of geographical contexts so that the plastics can only be used whenever the total benefits outweigh the total costs.

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BEACH SEINE FISHERY- A NEW METHOD FOR INDICATING PLASTIC POLLUTION IN COASTAL SEA BOTTOMS OF SRI LANKA

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Beach seine (Maa Dela) is one of the traditional fishing methods in Sri Lanka used to catch fish by bottom-dragging. Oruwella Beach in Tangalle is one such area that hauls beach seines six times per day, per month, except on Poya days. It was found out that a large amount of plastic settled in the ocean bottom was collected by the beach, which severely reduced the harvest. A gap exists in research assessing plastic waste using beach seine, which this study aims to address. The study was conducted for a 3-month period from October to December 2023. Data was collected from beach seins operated in the Oruwella area by counting the various types of plastics that were trapped in thenets after sorting. Due to the non-normal behaviour of the data ($p<0.05$, Anderson Darling test), themonths were considered as three independent groups. Data analysis shows that there was no significant difference in plastic collection between the three months ($P> 0.05$, Kruskal wallis test). Among the collected plastic types by one beach seine haul, 44.11% were plastic bags, 19.74% were PET (polyethylene terephthalate) bottles, 18.79% were other types of plastics (synthetic clothing materials, plastic fragments, etc.), 8.72% were fishing gear-related plastics, and 8.64% were plastic cups. The current study reveals that large amounts of plastics are settled down in the coastal sea bottoms, which severely affects the beach seine fishing community by reducing their harvest. Also, such plastic waste has become a huge threat to the adjacent sensitive coastal ecosystems as well as to tourism in the area. This study shows that fishing nets can be treated as a succession indicator for plastic accumulation in the ocean. Further research can be conducted to create predictive models using different variables, including fishing seines to explore the plastic settlement in ocean beds.

Keywords: *Beach seines, Ocean-bed, Plastic waste, Sri Lanka, Traditional fishery*

CONSUMER ATTITUDES AND BEHAVIOUR TOWARDS FOOD PLASTIC PACKAGING: A CASE STUDY FROM SABARAGAMUWA UNIVERSITY OF SRI LANKA

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Understanding the usage behaviours of food plastic items is crucial for informing policy development, especially in the context of the emerging and developing global plastic treaty. This research employed a self-administered questionnaire to collect information from 160 undergraduates from eight faculties, including Agricultural Sciences, Applied Sciences, Management Studies, Geomatics, Medicine, Technology, Computing, and Social Sciences and Language. The objectives were to investigate the usage patterns of single-use food plastic among undergraduate students and to explore dominant food plastic avoidance behaviours, as well as waste disposal attitudes and behaviours among them. The findings revealed no significant association between socio-demographic factors and plastic consumption patterns among the students using the descriptive statistical method. Plastic bottles (74%) and single-use plastic bags (71%) emerged as the most commonly used food plastic packaging. 71% of respondents purchased between 1 and 3 plastic bottles on average per week. Plastic tubs were frequently bought in quantities of 1–3 per week (80%), while single-use plastic shopping and grocery bags were often purchased in quantities of 1–3 per week (38%). 78% of respondents reused plastic food packaging, while 50% disposed of their waste in general waste bins. Furthermore, 41% of respondents expressed neutrality towards the role of government regulations in significantly reducing plastic usage. A considerable number of respondents have been concerned about the environmental impacts of plastic packaging. This concern leads to a growing preference for sustainable alternatives. These findings can inform the development of targeted policies to address plastic consumption and waste management among university students.

Keywords: *Consumer behaviour, Single-use plastics, University students, Waste disposal*

SOCIO-ECONOMIC IMPACTS OF PLASTICS- A SOCIAL REVIEW

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The ubiquitous use of plastics in contemporary society has led to a myriad of socio-economic impacts that extend far beyond their convenience and versatility. This abstract explores the multifaceted consequences of plastics on society, focusing on environmental degradation, human health, and economic implications. Plastics, due to their non-biodegradable nature, have become a significant contributor to environmental pollution. Their persistence in ecosystems, particularly in oceans and waterways, poses a threat to marine life and ecosystems. The resulting environmental degradation not only affects biodiversity but also compromises vital ecosystem services upon which human societies depend. On a human health level, the production and disposal of plastics introduce chemical pollutants into the air, water, and soil. Disproportionate impacts on marginalized communities may exacerbate existing socio-economic disparities, as these communities often bear a higher burden of environmental pollution. The Ellen MacArthur Foundation estimated that the annual cost of plastic pollution to the global economy could reach $2.5 trillion by 2050 if current trends continue (source: Ellen MacArthur Foundation). A study by the Ocean Conservancy found that the global fishing industry loses an estimated $10 billion annually due to plastic pollution, including damage to equipment and decreased fishery productivity (source: Ocean Conservancy). The World Bank reported that the economic cost of marine plastic pollution to marine ecosystems, fisheries, and tourism in East Asia and the Pacific could reach $1.3 billion per year (source: World Bank). Research published in Environmental Health Perspectives found that exposure to bisphenol A (BPA) was associated with a 27% increased risk of developing type 2 diabetes (source: Environmental Health Perspectives). A study in the Journal of Environmental Research estimated that microplastics ingestion by humans through seafood consumption could range from 39,000 to 52,000 particles per year (source: Journal of Environmental Research). Addressing the socio-economic impacts of plastics requires a holistic approach that incorporates policies promoting sustainable alternatives, waste management strategies, and public awareness campaigns. The transition to a circular economy, where the life cycle of plastics is optimized through recycling and reuse, holds promise for mitigating these impacts. The implementation of effective policies and global collaboration are essential to strike a balance between the convenience of plastics and the preservation of ecosystems, human health, and economic well-being.

Keywords: *Pollution, Environmental degradation, Waste management, Marine litter, Microplastics, Biodiversity loss*

INVESTIGATION OF THE POTENTIAL OF UTILIZING SOCIAL MEDIA IN PREVENTING PLASTIC POLLUTION AT ADAM'S PEAK

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Adam's Peak is part of the UNESCO World Heritage listed property located in Sri Lanka. Due to its perceived socio-cultural and religious importance, approximately 2 million visitors annually visit this site. Even though it is highly regarded socio-culturally, the visitors' behaviour does not reflect the same towards the environment of this location. There is heavy plastic pollution taking place annually due to irresponsible dumping of plastic garbage by these visitors. This dilemma became the subject of interest in this research. Even though volunteer groups make multiple cleaning efforts to reduce this pollution, in order to minimize the plastic pollution happening at Adam's Peak, we need to address the root cause, which is human behaviour and attitudes. Therefore, the objective of this qualitative exploratory research was to find out if attitudinal change could be affected by social media to protect Adam's Peak against plastic pollution. The available literature suggests that attitudinal change could be achieved with well-planned persuasive messaging and through interpersonal communication. The literature also suggests that social media could be a potential medium to discuss environmental risks and concerns. An analysis of existing literature and the top 50 Twitter posts and the top 50 Facebook posts with the hashtag #Adamspeak published on or before November 2020 by individuals was adopted as the methodology of this study. 41, 1, 1, 6, and 1 posts on Twitter and 42, 1, 5, 2, and 0 posts on Facebook were on scenic beauty, historical and religious value, conservation and pro-environment behaviour, pilgrimage, and politics, respectively. According to the analyzed data from social media campaigns from other countries, it was suggestive that social media has a huge potential for inducing pro-environmental behaviour in people. However, the research study found that there has been no significant effort or organized campaign done on both Twitter and Facebook social media platforms as of November 2020 by any organization within Sri Lanka to address the root cause of plastic pollution.

Keywords: *Adam's Peak, Plastic, pollution, Attitude, Social media, Communication*

ASSESSMENT OF THE DIFFERENT-SIZED MARINE PLASTIC LITTER ON THE NORTHERN SHORE OF SRI LANKA

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The issue of marine plastic debris has emerged as a prominent threat to local marine resources along the northern coast of Jaffna, Sri Lanka. A preliminary study was conducted to gather information on the abundance and characteristics of marine plastic debris along the northern shore of Sri Lanka. The marine plastic litter survey was carried out at Kankesanthurai (KKS), Myliddy, and Akkarai beaches from February to July 2023, following the protocols and guidelines established by NOAA and OSPAR. A wooden quadrate (50 cm × 50 cm) was placed at intervals of 20 m along the 100 m transect, with a width of 5 m from the high tide line on each beach and samples were collected at a depth of 1 cm. In the laboratory, the sand samples were dried, sieved, extracted, and quantified. The plastics were classified into macro (21 - 100 mm), meso (6 - 20 mm), and micro (< 5 mm). Plastics were also categorized as white, transparent, or coloured. Further classified as a fragment, filament, film, foam, or pellet based on their shape. A total of 1250 plastic items were recorded. Akkarai Beach had an abundance of plastic with 496 items, followed by Myliddy with 451 items, and the least abundance recorded at KKS Beach with 303 items. Shape category composition analysis revealed that fragments were the most dominant (66.64%), followed by films (15.92%), with filaments being the least abundant (1.68%). Based on the colour, it was observed that transparent plastic dominated with 47.84%, followed by coloured plastic (33.2%). White-coloured plastic had the least abundance, accounting for 18.96%. This study's findings offer valuable insights into the abundance and characteristics of marine plastic debris in the beaches of northern Sri Lanka, highlighting the need for effective management.

Keywords: *Abundance, Fragment, Marine plastic debris, Northern coast*

TOWARDS A SUSTAINABLE UNIVERSITY: ASSESSING PLASTIC USAGE AND IMPLEMENTING SUSTAINABLE PRACTICES AT THE OPEN UNIVERSITY OF SRI LANKA

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Excessive plastic usage contributes to environmental pollution, harming ecosystems and wildlife, while embracing sustainable alternatives and reducing single-use plastics can help mitigate the detrimental impact on the planet. Individuals and institutes must adopt responsible plastic management practices to address the growing environmental concerns associated with plastic usage. The study focuses on waste management at the Open University of Sri Lanka (OUSL) in response to the global issue of plastic pollution. Recognizing its responsibility, the OUSL initiated efforts to align practices with environmental sustainability goals. The research aims to provide insights into current waste management practices, emphasizing the need for improvement and aligning with the university's commitment to shaping environmentally conscious practices within its communities. The Open University of Sri Lanka initiated plastic management within its premises to minimize the environmental impact while fostering a sustainable and eco-friendly campus. Implementing plastic reduction strategies and promoting awareness among the university community can contribute to a more environmentally responsible and socially conscious institution. Therefore, the present study mainly focused on the Main Campus (CRC) of the Open University of Sri Lanka (OUSL) to understand the extent of plastic usage, its environmental implications, public awareness, the effectiveness of current management practices, and perceptions of polythene and plastic usage and disposal methods. A structured questionnaire was circulated among the registered students, and 120 students participated via online interviews. The study revealed that most of the participants were aware of the plastic-free OUSL concept, and 97.5% were aware of the green university concept. Further, it was noted that most of the students use lunch sheets (45.8%), shopping bags (36.4%), plastic water bottles (35.6%), yoghurt cups (21.2%), and non-reusable plastic cups (20.3%) within the university premises. It appears that 73.1% of students at the OUSL express satisfaction with the current waste management practices in place. This positive response suggests a majority approval of the university's efforts in waste management. In addition, the survey revealed that excessive plastic usage was observed in the main cafeteria (65.3%), milk shop (56.4%), and central cafeteria (30.7%). Therefore, it is important to introduce management strategies and increase awareness among the university community to control plastic usage on the university premises.

Keywords: *Plastic and polythene, Awareness, OUSL, Green University, Plastic Free OUSL*

THE EVOLUTION OF PLASTIC IMPORTS AND EXPORTS IN SRI LANKA: TRENDS ANDINSIGHTS (2012-2022)

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Plastic waste, including bags, bottles, and packaging, significantly pollutes oceans, landfills, and waterways, taking hundreds of years to decompose. Increased plastic consumption has emerged as a significant issue influencing Sri Lanka's economic and environmental sustainability. This paper aims to examine the evolution of plastic imports and exports in Sri Lanka from 2012 to 2022. The study employs descriptive statistics and trend analysis utilizing Microsoft Excel V.16 on plastic imports and exports in Sri Lanka. It examines the percentage of plastic imports and exports in relation to total imports and exports, as well as the per capita movement of plastic trash, using the UN COMTRADE database. Additionally, plastic import and export data are scrutinized based on countries. From 2012 to 2022, expenditures on plastic imports increased by US$163 million, reaching US$734 million, while earnings from plastic exports increased by US$2.5 million, reaching US$63.7 million. The percentage of plastic imports and exports over total imports showed an increasing trend, reaching 4.4% and 0.48%, respectively, in 2022. Per capita imports of plastic waste (0.07 t/per year) exhibited an increasing trend, while per capita exports of plastic waste (0.04 t/per year) displayed a decreasing trend. Sri Lanka's major plastic importers are China, India, and Saudi Arabia, accounting for 40.0% of total plastic imports, while its major exporters are the USA, Bangladesh, and India, contributing to 44.71% of total plastic exports. Plastic packing and articles of plastic (HS Hdg. 39.23 and 39.26) constitute over 60% of all plastic exports, whereas ethylene and propylene polymers (HS Hdg. 39.01 and 39.02) make up the majority of plastic imports, representing over 20% of total plastic imports. Over the past decade, there has been a significant rise in plastic imports and a modest increase in plastic exports, resulting in a net import of plastics due to the growing demand. More plastic waste is being imported into the population than is being exported. The study emphasizes the need for restricting imports and recommends introducing eco-friendly local alternatives.

Keywords: *Plastics, Plastic waste, Imports, Exports, Economy*

MICROPLASTIC CONTAMINATION IN SEAFOOD: KNOWLEDGE AND AWARENESS OF SEAFOOD SELLERS IN THE NEGOMBO LAGOON AREA

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Microplastics (MP) are minute plastic particles, measuring less than 5 mm in size, prevalent in freshwater, marine, and terrestrial ecosystems, posing a significant environmental threat with the potential risk of contaminating seafood. This study aimed to evaluate the awareness levels of sellers in the Negombo lagoon area regarding the contamination of seafood with microplastics. Data was gathered from 55 seafood sellers. A questionnaire comprising both closed-ended and open-ended questions was administered to extract information on participants' demographic data, awareness of microplastics, and sources and solutions of MPs. Demographic data revealed that 56.36% of sellers were aware of MPs. Approximately 50% believed in the impact of MP on human health. The primary sources of MP were identified as hotel wastage (52.72%) and X-press pearl incidents (32%). Notably, 45.45% of sellers reported observing plastics in fish gills and gut, with a prevailing belief (41.81%) that MP contaminates fish through polluted water. 78.5% of participants informed that plastic items were used mainly because of their durability and lower weight. Those who were aware of the pollution in MP suggested that the most effective methods to decrease plastic usage are reducing and recycling plastics. A smaller percentage of sellers (21.81%) actively participated in environmental initiatives, such as beach cleanups, showcasing limited engagement in eco-friendly practices. However, all participants expressed a strong willingness to adopt biodegradable alternatives, emphasizing a commitment to eco-friendly practices. In conclusion, reducing MP pollution can be enhanced by increasing awareness campaigns, adopting policy enforcement, and a shift towards eco-friendly materials as alternatives for plastics.

Keywords: *Microplastics, Seafood, Sellers, Awareness*

KNOWLEDGE AND ATTITUDES OF MICROPLASTIC POLLUTION: A PILOT SURVEY OF THE LEARNERS AT THE OPEN UNIVERSITY OF SRI LANKA

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Microplastics are degraded plastic particles that emerge as environmental pollutants and a pervasive threat to ecosystems and human health. The majority of microplastics originate from anthropogenic sources such as textiles, health, and personal care. Hence, raising public awareness is a pertinent strategy to reduce the microplastic pollution. Thus, this study aimed at assessing the knowledge and attitudes of a sample population of open and distance learners in Sri Lanka. A cross-sectional study was performed on a cohort of 106 students at the Open University of Sri Lanka (OUSL) using a self-administered and structured online questionnaire containing multiple-choice questions and the responses were statistically analyzed. Most of the respondents represented the Faculty of Humanities and Social Sciences (46%) followed by the Faculty of Natural Sciences (42%) with an overall 58% of female respondents. The survey showed that 61% of the respondents were aware of microplastics, and 68% were aware that they are present in our daily consumables such as water, salt, plastic bottles, and seafood. Only 28% of the respondents knew how microplastics are created and 58% stated that the microplastics are mainly released into the environment by industrial activities. Moreover, 72% specified that microplastics mainly affect marine ecosystems while 92% agreed that plastic pollution is a global environmental problem. From this survey, it was apparent that social media has been the main source of knowledge on microplastic pollution. Further, 86% believed that banning products containing microplastics is an effective approach to reducing microplastic pollution. However, only 36% of all respondents agreed to replace the product containing microplastic with an alternative environmentally friendly product and shop in such stores. More than 75% agreed to stop the daily use of plastic bottles, bags, and straws while 85% of the respondents showed interest in creating awareness among the people of reducing microplastic-containing products. This pilot study revealed that the knowledge of OUSL students on this issue is satisfactory, and this further highlights their willingness to reduce microplastic pollution by changing their attitudes toward plastic usage.

Keywords: M*icroplastics, Plastic pollution, Knowledge, Attitude, Survey, OUSL*

COMMUNITY AWARENESS AND PERCEPTION OF PLASTIC POLLUTION IN THE HEAD AND TRANSITIONAL REGIONS OF MAHA OYA BASIN.

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Products made of plastic and polythene, particularly single-use ones like packaging and bags, significantly contribute to environmental pollution. Plastic garbage ends up in landfills, rivers, and oceans due to improper disposal and it destroys ecosystems. The Maha Oya flows across five districts including 14 water supply networks to serve the need for water. The present study aimed to determine the usage and perception of household polythene and plastics and their disposal practices in the head and transitional regions of the Maha Oya basin. The survey was conducted for 100 respondents through face-to-face interviews to cover the entire study area. All the participants mentioned the use of polythene and plastic products in their day-to-day lives. The average Income level of the majority of people (30.46%) is representing in between Rs. 50,000-100,000 and most of the people were self-employed with GCE A/L education. Further, around 98% of participants stated that they would like to reduce the usage of plastic and polythene. All the respondents have ideas on the harmfulness of polythene and plastics to the environment. However, they did not know about proper controlling methods of plastic and polythene. Most of them mentioned outsiders directly dump garbage into the river and that is the main source of plastic pollution in the river basin. Therefore, a comprehensive strategy needs to be addressed for proper plastic and polythene disposal methods, especially in sensitive areas.

Keywords: *Maha Oya, Plastic and polythene, Awareness, Perception, Survey*

BUDDHIST 3R PRACTICES: A SUSTAINABLE APPROACH TO MITIGATE PLASTIC POLLUTION AND ENHANCE ENVIRONMENTAL WELLBEING

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The United Nations has underscored the urgency of addressing sustainability goals amid the alarming environmental crisis. This study explores the application of the Buddhist principles of Reduce, Reuse, and Recycle (3R) in the context of environmental sustainability and plastic usage. Research employs a qualitative methodology, analyzing primary Buddhist sources, scholarly articles, and relevant publications. Buddhism promotes mindful consumption, advising the use of resources within the limit of need, thus aligning with the principle of 'Reduce'. Monastic rules prohibit deforestation and pollution, reflecting an inherent respect for the environment. The principle of 'Reuse' is evident in monastic practices such as repairing and reusing bowls and robes. By cultivating mindfulness and an understanding of the consequences of one's actions, adherents seek to preserve the environment and promote overall well-being. 'Recycle' is embodied in the transformation of discarded clothes into robes, bed sheets, and other items, demonstrating resource efficiency. These practices contribute to environmental, physical, and mental well-being, and align with the Buddhist cause-and-effect theory. The study underscores the relevance of these practices in the current environmental crisis, marked by a surge in plastic production around 400 million tons in 2021. Despite the convenience of plastics, their adverse post-usage impact necessitates alternatives and adherence to the 3R concept. The study argues for the reduction of plastic usage through the application of Buddhist 3R practices, which involve controlling desires and understanding the negative consequences of actions. While these practices were originally intended for monks, they are applicable to laypeople in achieving environmental sustainability and reducing pollution from plastic usage. The research presents a compelling case for the integration of Buddhist 3R practices into contemporary strategies for environmental sustainability. By aligning with Buddhist principles, individuals can contribute to environmental sustainability and mitigate the harmful impacts of plastic pollution on human health and the planet.

Keywords: *Buddhist environmentalism, Plastic pollution, Reduce, Reuse, Recycle (3R), Mindful consumption*

VOLUNTEER BEACH CLEANUPS: PUBLIC ENVIRONMENTAL STEWARDSHIP COMBATING PLASTIC POLLUTION IN SRI LANKA

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As a prime environmental conservation entity, the Turtle Conservation Project (TCP) has taken the responsibility of organizing beach cleanup for volunteers by providing a platform to advertise beach cleanup events, recruiting volunteers, leading the cleanup on-site, and ensuring the collected litter is removed from the site. The TCP aids in organizing multi-site cleanup campaigns and providing support materials like collection bags, gloves, and step-by-step guides for organizing cleanups. The campaign aims to decrease litter on Sri Lankan beaches, and five entities have so far participated: the government, universities, the private sector, foreign nationals, and non-governmental organizations. Fifteen beaches in the Western and Southern provinces from Ja-Ela to Ussangoda were cleaned between August 2022 and January 2024, with some beaches undergoing multiple clean-ups. This assessment was conducted to evaluate the beach cleaning process. During the assessment period, TCP participated every day (100%), while government entities participated on 19% of the evaluated dates, followed by NGOs on 14%. Universities, the private sector, and foreign nationals volunteered equally, each contributing to 10% of the dates for the beach clean-up. During the specified period, the cleanup efforts were focused on selected beaches. Panadura accounted for the highest percentage of cleanups from the total number of events (29%), followed by Kalutara (12%), Galle, Matara, and Ja Ela each subjected to 9% of the cleanups, while Rekawa accounted for 6%. The other beaches were similarly cleaned, accounting for 3% of the overall cleanup efforts. Regardless of the reasons behind the selective approach, it's essential to continually assess and adapt cleanup strategies to address evolving environmental challenges and community needs. Additionally, efforts should be made to acquire broader stakeholders' support and participation. TCP is implementing a holistic approach to beach cleanup, thereby significantly preserving Sri Lanka's coastal ecosystems, and promoting environmental stewardship.

Keywords: *Beach cleanup, Plastic pollution, Sri Lanka*

SECURING MARITIME ENVIRONMENTS: COLLABORATIVE STRATEGIES IN SRI LANKA'S NAVY AND COAST GUARD'S BATTLE AGAINST PLASTIC POLLUTION

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As Sri Lanka faces a crippling tide of plastic pollution choking its coastlines, this study navigates the collaborative strategies employed by the Sri Lankan Navy and Coast Guard in tackling this environmental crisis. Employing a nuanced mixed-methods approach, the research utilized qualitative interviews (n = 10) with key stakeholders from the Navy and Coast Guard, alongside quantitative surveys (n = 230) distributed within coastal communities in the western province. This comprehensive approach unveiled a spectrum of collaborative initiatives, each with its own nuance and impact. Joint clean-up drives emerged as highly supported, with 73% of participants expressing satisfaction due to a visible reduction in plastic waste along Sri Lanka's coastlines. However, these efforts were often hampered by inadequate funding, logistical hurdles, and uneven awareness levels within communities. Meanwhile, technology-driven waste monitoring garnered the interest of 48% of respondents, who recognized its potential to leverage real-time data for optimized collection and disposal and emerged as a potential game-changer within the Sri Lankan context. Additionally, community-led recycling initiatives received endorsement, with 63% of surveyed individuals acknowledging that local communities taking ownership of their environment offered a sustainable and scalable path forward. Further, these percentage representations not only highlight these innovative approaches but also underscore the crucial need for improved communication andresource allocation among stakeholders. The study further pinpointed critical systemic challenges, with inadequate waste management infrastructure and limited stakeholder coordination acting as roadblocks to long-term effectiveness. By contextualizing these findings within the broader landscape of existing plastic pollution management and collaborative governance literature, the study sheds light on the intricacies of navigating this challenge in the Sri Lankan context. Ultimately, this research stands as a valuable contribution to the global discourse on sustainable practices and collaborative governance for combating coastal plastic pollution.

Keywords: *Coastal pollution, Plastic pollution management, Collaborative strategies, Community empowerment.*

POLYTHENE AND PLASTIC USAGE IN PUTTALAM URBAN COUNCIL: A SURVEY ON HOUSEHOLD PRACTICES

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Plastic and polythene have become an integral part of modern human life, offering convenience and innumerable applications. Plastics and polythene are exceptionally versatile and beneficial, but they lead to environmental pollution due to improper disposal and mismanagement of plastic and polythene. Therefore, the present study was aimed to determine the usage of household polythene and plastics and disposal practices in Puttalam urban council. A structured questionnaire survey was conducted to understand the utilization of plastic and polythene, disposal practices and knowledge of waste disposal, and public perceptions about plastic and polythene. The 150 respondents were selected using the cluster sampling technique; face-to-face and online interviews were conducted to collect information. The study results revealed that all the respondents use plastic and polythene, including 94.6% of those who use shopping bags for their daily lives. Further, most respondents use plastic and polyethylene due to their easy availability (46%), lack of alternatives (40%), lightweight, and low cost. In addition to that, it was noted that HDPE, LDPE, PET, and PS were usually found in the study area. However, around 66% of respondents hand over their waste to local authorities, and others mismanage their household polythene waste. Even though the participants were knowledgeable about waste segregation, recycling, and reuse of plastics, the local authority collects the unsegregated waste. Therefore, it's timely and important to implement strict regulations, raise awareness, and take the necessary actions to control the mismanagement of polythene and plastics.

Keywords: *Polythene and plastic, Usage, Disposal, Puttalam Urban Council, Waste management*

UNDERSTANDING CONSUMER BEHAVIOUR OF POLYTHENE AND PLASTIC GENERATION IN SUPERMARKETS FROM KEGALLE, SRI LANKA

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Polythene and plastic trash are persistent in the environment and can have detrimental effects on ecosystems, wildlife, and human health. The rate and volume of plastic and polythene generation have increased over time. Due to their substantial use of plastic packaging for a wide range of products, supermarkets play a key role in the development of plastic waste and polythene. The quantity and kind of plastics and polythene used in Sri Lankan supermarkets are not being managed effectively and supermarkets in the Kegalle area were selected for the study. A structured questionnaire was used to gather information about the topics of personal and social background; the status of supermarket plastic and polythene; shopping habits and plastic pollution. 200 respondents were selected from the supermarkets located in Kegalle, Sri Lanka. The data were collected through face-to-face interviews. All the participants use polythene and plastic products in their day-to-day activities and 37% stated that it's safe for packaging. Results further revealed that there is a difference in polythene purchased from the supermarket and actually needed polythene bags for participants. Further, around 45% of participants stated that they do not require extra bags for their goods and 55% of them mentioned that they must take polythene bags from the supermarkets. The fruits and vegetables area has the highest number of polythene generation (24%) and the pharmacy area is the least polythene generating area (3%) in the supermarkets. LDPE and HDPE are the most used plastic types that are generated from the supermarkets in the Kegalle area. Most participants were aware of plastic and polyethene pollution and obtained information from television (40%) and social media (31%). However, most of the participants have no proper knowledge of household waste disposal methods, and 88% of participants are ready to avoid the use of plastic items if they have alternatives. Therefore, a comprehensive strategy incorporating adjustments to customer *behaviour*, supplier and engagement of the local community, and packaging methods is needed to address the problem of plastic and plastic generation in supermarkets.

Keywords: *Plastic waste, Supermarkets, Kegalle, Consumer behaviour*

Track 5
Plastic Waste Management

Global Trends in Plastic Waste Management: Challenges and Opportunities

The worldwide production of plastics reached a staggering 400.3 million metric tons in 2022. An increase of 1.6 percent from the previous year. The incredible versatility of this group of materials accounts for the continued growth in production year after year since the 1950s. The market value of plastics also continues to grow, and it will appreciate the reduction of fossil fuel extractions. World Economic Forum predicts production to double in the next 20 years. Plastic recycling rates, meanwhile, hover around 30 percent in Europe, just nine percent in the USA, and zero or close to it in much of the developing world.

There is considerable influence of plastics in the process of urbanization and industrialization. There are also marked disparities in the use of plastics between developed and developing countries. In a recent publication of the non-profit Worldwide Fund for Nature, WWF stated, "Mismanagement costs low- and middle-income countries at least $149 per kilogram of virgin plastic, compared to just $17 per kilogram for wealthier nations". In places like Brazil, Ethiopia, Fiji, and India, governments' limited capacity to control or regulate plastic production has led to growing health risks from petrochemical plants' toxic air emissions and chemical spills. Meanwhile, a pileup of discarded plastic threatens to overwhelm these countries' waste management infrastructure, causing widespread land and water pollution. The costs are not inclusive of diminishing "ecosystem services".

Elaborating further, the manufacturing processes of plastics generate a large amount of pollution, including greenhouse gases, volatile organic compounds (VOCs), and other toxic chemicals. Moreover, energy pollution is very high, with 83.85 MJ/kg of plastic and for recycling 35 to 60 MJ/kg. In most developed countries, there are effective controls because manufacturers have much understanding of the penalties. Regulatory compliance is essential for any business, including plastics manufacturers. Failing to comply with regulations can lead to severe legal, financial, and reputational consequences. Regulations can help mitigate these impacts and promote more sustainable practices. Therefore, the utility value of plastics is higher in developed countries. Inventions and innovations become meaningful with greater care for workers and consumers alike. Many countries have banned the use of microbeads in cosmetics and personal care products due to their harmful impact on the environment. According to the EU, alternative plastics, such as biobased, biodegradable, and compostable plastics may be a more sustainable alternative to fossil-based, non-biodegradable plastics. However, they also present their sustainability challenges and trade-offs that must be carefully assessed and considered. The regulations too drive EPR to get market access and advantages like stable bioplastics. In the UK, a plastic packaging tax has been introduced to incentivize manufacturers to reduce their use of plastic. This tax is aimed at reducing the amount of plastic waste that is sent to landfills.

Enforcement Mechanisms are binding by the regulatory agencies. Manufacturers are also expected to self-regulate, implementing internal controls and procedures to ensure

compliance with regulations. Third-party auditors may also be used to verify compliance and identify areas for improvement. Environmental Courts/Green Tribunals play a major role even in developing countries. Express Pearl disaster causing severe plastic and other chemical pollution of the sea and the coast is a good example of poor enforcement of environmental laws to prevent and obtain rightful compensation for the damages.

The average Japanese person uses around 450 plastic shopping bags per year, an astounding figure that is 11 times higher than Indonesia and 17 times higher than the United Kingdom. Only 22% of the collected plastic waste becomes mechanically or materially recycled because Japan is second to the USA in the use of single-use plastics. Hence, incineration is dominating in Japan and landfills in the USA. Most of the incineration plants of mass burning are not efficient and require upgrading or replacement.

The supermarkets are reducing the income generation of the vendors while increasing the use of plastics. These enterprises are highly dependent on the use of plastics. It reduces the internalization of the economy, thus promoting outflow of capital. Even in the UK, a reversal of market system taking place because the quality of life improves with fresh products and increasing community spirit. Such systems like in Germany are reducing the use of plastics and promoting better packaging materials with lower consumption of food. Ironically, a consortium of petrochemical and consumer-goods companies have called the Alliance to End Plastic Waste. They have only allocated $1.5 billion over five years to the problem. They aim to support alternative materials and delivery systems, beef up recycling programs, and more controversially promote technologies that convert plastics to fuel or energy. It boils down to greed or motivation.

Partly, the Mismanagement of Plastic Waste (MPW) arises from social behaviours. The World Bank studies in Indonesia and Thailand show similarities to Sri Lanka in the MPW, polluting oceans. Colossal amounts of plastics get washed into oceans from tsunamis and increasing the incidence of floods while affecting the marginalized poor. Henderson of Brunel University, London stated that Governments across the EU and beyond are implementing various regulatory policies but there is also an increasing focus on human behaviours. After all, if this is a relatively recent, 'human-made' problem perhaps the solution lies in simply changing our consumption or disposal practices or both. The author was interested in how different groups of socially situated people made sense of the idea that plastic waste could be hazardous. "Litter Things Matter" (Wastebuster, 2018) is a successful story by the author.

The basis of changes in the national policy will grossly depend on definitive limits on the use of plastics in the open environment. A legally binding international instrument on plastic pollution, including the marine environment is being formulated by the second Intergovernmental Negotiating Committee (INC-2) (UNESCO-UNEP). The agreement should include legally binding obligations for countries to reduce their plastic production and eventually eliminate "all harmful plastic products". WWF is also calling for globally harmonized product design requirements that make reuse and recycling easier, for rich countries and the private sector to help finance the treaty's implementation in low- and middle-income countries. Other groups would like the treaty to crack down on chemical additives used in plastic products, and to ban controversial waste management technologies

like chemical recycling. Many organizations have also pushed for a just transition for waste handlers (pickers) to make healthy working environments.

Japan and Germany have cutting-edge plastic waste management systems, advanced infrastructure, and various other technologies and policies for recycling and waste processing with proactive cooperation with citizens, companies, and local authorities. The German policy of restricting the categories of plastic to enable recycling is commendable. Waste-to-energy systems are growing as a transition technological option. China alone has 300 WTE with another several hundred in the pipeline. They should be upgraded to produce more power and emit low levels of toxic pollutants such as dioxins, acid gases, and heavy metals. Modern plants employ sophisticated scrubbers, precipitators, and filters to capture these compounds, but as the World Energy Council cautiously states, in a 2017 report, "These technologies are useful as long as the combustion plants are properly operated, and emissions controlled". Moreover, gasification and pyrolysis systems are becoming more promising. Lifecycle Assessment (LCA), carbon footprint studies, Social Impact Assessments, and a likely entropy increase values will dictate the choice of technological options with the final aim of reducing plastics. Why not mimic the developed countries by credible taxation of the polluting enterprises or provide the opportunity for them to reinvest in sustainable bioplastic production or biomaterials, like veg-leather, and their recycling pathways with the use of renewable energy? Japan for example more concretely embarked on ambitious goals in their strategy to maximize the introduction of bioplastic up to 2 million tons approximately by 2030. Developing countries too could have a strong socio-economic basis with homegrown technologies to produce sustainable bioplastics.

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Innovations and Strategies in Plastic Waste Management

Plastic is an essential material, and it plays an important role in the life of human beings because of its unique and robust properties. The exponential growth of the plastic industry is due to its cheap production from petroleum and the availability of a variety of plastics. The use of these plastics is increasing tremendously around the world due to their compatible properties in diversified applications. About 42% of the total non-fibre plastics (mostly PP, PE, and PET are used in packaging applications. PVC and non-fibre plastics are mainly used in building and construction. The use of these plastics produces lots of waste. The plastic used in the majority of the applications has a low life leading to the generation of huge plastic waste, huge littering on the outskirts of towns creating unhealthy conditions in and around the human ecosystem. In addition, the unscientific dumping and unskilled processing or recycling of such plastic wastes may lead to fugitive and toxic emissions, infertile land due to its barrier properties, drain chocking problem, and disrupt the marine ecosystem. The important concern is regarding the marine ecosystem. It is estimated that 100 MT of plastic waste will enter the oceans by 2025. These plastics degrade slowly and the fragments change into microplastics, they cause extensive contagion of marine ecosystems because these plastics are engulfed by algae (zooplankton and phytoplankton) and affect their functioning and health. Marine plants on photosynthesis produce approximately 70% of the world's oxygen and the growth of these plants is inhibited by microplastics and hence adversely affected climate change and global warming. Due to bio-accumulation of microplastics in humans causing the oxidative stress to carcinogenic behaviour, as these plastics once release inside the body, releases constituent monomers and toxins. It was reported that yearly human consumption of microplastics varies from 74,000 to 121,000 particles.

All these issues have become very acute and the government has imposed a ban on plastic bags. Scientific breakthroughs have made it possible to provide some sustainable and green solutions to this problem. Non-woven plastics are one such invention that is being encouraged to be used as a substitute for ordinary plastic bags as they can be used several times before they get worn out, and also, they are recyclable although not compostable. Another alternate is the use of bioplastics, which are of two types.1) Biodegradable plastics: These plastics are completely degraded to form carbon dioxide, water, and an insignificant amount of residue. 2) Bio-based: these plastics are the result of renewable sources such as biomass instead of fossil feedstock. For example, PE a conventional plastic can be produced by modern technologies from renewable sources, which turns into bio-based polyethylene. In addition to synthetic plastics, the global production of bioplastics increases day by day. The global manufacture of biopolymers was 2.110 MT in 2018 and it is estimated that it will reach 2.620 MT by 2023. Despite a hasty market growing, bioplastics represent below 1% of the entire plastic production because of their inferior mechanical properties. Now slowly synthetic plastics are replaced by non-woven and biodegradable plastics. In this digital age, a large amount of electronic goods is being used, which are also responsible for the generation of plastic wastes. The increase in waste plastics also creates pollution. Therefore, it is a

difficult task for the local municipal authorities to find out a suitable way of solid waste management and sanitation. These waste plastics create a negative impact on the environment and public health due to improper solid waste management and it also causes the littering and choking of the sewage system.

Plastic waste recycling is the most environmentally sustainable method to address the issue of discard waste plastics. The recycling of waste plastic is economically feasible due to its conversion into different resources. Plastic waste recycling is mainly done in four ways 1) primary (mechanical reprocessing in products with similar properties): It is also known as closed-loop recycling 2) secondary (mechanical reprocessing in products requiring inferior properties): It is referred to as downgrading 3) tertiary (recovery of chemical constituents): When plastic is de-polymerized into its original chemical ingredients, it is referred to as chemical reprocessing. The advantage of this process is the recovery of the petrochemical elements of the polymer. Another example of tertiary recycling is the composting of biodegradable plastics. This process is no doubt technically feasible but economically not viable due to the cost of plant and process to produce monomers from waste plastics 4) quaternary (recovery of energy): Energy is recovered from waste plastics by incineration. Recently waste plastics are also reported to be used in the production of different carbonaceous products like CNT, Carbon quantum dots, carbon fibers, activated carbon etc. Other applications include co-firing of plastics in cement industry, making of plastic roads, and paver blocks from waste plastics. The present talk focus on the different plastic waste management approaches with a brief overview of each technique. The methods and technologies of waste plastic conversion have been selected based on economic, environmental, social, and technical characteristics.

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VALORIZATION OF WASTE PLASTIC MULCH AND INVASIVE WEED BIOMASS THROUGH CO-PYROLYSIS INTO BIOCHAR

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Circular economy drives towards sustainable conversion of waste and biomass into valuable resources. While prior research has delved into the co-pyrolysis of plastic blends with lignin-rich biomass: woody and agricultural biomass, a notable research gap exists regarding the co-pyrolysis of mixed invasive weed biomass and plastic mulching sheets. This study emphasizes the underexplored recovery of biochar from the co-pyrolysis of Invasive Weed Biomass (IWB) and Waste Plastic Mulch (WPM). Six invasive weed species: Wal Suriyakantha (*Tithonia diversifolia*), Ipil-ipil (*Leucaena leucocephala*), Baloliya (*Lantana camara*), Katakalu Bovitiya (*Clidemia hirta*), Podisinchomaran (*Eupatorium odoratum*), and Wedelia (*Sphagneticola trilobata*) were subjected to co-pyrolysis with WPM at a temperature of 550°C. This experiment involved six distinct IWB: WPMmass ratios as 100:0, 99.75:0.25, 97.5:2.5, 95:5, 92.5:7.5, and 90:10, respectively. All pyrolysis experiments were done in triplicates, and produced biochar qualities were evaluated using physicochemical and surface morphological attributes. The findings indicated that, among the weedbiomass species, *Clidemia hirta* exhibited the highest biochar recovery (31±1%) compared to the lowest yield from *Tithonia diversifolia* (28 ± 1%) and the yield difference was significant ($p \leq 0.05$).The increasing plastic ratio of the mixture decreases the biochar yield by 1–5%. Furthermore, an increase in WPM content was observed to elevate the volatile matter content by 1–7%. Notably, thepH values of all biochar samples fell within the range of 10 to 12, interpreting them as well-suited for soil acidity management. Additionally, Fourier-transform infrared (FTIR) analysis performed in 1000 cm^{-1} to 3500 cm^{-1} wavelength owing unveiled prominent surface functional groups such as carbonyl in the biochar, with the possible presence of alkene groups owing to the involvement of plastic mulch. In conclusion, the co-pyrolysis process involving invasive weed biomass and waste agricultural plastic mulch emerges as a promising avenue for valorizing agricultural waste.

Keywords: *Circular economy, Biochar, Co-pyrolysis, Invasive weed biomass, Waste plastic mulch*

STUDY THE EFFECTIVENESS OF CATALYTIC PYROLYSIS OF LDPE WASTE PLASTICS USING ZSM–5

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The catalytic pyrolysis process enhances selectivity towards desired products while reducing temperature in the process, making it an attractive approach for waste valorization. ZSM-5 (Zeolite Socony Mobil-5) is a zeolite catalyst widely used in plastic waste pyrolysis. This catalyst has shown effectiveness in cracking larger hydrocarbon molecules present in plastic waste into more valuable, smaller hydrocarbons suitable for fuel production or chemical feedstocks. This study investigated the catalytic pyrolysis of waste LDPE using ZSM-5 catalysts at the ratio of waste to catalyst 10:1. A cost-effective, lab-scale pyrolysis system was employed for this study, utilizing ZSM-5 catalysts having different Si/Al ratios (360, 117, and 38). Thermal pyrolysis was conducted in the absence of a catalyst and yielded a liquid fraction of 74.06 ± 2.98 wt.%. Amongst the three catalysts, the highest liquid yield, 38.08 ± 1.86 wt.%, was produced by the ZMS-5 (Si/Al-360) catalyst, while the lowest (31.84 ± 1.28 wt.%) was observed in ZMS-5 (Si/Al-38). The yield of ZMS-5 (Si/Al-117) was 35.11 ± 0.86 wt.%. The resulting liquid fractions were fractionated at different boiling point ranges (70 – 160 °C, 160 – 250 °C, 250 – 340 °C, and above 340 °C) and each fraction was analyzed using GC-MS. According to the GC-MS results, the major compounds in the liquid yield resulting in the thermal pyrolysis process are decane, 1-undecene, 1-tridecene, tetradecene, and hexadecane. The ZMS-5 (Si/Al-360) produced 1-ethyl-2-methyl-benzene, diethylbenzene, and 1-ethyl-4-methyl- benzene as the predominant compounds, while that by ZMS-5 (Si/Al-117) were 1-ethyl-2-methyl- benzene, 1-methyl-2-propyl-benzene, and 1-ethyl-2-methyl-benzene. The major constituents in the liquid yielded by ZMS-5 (Si/Al-38) were 1-ethyl-2-methyl-benzene, decane, and pentadecane. The ZSM-5 catalysts exhibited a higher formation of alkylated aromatics than aliphatic alkanes and alkenes. Current results indicate that thermal pyrolysis is more favorable for plastic waste conversionto fuel oil, yielding higher liquid products and predominant aliphatic compounds, enhancing suitability for use as fuel oils.

Keywords: *Pyrolysis, LDPE waste, ZSM–5 catalyst, Fractionation, GC-MS analysis*

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REVOLUTIONIZING WASTE MANAGEMENT THROUGH AN EMERGING SOLUTION: POTENTIAL OF MICROPLASTICS (MPS) PHYTOEXTRACTION FROM TEXTILE WASTE SLUDGE USING LEMNA MINOR

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Microplastics (MPs) have gained significant global concern due to their widespread presence, potential harm to ecosystems, and ability to enter biological systems. The wastewater treatment plant (WWTP) sludge, rich in fibrous-shaped MPs, is a primary source of MPs in terrestrial environments. Managing MPs in soil from WWTP sludge presents significant challenges. Therefore, it is necessary to develop effective management solutions for this waste stream. The study aimed to assess the potential of duckweed (*Lemna minor*), an aquatic macrophyte, in phytoextracting MPs from the sludge. Preparation of dry samples and wet peroxide oxidation processes were done for the identification of fiber-shaped MPs in selected sludge. Microscopic analysis revealed an average MP concentration of 2.2 particles per gram in the selected textile waste sludge, primarily in fibrous form. *Lemna minor* was cultivated in the sludge samples. As the plants matured, a steady increase in fibrous-shaped MPs phytoextraction was evident, with concentrations reaching 1.3 MPs per plant after 7 days, 5.6 MPs per plant after 21 days, and 9.2 MPs per plant after 45 days. The visual sorting method was carried out to count MPs using an optical microscope. These results highlighted the proficiency of *Lemna minor* in MP phytoextraction through an eco-friendly and economically viable process to mitigate MP contamination from textile waste sludge. Once these macrophytes reach their maximum biomass yield, it is recommended to harvest and burn them in available burning facilities. The resulting remediated sludge can be used as a fertilizer. In addition, attention should be directed towards industrial plants with potential for textile fiber production, such as corn, wheat, hemp, and bamboo, to offer a more comprehensive solution to MP phytoextraction aligned with circular economy principles.

Keywords: *Phytoremediation, Aquatic macrophyte, Microplastic pollution, Textile waste*

KNOWLEDGE, ATTITUDE AND PRACTICES TOWARDS SINGLE-USE PLASTICS WASTE AMONG HOUSEHOLDS: A CASE STUDY IN EASTERN PROVINCE, SRI LANKA

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The rise of single-use plastic waste has become a global challenge that needs to be rationally managed by all nations to have a sustainable environment. The Sri Lankan government banned selected items of single-use plastics in July 2023. However, the public seems not concerned about the restrictions on the consumption of plastic or about their responsibilities. There is a lack of studies on single-use plastic waste in rural settings. The Divisional Secretariat (DS) area, Sammanthurai is one of the largest DS areas in the Eastern Province and the study assessed the knowledge, attitude, and practice of households towards single-use plastic waste management in the DS area, Sammanthurai. A community-based cross-sectional descriptive study was carried out from October to November 2023 among the households. Interviewer-administered questionnaires were used to collect data from randomly selected 320 adults aged more than 18 years. The majority of respondents (64%) were less than 60 years, 58% were females and the majority of them (76%) were Muslims. Half of them were employed and 30% of them were housewives. Only 55% were aware that single-use plastics cause harmful effects on health and more than 70% were unaware that it could cause environmental damage and climate change. Only 25% of them knew about the ban imposed on single-use plastics. The attitude towards single-use plastic was satisfactory as 60% of them thought that single-use plastic should be prohibited and more than half of them were willing to use alternatives for plastics. However, the practice was found to be poor as more than 90% were using single-use plastics daily. Although the overall knowledge of single-use plastic was inadequate and practices were unsatisfactory, the attitude was favorable toward banning plastics. Sensitizing the public about the harmful effects of plastics and promoting reusable items, empowering households to utilize the alternatives and strict implementation of the plastic ban is crucial for a sustainable environment.

Keywords: *Single-use plastic, Plastic waste, Knowledge, Attitude, Practice*

CLIMATE CHANGE EDUCATION FOR ENGAGEMENT, INVOLVEMENT AND EMPOWERMENT IN PLASTIC POLLUTION MITIGATION IN SRI LANKA: A LITERATURE REVIEW

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This literature review explores the imperative role of climate change education in addressing and mitigating plastic pollution, focusing on the interconnection between engagement, involvement, and empowerment within communities. During the review of indexed research papers, a noticeable gap was identified in the exploration of the role of climate change education in mitigating plastic pollution in Sri Lanka. This abstract highlights the need for further investigation into the underexplored relationship between climate education and plastic pollution mitigation within the Sri Lankan context. Accordingly, the objective of this literature review is to provide comprehensive knowledge on how climate change education can effectively increase the participation of the community of Sri Lanka in taking responsible actions in demand management and end-of-life management of plastics. As plastics emit greenhouse gases in their entire lifecycle, from raw material extraction to disposal, they contribute directly to the increase in the average global temperature and escalating climate change. Climate change education can provide knowledge of the impact on the environment, and this awareness can empower communities to rethink and take forward responsible plastic demand management, production, and consumption measures to prevent and reduce greenhouse gas emissions throughout the plastic value chain. This literature review highlights the necessity of addressing all three domains of learning-cognitive, affective, and psychomotor-equally to enhance knowledge, cultivate a sense of responsibility, and take positive actions to mitigate plastic pollution. Furthermore, it can lead to innovative new technologies and the development of impactfulpolicies and regulations to overcome this challenge. This literature review also explores the practical impact, evaluating the progress Sri Lanka has made in tackling plastic pollution through climate change education initiatives. Finally, the findings provide evidence to understand the imperative of implementing plans to ensure the delivery of better climate change education to the communities to reduce pollution and achieve Sustainable Development Goals: Quality Education (SDG 4), Responsible Consumption and Production (SDG 12), and Climate Action (SDG 13), and indirectly all the other goals through changing linear economic practices to circular economy practices to bring benefit to all living beings.

Keywords: *Climate change, Education, Mitigation, Plastic, pollution*

CHALLENGES IN E-WASTE MANAGEMENT IN THE WESTERN PROVINCE OF SRI LANKA

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Plastic and e-waste are classified under two categories, although both can sometimes be found together, especially when it comes to electronics, many parts contain plastic. The modern era's growth of electronic devices has increased electronic waste, creating problems for the world's waste management systems. E-waste is a fast-growing waste type due to the rapid urbanization and economic development that have accelerated the consumption of electronic products. The improper management of electronic waste is a significant environmental issue in Sri Lanka, especially in the western province, being the most urbanized, industrial activities-oriented province in Sri Lanka. The study focuses on exploring the challenges encountered in e-waste management in the western province through a qualitative study. Purposive sampling was used to collect data from fifteen formal e-waste collectors through an online questionnaire and five subject matter experts related to e-waste management from the Central Environmental Authority, Waste Management Authority, Ministry of Environment, and the University of Peradeniya through semi-structured interviews. Challenges that were found were categorized into two groups: challenges for subject experts and formal electric waste collectors. The subject experts mentioned several challenges, including the importation of used and small electronic items by workers from other countries, a lack of a suitable database for collecting e-waste, low-quality equipment with a short lifespan on the market, the difficulty of coordinating and expediting the clarification of Harmonized System Codes (HS codes), and a lack of cooperation among other institutions. The informal collectors' involvement in e-waste collection, fluctuations in the US dollar, the length of time required to obtain an Environmental Protection License, the lack of government support, the time-consuming and expensive segregation process, and the lack of knowledge regarding e-waste recycling were identified as challenges for formal e-waste collectors. In conclusion, further improvements are needed to enhance the e-waste management system in the Western province before it becomes a critical issue. Recommendations include establishing a separate authority for e-waste management, developing a proper database for e-waste collection, promoting the concepts of circular economy, extending vendor responsibility as most electronic equipment is imported, conducting education and awareness programs for producers and retailers, and further research and development is required to address the issue.

Keywords: *Challenges, E-waste collection, E-waste management, Western province*

PLASTIC WASTE MANAGEMENT: CHALLENGES, STRATEGIES, AND SUSTAINABLE SOLUTIONS

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The escalating global issue of plastic waste necessitates a focused exploration of effective management strategies. This paper reviews the challenges associated with plastic waste, including its prolific generation, inadequate disposal methods, and environmental consequences. Sustainable solutions, encompassing technological innovations, public awareness campaigns, and policy frameworks, are analyzed for their potential to mitigate the environmental impact of plastic waste Exponential growth in plastic production over the past decades has resulted in a pervasive environmental challenge of accumulation of plastic waste. This issue poses a significant threat to ecosystems, human health, and the overall well-being of the planet. Single-use plastics, packaging materials, and disposable products contribute to the persistent accumulation of plastic in landfills, oceans, and other ecosystems. The inadequacy of traditional waste disposal methods exacerbates the problem, leading to pollution and ecological harm. Recycling initiatives are pivotal in reducing the demand for new plastic production, conserving resources, and minimizing environmental degradation. However, challenges such as limited recycling infrastructure, contamination of recyclables, and insufficient public awareness hinder the effectiveness of recycling efforts. The transition towards a circular economy, where plastic products are designed for durability, reuse, and recycling, represents a promising strategy. This approach aims to break away from the linear "take-make-dispose" model, promoting a closed-loop system that maximizes the value of plastics throughout their lifecycle. Innovative technologies, such as advanced sorting and recycling processes, contribute in enhancing the efficiency of plastic recycling hence waste minimization. Policy frameworks also play a crucial role in shaping effective plastic waste management. Governments and international organizations are increasingly recognizing the urgency of addressing plastic pollution through legislation and regulations. Extended Producer Responsibility (EPR) programs, plastic bans, and incentives for sustainable packaging are among the policy measures implemented to mitigate the environmental impact of plastic waste. The research on plastic waste management involves Quantitative research methodology and comprehensive approaches to understand and address the complexities associated with this global challenge. In conclusion, addressing the challenges of plastic waste management requires a holistic and concerted effort from various stakeholders. Sustainable solutions encompass technological innovations, public awareness campaigns, and robust policy frameworks. By embracing these strategies, society can move towards a more responsible and sustainable approach in managing plastic waste and safeguarding the environment for future generations.

Keywords: *Biodegradable Plastic, waste management, recycling, circular economy*

ABIOTIC DEGRADATION OF MICROPLASTICS IN IRON RICH SOIL

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Microplastic accumulation in the environment has become a global concern. Natural degradation of microplastics takes an extended period; hence, their persistence in the environment affects the biological, chemical, and physical properties of the immediate environment. The Fenton process and photo-catalytic reactions are two main abiotic mechanisms affecting the degradation of organic materials and polymers. The present study examines the potential of iron oxide-rich natural soil (IS) in microplastics degradation via the Fenton process and photo-catalytic oxidation. Micro-sized polyethylene (PE), polypropylene (PP), and polyethylene terephthalate (PET) were used as microplastic test samples. Each type was mixed with IS (PE = 1.5 mg/kg, PP = 0.5 mg/kg, PET = 3 mg/kg) separately in glass containers. Two distinct experimental setups were employed to evaluate the effect of UV light using a UV-light box with 4 UV lamps of 365 nm and 10 W and the effect of ambient light. The same procedure was repeated with garden soil (GS) for comparison purpose. After 24 hours, MPs were separated, washed with DI water, and analyzed for morphological and structural changes by Scanning Electron Microscopy (SEM) and FTIR spectroscopy, respectively. All plastic types showed some morphological changes upon treatment compared to the untreated original samples. Variations in FT-IR peak positions and intensities were indicative of the extent of MPs degradation. The highest degree of degradation was recorded for both PE and PET in IS compared to GS under UV light. The extent of PP degradation was higher in IS over GS under ambient light. The data further confirmed that iron-rich soil enhances the degradation of PE, PP, and PET compared to GS.

Keywords: *Microplastics, Degradation, Iron-rich soil, Polyethylene (PE), Polypropylene (PP), Polyethylene terephthalate (PET)*

NAVIGATING PLASTIC WASTE GOVERNANCE, RESEARCH, AND THE CONTEMPORARY LANDSCAPE OF THE COASTAL ZONE OF SRI LANKA

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Sri Lanka is a top plastic beaching island in the Indian Ocean. This study investigated plastic waste management in the Sri Lankan coastal zone in three stages. A database of policy and institutional management structures was constructed in MS Excel and examined to connect laws and responsible institutions. A literature survey of marine pollution research conducted during the past 50 years was conducted to recognize available knowledge, and a time series analysis was conducted in Minitab 20.3 software. The current pollution status was assessed by a reconnaissance survey along the entire coastal belt of Sri Lanka at 10 km intervals during the period of December 2021 – April 2022. The data were analyzed using MS Excel. The geographical distribution of literature and current pollution were both mapped in Arc GIS 10.5. The National Environmental Act No. 47 of 1980 and several regulations thereunder specify and restrict the use of various plastics. The Marine Pollution Prevention Act and the Coast Conservation and Coastal Resource Management Act also significantly contribute to plastic waste management in the coastal zone. While the Central Environmental Authority is the main responsible institution, nine other principal bodies, including all local authority categories covering 111 local government ranges and waste management authorities established for selected areas, manage coastal plastic waste. The geographical distribution of plastic pollution research was not homogenous, presenting research in concentrated areas with gaps. There was a distinct absence of research in the Northern region of the country. Coastal pollution research was a relatively new discipline where plastic pollution appeared at its latter part. The origin and types of current artificial pollutants varied geographically around the island. Plastics were dominant among them, ranging from macrodebri to nurdles. Neglect of transboundary plastic pollutants, neglect of different plastic types in contrast to regulated plastic pollutants, limited research, inadequate collaboration, and challenges in monitoring, cleanup, and mitigation are major obstacles to plastic waste management in the coastal zone of Sri Lanka.

Keywords: *Plastic waste, Waste management, Transboundary plastics, Coastal zone, Coastal waste, Coastal pollution*

A COMPREHENSIVE REVIEW OF CIRCULAR ECONOMY METRICS IN PLASTIC WASTE MANAGEMENT FOR A SUSTAINABLE LIVING ECOSYSTEM

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Plastic waste has evolved as a critical risk factor in the global world. Nearly 4% of total greenhouse gas emissions come from the plastic life cycle. The objective of this comprehensive literature review is to analyze the various strategies in the plastic waste management mechanism around the world and their potential in circular economy metrics to meet sustainable practices. To achieve this scope, a broader search was done in the databases of Google Scholar, Science Direct, PubMed, IEEE Xplore, and Elsevier's Scirus using keywords such as "plastic, waste management, circular economy, sustainability, and impacts to the environment and human health." The articles were extracted from the database from 2000 to 2024 and reviewed from around 300 publications. The key findings of this study are the development of a holistic metric framework for plastic waste management strategy based on circular economic metrics from production to end-of-life disposal, resource efficiency identifications and innovations in plastic waste management, and eco-system impact assessment. Increased plastic pollution correlates with incompetence in ecosystem health and human well-being. The future trends of the plastic waste business to overcome pollution issues based on ongoing research were also discussed. In conclusion, this study revealed the need to adopt circular economy principles in plastic waste management for a sustainable eco-system. A holistic approach concerning technological advancements, multi-stakeholder involvement, collaborative teamwork, a regulatory framework, green consumerism, and public education are key contributing factors in creating a sustainable ecosystem through effective plastic waste management. The influence and concern of stakeholders in the life cycle assessment of plastic waste play a crucial role in an effective waste management strategy. This study embarks on the value of the circular economy approach, validating the need for proper plastic waste management with responsible production and consumption patterns and the proactive behavior of people.

Keywords: *Circular economy, Incineration, Plastic pollution, Recycling, Sustainability, Waste management.*

GAMIFICATION OF PLASTIC WASTE MANAGEMENT FOR BEHAVIORAL CHANGE

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In response to the escalating plastic waste crisis, this study explores innovative solutions to promote responsible waste management practices, specifically focusing on the efficacy of gamification in driving behavioral change towards plastic bottle recycling. Employing a user experience, investigated the motivational impact of gamified elements on participants' recycling habits, emphasizing engagement, enjoyment, and long-term adherence. The study was conducted within a Sri Lankan university setting, where a SMART IoT device was deployed to track bottle deposits, including timestamps, quantities, and associated phone numbers. Participants were incentivized to engage in the recycling process through a gamified reward system, with weekly rewards offered to the highest depositor. A diverse sample of 100 participants took part in the study, providing valuable insights into the effectiveness of gamification in promoting sustainable waste management practices. Preliminary findings indicated a notable increase in participant engagement and enjoyment. Further, there was a significant difference in recycling rates between groups exposed to gamified interventions and control groups. These findings underscore the potential of gamification as a powerful tool for fostering behavioral change towards plastic bottle recycling. Furthermore, the study sheds light on both the strengths and limitations of gamification techniques in the context of waste management, offering valuable insights for designing effective and sustainable solutions. By understanding the motivational factors driving recycling behavior within a gamified framework, this research contributes to the ongoing efforts to combat the plastic waste crisis and promote environmentally conscious behaviors.

Keywords: *Gamification, Plastic waste management, Behaviour change, IoT smart device, Recycling*

QUALITATIVE & QUANTITATIVE ANALYSIS OF MACRO PLASTIC ALONG SELECTED BEACHES IN COLOMBO DISTRICT-SRI LANKA

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The study examined the quantity and quality of macroplastic along selected beaches in the Colombo district of Sri Lanka. A beach with fishing (Dehiwala), recreational (Wellawatta), and a beach close to a river mouth (Mattakkuliya) was examined to signify the characteristics of plastic debris produced due to different anthropogenic influences. Samples were collected using 100 m line transect method that was positioned parallel to the shoreline. The area of sampling spanned the low tide line and high tide line where three lines of transects were placed including the tidal lines and in-between. All surface plastic debris was collected by walking in parallel to the line. The surface sand of each line transect was dug (approximately 2 cm) using a small shovel and subsurface plastic debris were collected. The collected plastic debris were separated and recorded on-site. Results revealed that Mattakkuliya beach contaminated with surface plastic bags (pieces 41.11/ 100 m) than the other two sites. Mattakkuliya (Pieces 8.89/100 m) and Wellawatta beaches (pieces 4.22/100 m) were far more contaminated with dressing and cosmetic materials. Being a fish landing beach, the Dehiwala subsurface was more contaminated with fishing and netting materials than the other two sites. Subsurface samples of Dehiwala (pieces 15.00 /100 m) and Mattakkuliya near river mouth beach (pieces 8.22/ 100 m) were severely contaminated with bottles and container parts. Mattakkuliya beach subsurface was heavily polluted with dressing and cosmetics (Pieces 4.89 /100 m). In general, cutlery and food packages were the most prevalent plastic trash types when compared to the entire surface and subsurface categories. Present findings demonstrated the site specificity of plastic trash highlighting the necessity of commitments and mitigatory actions that are site-specific.

Keywords: *Plastic manufacturing, Plastic waste, Sri Lankan law for plastic disposal, Extended Producer Liability, Responsible manufacturing*

QUANTIFYING AND SEGREGATING MARINE LITTER ON SELECTED BEACHES IN SRI LANKA

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Marine litter, produced by land-based and maritime operations, poses a significant threat to marine biodiversity, causing a growing threat to marine and coastal ecosystems. The plastics sector in Sri Lanka has grown significantly over the last 45 years, indicating the severity of the problem with plastic consumption. The study aims to assess marine litter content and categorize it into different components, to reduce garbage in the marine ecosystem as the data can be utilized to evaluate the efficacy of current laws and regulations and to concentrate on mitigation measures that work. The study was initiated to collect information about the amounts, and sources of marine litter collected in Negombo (Porutota), Thalpitiya, Wellwatta, and Rekawa from December 2023 to February 2024 coinciding with the Northeast monsoon. The litter was collected segregated and quantified by recording weight. The results revealed that Porutota beach had the highest total quantity of litter accumulation (10 kg/ha), while Thalpitiya recorded half of that amount (5 kg/ha). Rekawa beach displayed the least amount of trash accumulation across the Northeast monsoon period, while Wellawtta and Thalpitiya beaches accumulated roughly comparable amounts of litter during the period. Porutota has the most segregated items, followed by Thalpitiya and Wellawtta. Plastic/ Polystyrene items were observed in all the beaches in higher percentages and rubber in very few quantities. It is concluded that the stakeholders can develop evidence-based strategies to protect coastal and marine ecosystems from plastic pollution by understanding regional variations, seasonal dynamics, and marine litter composition.

Keywords: *Plastic pollution, Debris, Beaches, Northeast monsoon*

SMART TRACKING OF PLASTIC CONTAINERS FOR AN EFFICIENT WASTE MANAGEMENT FUTURE

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Sri Lanka's current plastic waste collection system lacks efficient tracking, hindering both waste management and the nation's progress towards a circular economy. To address this challenge, the present study focused on designing a smart bin device. The device utilizes a microcontroller and various sensors, including passive infrared (PIR) sensors to distinguish between container deposits and bin opening/closing, a barcode reader for material identification and volume estimation to enable targeted recycling efforts, a keypad for user input (mobile number) for potential reward programs or data transparency, a Liquid Crystal Display (LCD) for user interaction and device status display, and a cellular communication module for secure cloud data transmission. The user initiates the process by entering their phone number, followed by scanning the barcode on their plastic bottle, before depositing it in the bin. The PIR sensor then detects the deposit, counts the bottles, and transmits data including phone number, barcode information, and the number of bottles to the cloud for analysis. This data empowers data-driven waste management, allowing for optimized collection routes based on real-time bin fill levels and accurate plastic container counts. Additionally, targeted material identification and estimated volume measurement from the barcode reader enhance recycling efforts. Finally, transparent data accessible to stakeholders fosters increased accountability. This scalable and cost-effective solution, currently undergoing pilot implementation at a selected location in Northern Sri Lanka, supports the nation's transition towards a circular economy by promoting responsible plastic consumption and fostering a sustainable future.

Keywords: *Plastic waste collection, Circular economy, Smart bin, Data transparency, Pilot implementation*

AN OVERVIEW OF PLASTIC WASTE ON THE ROADMAP TOWARDS NET CARBON ZERO 2050 SRI LANKA

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Joining the global push for net carbon zero, we strive for a sustainable future where emissions are balanced with nature's capacity, ensuring a thriving planet for generations to come. Sri Lanka's Carbon Net Zero 2050 Roadmap envisions "A CARBON NEUTRAL PROSPEROUS SRI LANKA." The waste sector plays a crucial role in achieving net carbon zero as almost all the products end up as waste in one way or another. The time series modeling based on the waste factoring in population growth and gross domestic product predicted a carbon emission of 2,332.66 thousand tons CO_2eq per year in 2050. The roadmap draws from a comprehensive review of global best practices and Sri Lanka's Nationally Determined Contributions for 2030 to propose mitigatory actions to reduce carbon emissions within the sector to a minimum by 2050. Key strategies include waste reduction initiatives at the source mainly focusing on plastics, bolstered by implementing smart waste management systems and incentives for reducing disposable containers. The roadmap emphasizes the promotion of recycling and the utilization of recycled materials, coupled with the integration of circular economy principles into supply chains. Efficient plastic waste management practices are underscored, including clustering administrative organizations for enhanced waste management systems and addressing the pervasive issue of microplastics in the environment. At the national level, strategies focus on the 3R approach (Reduce, Reuse, Recycle) and cultivating a circular economy ethos. These collective actions on plastic waste along with other mitigatory actions in the sector are projected to achieve a 26.24% reduction in emissions within the waste sector in Sri Lanka, contributing significantly to a sustainable and environmentally friendly future aligned with the Carbon Net Zero 2050 vision.

Keywords: *Circular economy, Greenhouse gas, Mitigation, Plastics*

MITIGATING MICROFIBER POLLUTION IN LAUNDRY WASTEWATER: A CASE ANALYSIS

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Synthetic fibers, owing to their durability, elasticity, non-wrinkle nature, and cost-effectiveness, have become ubiquitous globally. However, the widespread use of synthetic fibers has raised concerns about microfiber pollution, particularly in laundry wastewater. While source reduction could be considered the main management method to prevent microfiber-induced pollution, advanced technology is essential to manage the discharge of significant quantities. The present study focuses on analyzing the efficiency of a laundry wastewater filtration technique and its applicability for large-scale washing machines to control microfiber emissions during the washing process. Samples were taken from the front-loading washing machine (capacity: 23kg) equipped with a treatment unit, filled with 12 kg of clothing. ent unit. The 1L sample was collected from both untreated and treated water outlets during four washing cycles until the end of the wash. These samples were filtered through a 100 µm net to collect the microfibers. Catalytic wet peroxide oxidation and density separation were employed to extract possible microfibers, which were then collected on a membrane filter paper (0.45 µm) and observed using a stereo microscope. In untreated laundry water (n=4) 10028.7±1420.8 of microfibers per liter were identified. Conversely, treated laundry wastewater (n=4) exhibited a significantly lower count, with 191.5±109.4 pieces per liter of microfibers. Predominantly, microfibers of black and white/transparent colors were observed, with smaller quantities of red and blue microfibers. The treated wastewater samples showed a similar dominance of black and white/transparent microfibers. Further, it was revealed that 1kg of cloth can generate 336,833 microfibers per wash and it was reduced to 6,367 microfibers after the treatment. The filtration technique demonstrated an impressive efficiency of 98.09%, indicating a remarkably high microfiber filtration capacity. These findings underscore the potential of such filtration techniques to substantially reduce microfiber emissions from laundry wastewater, presenting a promising potential for widespread implementation in mitigating environmental pollution from microplastics.

Keywords: *Microfibers, Treatment unit, Laundry wastewater, Efficiency, Microplastics*

*This model project is being implemented as part of an umbrella project entitled "Marine litter and microplastics: promoting the environmentally sound management of plastic waste and achieving the prevention and minimization of the generation of plastic waste' (BRS-Norad-1), which is facilitated by the IGES Centre Collaborating with UNEP on Environmental Technologies (CCET), the Ministry of Environment, Sri Lanka, the Secretariat of the Basel, Rotterdam and Stockholm Conventions (BRS Secretariat) and HELP-O, with the financial assistance by the Norwegian Agency for Development Cooperation (Norad) with additional funding provided by the Government of the Netherlands.

CONVERSION OF WASTE PLASTICS INTO HYDROCARBON FUEL: A SUSTAINABLE APPROACH FOR WASTE PLASTICS RECYCLING

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Municipal Solid Waste (MSW) generation in Sri Lanka is over 7210 tons/day; approximately 9% of MSW comprises plastic waste. Thus, the plastic waste generation in Sri Lanka can be estimated to be 650 tons/day, and above 85% of it end up without applying any appropriate waste management technique causing huge environmental pollution. As a developing nation, Sri Lanka is facing a severe problem of MSW management, with the currently adopted predominant method being open dumping. However, this practice is hazardous, and causes significant negative impacts on the environment and human health which in turn creates many social, economic, and political problems. The aforementioned waste plastics can be converted into hydrocarbon fuel by the thermal pyrolysis process which was investigated in this study. Pyrolysis of waste plastics was investigated in a reactor system that consists of a semi-batch reactor, a condenser, and a liquid-gas separator. This reactor system is capable of converting waste plastics into hydrocarbon fuel at a maximum conversion rate of 99% when the semi-batch reactor is operating around 450 °C and near atmospheric pressure. Liquid and gas yield at the optimum conditions of the process are 66% and 31% respectively. Liquid fuel derived from waste plastics was found to consist of light and middle distillates in the range of C_5 to C_{12} hydrocarbons with higher concentrations of C_7, C_8, and C_9 fractions. The properties of liquid fuel are closed to that of commercial diesel. The combustion performance and emission characteristics of the derived fuel blended with diesel up to the volume percentage of 60% were found to be close to that of diesel when the fuels were tested in an engine test. Gaseous fuel was found to be chemically equivalent to liquid petroleum gas giving a similar amount of heat of combustion. The net energy return of the conversion process was found to be 16,521 kJ/kg of wasteplastics. Therefore, the conversion of waste plastics into hydrocarbon fuel using the developed reactor system is a sustainable approach for waste plastics recycling in terms of having usable hydrocarbon fuels and positive net energy return.

Keywords: *Waste plastics, Conversion, Hydrocarbon fuel, Sustainable approach, Recycling*

Track 6
Plastic Production and Legal Aspects

PUBLIC PERSPECTIVES ON POLYTHENE REGULATION IN SRI LANKA: EVIDENCE FROM SURVEY IN JAFFNA PENINSULA

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Plastic pollution has presented a significant impact on the environmental conditions in Sri Lanka, presenting an alarming challenge to the nation's remarkable natural scenery, flourishing urban centres, and coastal regions. The aesthetic attractiveness and ecological conditions of previously unpolluted and clean tourist destinations have deteriorated due to the existence of plastic garbage. Moreover, the municipal areas have not been relieved from the adverse consequences of plastic pollution. Streets, parks, and other public places have become inundated with plastic waste, resulting in visually unappealing and unclean surroundings. As the detrimental environmental impact of polythene usage becomes increasingly evident, governments worldwide are implementing regulations to curb its use. Sri Lanka, in its commitment to environmental sustainability, has enacted polythene regulations in recent years. In 2007, a prominent measure was commenced to mitigate plastic pollution through the enforcement of a prohibition on the manufacture of polythene or any polythene product of twenty (20) microns or below in thickness for in-country use and the sale or use of polythene or any polythene product that is twenty (20) microns or below in thickness. In 2017, there was the enforcement of a prohibition on the manufacture of polythene or any polythene product of twenty (20) microns or below in thickness for in-country use; the manufacture of food wrappers from polythene as a raw material for in-country use; the manufacture of any bag of high-density polyethylene as a raw material for in-country use; and some other polythene regulations like the prohibition of open burning of refuse and other combustible matters, including plastics. In 2023, certain plastic items will be prohibited from use. The study employed a mixed-methods approach, combining surveys and interviews, to gather comprehensive insights. A structured survey questionnaire is administered to a diverse sample of participants from various regions in Jaffna District. Additionally, in-depth interviews were conducted with key stakeholders, including traders and consumers. Further, this study also aims to uncover public awareness levels, perceptions, and compliance with existing regulations related to polythene use. Furthermore, it is intended to identify potential challenges faced by both the public and businesses in adhering to these regulations. The study also investigated the effectiveness of government initiatives in raising awareness and promoting sustainable alternatives to polythene. Based on the results obtained from the survey conducted on plastic management via a structured survey questionnaire among 1000 samples, the size of the population includes traders, the general public, and environmental activists in all divisional secretariats in the Jaffna Peninsula in the later part of the year 2023. The survey includes questions addressing levels of awareness about regulations stipulated regarding polythene use, perceptions of their effectiveness, challenges faced in compliance, and opinions on sustainable alternatives. The results showed that above 50% of people were unaware of the adverse effects of single-use polythene/plastic and regulations on plastic usage; about 30% of people, including traders, noted their concerns over the government regulation regarding polythene use because of less availability and higher cost of alternatives for restricted plastic items in the market; and about 75% of traders argued about the mushrooming of illegal manufacture and sale of prohibited polythene and plastic items. Preliminary findings suggest a varied understanding of polythene regulations among the public, with factors such as education, age, and socio-economic status influencing perspectives. Challenges related to the availability and affordability of alternative materials were identified, highlighting the need for comprehensive solutions. This study explored the attitudes and perceptionsof the general public in Sri Lanka regarding polythene regulations. Additionally, the survey sheds

light on the public's willingness to adopt alternative materials and their preferences in sustainable packaging.

Keywords: *Plastic pollution, Environmental pollution, Plastic waste management*.

COMPARATIVE ANALYSIS OF EFFECTIVENESS OF LEGAL REGULATIONS RELATED TO PLASTIC PACKAGE PRODUCTION AND WASTE MANAGEMENT IN SRI LANKA

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With a population of 21.4 million, Sri Lanka confronts a substantial waste management issue in disposing of 7,000 metric tonnes of solid waste daily. Since plastic pollution has become a major concern, global and local companies have played substantial roles in exacerbating this problem. Single-use plastics, which endure for centuries, cause environmental degradation and health issues. In Sri Lanka, it is deemed essential for manufacturers to assume control over post-consumer plastic packaging (P.C.P.P.) to mitigate the influx of waste into landfills or incinerators. This study evaluated the effectiveness of plastic packaging and waste management regulations in Sri Lanka. The methodology entails qualitative research scrutinizing Sri Lankan policies, statutes, and case law while drawing examples from international best practices that can be used to alleviate loopholes in existing laws. While Extraordinary Gazettes No. 1466/5 and 2034/34, issued according to the National Environmental Act, No. 47 of 1980, have limited provisions to regulate plastic packaging, the National Waste Management Policy of 2018 has not identified plastic waste as a specific waste stream. It is recommended for Sri Lanka to draw examples from Germany's Extended Producer Responsibility (E.P.R.) regulations, which hold manufacturers and distributors accountable for the ultimate disposal of their packaging waste. As a result of this, Germany currently produces only ten kilograms of waste monthly. Cultivating collective social awareness, altogether banning the use of harmful plastic packaging, fostering innovation in manufacturing practices, and establishing sustainable business models are the recommended steps that can be taken to improve the effectiveness of plastic waste management in Sri Lanka. Thus, Sri Lankan policymakers should draw insights from successful international plastic waste regulations and strive towards sustainable waste management practices through a holistic strategy.

Keywords: *Plastic manufacturing, Plastic waste, Sri Lankan law for plastic disposal, Extended Producer liability, Responsible manufacturing*

THE TREND OF PLASTIC WASTE IN SRI LANKA: A COMPREHENSIVE ANALYSIS USING IMPORT AND EXPORT OF PLASTICS SURPLUS

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Globally, mass polymer production and poor end-of-life product control have increased in plastic entering the environment each year. Plastic may be carried over vast distances and remain for a long time in the environment due to its density and resilience. The widespread use of plastics has led to environmental contamination in ecosystems. To increase the circularity of the industry, Sri Lanka, a developing nation, must assess its current Plastic Waste Management (PWM) scenario and export and import trends for plastics. Therefore, this review aims to model plastic waste based on the current status and future forecast of import, export, and plastic surpluses in Sri Lanka. The import and export data of plastic articles for the conveyance of packing materials such as stoppers, lids, caps, and other closures of plastics from January 2010 to December 2022 was taken from the United Nations Commodity Trade Statistics (UN Comtrade) Database. The statistical analysis was done using an Additive Triple Exponential Smoothing (ATES) model, where the cumulative plastic surplus was predicted for five years starting from December 2022. The seasonal trend component was taken as 47 months. Symmetric Mean Absolute Percentage Error (SMAPE) was used to check the accuracy of the ATES model because of the asymmetric nature of the predicted series. The SMAPE of the resulting model was 0.29. According to the analysis, the historical data showed a 27% increase in plastic surplus from 2021 to 2022. Aligning with the historical data, the forecasted values showed a 54% increase in plastic surplus in Sri Lanka by 2027. This indicates a significant increase in plastic waste disposal in the upcoming five years. Hence, implanting rules and regulations to minimize the generation and import of plastic while improving the reuse and recycling of plastic is a timely needed approach for a green Sri Lanka.

Keywords: *Exponential Smoothing Model, Plastic waste management, Plastic surplus, Plastic import, Plastic export*

Track 7
Alternatives for Plastics

Circular Economic Approaches, Product Life CycleAssessment and Production of Biodegradable Plastics for Sustainable Management of Plastic Wastes

The sustainable management of plastic waste through circular economic approaches involves a comprehensive strategy to minimize the environmental impact of plastics while promoting resource efficiency and circularity. In this approach, measures will be adopted to reduce single-use plastics, encourage recycling, and implement circular inputs in systems. After a thorough investigation of the circular economic approach for sustainable plastic waste management, six key elements were identified:

1. Reducing Single-Use Plastics: decrease the consumption of disposable plastics by promoting alternatives and encouraging behavioral changes among people and businesses.
2. Recycling Infrastructure: implementing robust recycling systems, including efficient collection, sorting, and processing facilities, helps divert plastic waste from landfills and promotes the reuse of materials.
3. Circular Design: planners and businesses design products and packaging ensuring circular principles, safeguarding their recyclability, reusability, or composability.
4. Waste-to-Energy: encouragement of technologies such as waste-to-energy facilities to convert non-recyclable plastics into energy, contributing to sustainable energy production while reducing the volume of waste.
5. Public Awareness and Education: harnessing public engagement to foster a culture of responsible consumption and waste management through awareness campaigns and educational initiatives.
6. Innovation and Collaboration: linking innovation and collaboration among industries, policymakers, and communities to develop sustainable solutions, such as the use of biodegradable plastics or the incorporation of advanced recycling technologies.

By embracing circular economic approaches, plastic waste management can transform into a more sustainable and resilient system. This addresses the immediate challenges posed by plastic pollution and aligns with broader environmental goals, promoting a circular economy that values plastics as resources rather than disposable items. By integrating these approaches, a more sustainable and circular future can be achieved while mitigating the negative environmental impacts associated with plastic waste.

A product life cycle assessment (LCA) for plastic waste management involves analyzing the environmental impacts associated with the entire life cycle of plastic products, from raw material extraction to disposal or recycling. The LCA of a manual plastic toothbrush reflects a cradle-to-grave approach amalgamated with the development of a low-impact plastic toothbrush model according to the Design for Sustainability (D4S) concept introduced by the UNEP. This study has been designed and carried out according to the ISO 14,0040 and ISO 14,044 standards considering eighteen midpoint impact categories and three endpoint impact categories. Accordingly, the cradle-to-grave life cycle approach of a plastic toothbrush has

resulted in a high Global Warming Potential (GWP). The manufacturing stage of the plastic toothbrush was quantified as the highly impacted life cycle stage which involves the emission of Nitrous Oxide, a greenhouse gas 310x more potent than CO_2.

In this study, the concept of D4S, as a sustainable circular economical approach for plastic waste management, models four major strategies out of the seven to reduce the impact associated with a plastic toothbrush in the Sri Lankan context. The four major strategies that were analyzed as solutions to develop a low-impact product model for a plastic toothbrush were selection of low-impact raw materials, optimization of production techniques, reduction of impact during use, and optimization of end-of-life systems. It was concluded that this study was an integrated approach of LCAs and circular economical approaches that made the relevant stakeholders informed about the environmental impact of the manual plastic toothbrushes throughout their life cycle and produce new product designs combining life cycle thinking and circular economy.

Bioplastics derived from renewable resources like vegetable waste offer a novel avenue to replace conventional plastics. A recent study successfully demonstrated the production of bioplastic films from various types of vegetable waste, including Manioc, Sweet Potato, Potato, Cabbage and Leeks. These bioplastic films exhibited desirable properties, including flexibility, strength, and biodegradability, water absorption and chemical solubility making them promising alternatives to traditional plastics. The bioplastic films derived from vegetable waste exhibited varying colours. This indicates the influence of vegetable waste composition on the bioplastic films' appearance. All bioplastic formulations demonstrated significant biodegradability indicating their ability to break down naturally and reduce their environmental impact. Vermicompost biodegradability analysis showed no significant difference between formulations, further supporting their sustainability credentials. Water absorption and chemical solubility analyses revealed variations in the bioplastic films properties, attributed to their distinct molecular structures and surface characteristics. Water absorption capacity and sulfuric acid solubility suggested potential applications in sulfuric acid-resistant coatings or bio-based membranes. Other solubility studies demonstrated the possibility of tailoring bioplastic formulations for specific applications. The sweet potato-based bioplastic emerged as the best bioplastic sample due to its superior tensile strength and elongation properties. Its high strength and flexibility make it suitable for a wide range of applications, including packaging, coatings, and membranes. Overall, the study provided compelling evidence for the potential of converting vegetable waste into valuable bioplastic materials, offering a sustainable solution to reduce plastic pollution and promote environmental sustainability.

Keywords: Sustainable plastic waste management, circular economic approaches, product Life Cycle Assessment (LCA), biodegradable plastic.

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Alternatives to Conventional Plastics: A Sustainable Approach

Plastics have become an integral part of modern day lifestyle based upon their properties such as light weight, electrical insulation, heat insulation which are determined by their molecular structure. Therefore, even contradictory properties like electrical or heat conductivity could be achieved. Common polymer materials like polyethylene (PE), polypropylene (PP), polyvinylchloride (PVC), polyethylene terephthalate (PET), and polystyrene (PS) are widely used in various industries including furniture, electrical appliances, healthcare, packaging, and household equipment manufacturing. By the year 2022, the global annual plastic production exceeded 400 million tons, with over 95% being single-use plastics [1]. This significant increase has strained waste management systems, leading to pollution and ecosystem harm. The generation of micro-plastics poses serious threats to the environment and animal health. It is crucial for industries and individuals to adopt sustainable practices and reduce plastic consumption to mitigate these adverse effects.

Efforts such as the Reduce, Reuse, Recycle (3R) campaign are aimed at addressing the challenges posed by the increasing use of plastics. However, these initiatives encounter obstacles. Recycling facilities often struggle to manage the vast quantities and diverse types of plastic, leading to the production of low-quality recycled products or their disposal in landfills. Additionally, reducing plastic usage, particularly for essential purposes, is challenging without disrupting established production chains.

To effectively address the plastic crisis, a comprehensive approach is necessary. This includes investing in research and development of renewable and biodegradable plastics, which is gaining traction among researchers. Biodegradable materials can decompose gradually without causing harm to the environment. Biodegradable polymers exhibit a wide range of properties and can now compete with non-biodegradable thermoplastics in various applications. Materials such as polylactic acid (PLA), polyhydroxyalkanoate (PHA), and Polycaprolactone (PCL) are commonly used in biodegradable plastic production [2-4]. These materials, derived from biomaterials, are increasingly replacing traditional petroleum-derived plastics, particularly in the packaging industry.

PLA is a polymer which could be derived from plant materials such as corn, sugarcane, cassava or sugar beet [2] has properties similar to existing Polyethylene, Polypropelene materials. PLA is advantageous due to abundancy, biocompatibility, processability, energy efficiencies and good mechanical properties [5]. Owing to high biocompatibility, PLA has many biomedical applications. With the immerging new technologies to manufacture high molecular polymer, PLA has attracted the interested in packaging industry. However, slow crystallization and low toughness, high brittleness which is about 10% elongation, hinders itsapplications in high temperature and high impact applications [6]. To improve these properties many studies tried to use different plasticizers which includes, triacetin tributyl citrate, tributyl acetyl citrate and triethyl acetyl citrate. Blending PLA with natural rubber

(NR) in small quantities, a natural biopolymer with excellent elasticity is a novel approach to overcome the problem. However, the chemical incompatibility between PLA and NR still limits the application in the industry.

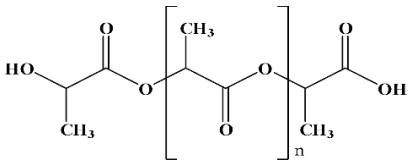

Figure 1. Chemical Structure of poly (lactic acid)

Green composites are emerging as another sustainable alternative to traditional plastics, offering a more environmentally friendly option for various applications. These composites are typically made from natural fibers such as cotton, jute, hemp, sisal, bamboo, or kenaf, combined with biodegradable polymers or resins. Natural fibres are renewable and abundant raw materials which are less harmful for humans and animals, which also contribute to faster degradation. Further, these composites could also be made with the recycled plastics in place of virgin polymer matrices [7,8]. Green composites exhibit properties similar to conventional plastics, making them suitable for a wide range of applications in industries such as automotive, construction, packaging, and consumer goods [9]. These composites can offer advantages such as lightweight, high strength, and biodegradability, making them an attractive choice for companies looking to reduce their carbon footprint and promote sustainability.

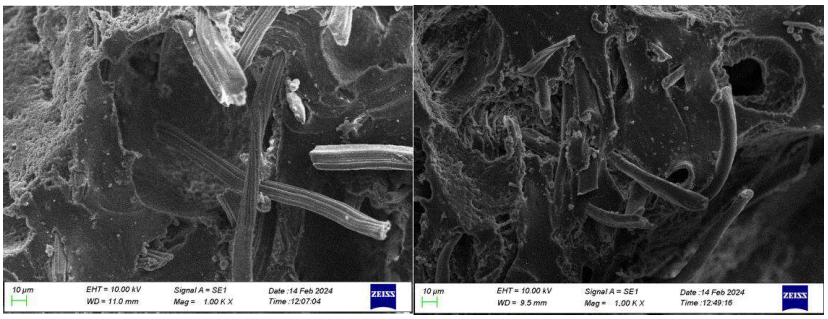

Figure 2. SEM images of natural fibre - natural rubber based composite materials prepared for acoustic insulation.

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REWIND IN TIME TO RECOGNISE SAFE PLASTIC ALTERNATIVES AS A RECONCILIATORY SOLUTION TO THE HEALTH AND ENVIRONMENTAL IMPACTS OF PLASTICS: A REVIEW

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Studies conducted using scooping review methodology revealed that Bisphenol A (BPA) is a cytotoxic substance and endocrine-disrupting chemical found in plastic bottles. BPA mimics oestrogen when exposed to human cells. This chemical additive is used to harden the plastic. When you drink water stored in polyethylene terephthalate (PET) bottles kept in direct sunlight or in a car parked under sunlight, water in plastic bottles tastes weird. This is because distilled water in the bottle after reverse osmosis often lacks native impurities such as natural minerals thus, the water is more likely to grab impurities from its surrounding environment than the water with high total dissolved solids (TDS). Heat encourages the degradation of plastic and the harmful BPA or its alternatives, BPS or BPAF. BPA plastics are banned in countries like Canada, France, Sweden, and Denmark. In those countries, Tritan is being used as an alternative to bisphenol. However, transient BPA release has been reported in Tritan plastic bottles and Titan also has oestrogen activity. In addition, Triton plastics are very expensive, making them unaffordable for consumers in developing countries. Thus, people from developing countries have no choice but to rewind in time to reintroduce what they have been using before introducing plastics. In Sri Lanka, glass bottles are gaining popularity again. To overcome the fragility and high weight of glass bottles, stainless steel bottles are being considered. Yet, other plastic product alternatives, such as beeswax food wraps, seaweed, cellulose, or paper-based products, are already storming the world markets. It is high time for Sri Lanka to enhance the production of their past traditional and aboriginal products from beekeeping, seaweed, common rattan (cane wicker), palmyra, coconut palm, reed-bamboo, areca palm, nut grass, greater club rush, soft rush, *Pandanus kaida*, plantains, and snake wood with present technology. Using green, sustainable, and reconciliatory product alternatives to plastics is also now being considered a fashion and much healthier option in the West. Thus, developing countries should use this loophole to find their fortune towards economic prosperity, which also improves the livelihood of their village communities.

Keywords: *Bisphenol A, Plastic bottle, Regenerative solution, Plastic pollution, Food safety, Toxicology*

DEVELOPMENT OF OPAQUE PACKAGING USING CASSAVA POMACE AND EVALUATION OF PHYSICAL AND MECHANICAL PROPERTIES

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Many countries, including Sri Lanka, regulate plastic, polythene, and other non-biodegradable packaging materials to reduce environmental pollution. As a result, both industry and researchers are focusing on alternatives for plastic packaging materials. Corn and cassava starch are key ingredients in biodegradable packaging. However, due to global hunger concerns, it is not suitable to use consumable raw materials unless the packaging is edible. The present study developed an opaque, biodegradable packaging material from cassava pomace, the main industrial waste from cassava starch production. The casting technique was used to develop three packaging materials, C1, C2, and C3, by combining different proportions of cassava pomace and plasticizer combinations. The color, thickness, density, moisture content, solubility, swelling index, and mechanical properties of the developed films were evaluated. The films C1, C2, and C3 exhibit thickness values (mm) as, 0.31 ± 0.15^{c}, 0.39 ± 0.03^{b}, 0.58 ± 0.03^{a}, density values (g cm-3) as 1.19 ± 0.07^{b}, 1.78 ± 0.06^{a}, 1.87 ± 0.04^{a}, moisture content (%) as 14.43 ± 0.57^{a}, 14.88 ± 0.47^{a}, 11.32 ± 0.37^{b}, solubility values (%) as 26.15 ± 0.67^{b}, 28.99 ± 0.49^{a}, 21.89 ± 0.22^{c}, and swelling index values (%) as 279.55 ± 2.78^{b}, 123.82 ± 0.99^{c}, 472.20 ± 2.30^{a}, respectively. All the films appeared brown, and the intensity of the brown color increased with the cassava pomace content which is indicated by the increment of the a* and b* values and reduction of L* values. The L* values for C1, C2, and C3 films were 78.30 ± 2.11^{a}, 69.08 ± 2.65^{b}, and 62.64 ± 4.40^{c}, respectively. The corresponding a* values were 5.50 ± 0.30^{c}, 8.36 ± 0.98^{b}, and 10.74 ± 1.45^{a}, whereas the b* values were 10.46 ± 2.70^{c}, 23.64 ± 2.94^{b}, and 31.06 ± 3.50^{a}, respectively. Furthermore, the films C1, C2, and C3 also exhibit mechanical properties respective to tensile strength (MPa) as 0.22 ± 0.09^{a}, 0.28 ± 0.03^{a}, 0.07 ± 0.02^{b}, elongation at break (%) as 0.00 ± 0.00^{b}, 11.90 ± 1.15^{a}, 0.00 ± 0.00^{b}, and Youngs model (MPa) 0.00 ± 0.00^{b}, 2.81 ± 0.37^{a}, 0.00 ± 0.00^{b}, respectively. Accordingly, the C2 composition exhibited the highest mechanical characteristics, solubility, and moisture content. The Turkey comparison revealed a significant difference ($P < 0.05$) in every test parameter in the three packaging materials. Furthermore, the lowest percentage of cassava pomace (C1) film is more appropriate for cling films, while medium (C2) for bags such as Zip-lock bags, and the highest percentage (C3) is suitable for plates. The study emphasizes the feasibility of employing cassava pomace as a sustainable and environmentally friendly alternative to standard packaging materials.

Keywords: *Waste utilization, Cassava waste, Cassava pomace, Biodegradable packaging, Eco-friendly packaging*

ENHANCING THE MECHANICAL STRENGTH OF TENDER PALMYRAH LEAVES USING DIFFERENT DRYING METHODS

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Using synthetic food packaging materials, especially single-use plastic items, has led to the massive annihilation of natural ecosystems. Palmyrah (*Borassus flabellifer*) is a fan farm native to South Asia and Southeast Asia, predominantly called a 'celestial tree,' as the whole plant offers plenty of economic uses. Palm leaf-made tableware items are among the many products which is a sustainable alternative for replacing some single-use plastic wares. However, their application is limited to the usage for domestic purposes and aesthetic occasions. As a further step, this study was conducted to evaluate the effect of different drying techniques on the mechanical properties of palmyrah leaves. The tender palmyrah leaves (TPL) were manually harvested randomly from different regions of the Jaffna district, and the leaf blades were separated at the folded ends and reduced in length (30 cm). These leaves were washed with water and subjected to three different drying methods: Sun drying, Oven drying (60 ºC), and Shed drying for 48 hrs. and then assessed for mechanical properties such as load-bearing capacity, tear resistance, and hardness. The results revealed that there was a significant increase ($P<0.05$) in the load-bearing capacity (from 30.90 ± 1.19 N to 35.86 ± 1.17 N), tear resistance (from 4.36 ± 0.21 N to 7.59 ± 0.26 N), and hardness (from 60 ± 2 HA to 63 ± 2 HA) of TPL due to sun drying. However, there is no significant change in the tested properties of dried TPL after shed drying. Further, the oven-dried TPL also had significantly higher values of tear resistance (7.31 ± 0.22 N) and hardness (64 ± 1), which were not significantly different from sun-dried. Hence, the sun-dried TPL has significantly higher values for three tested mechanical properties among the selected drying conditions. Meanwhile, the literature reveals that the expanded polystyrene has higher tensile strength ultimate (765.6 N) and tear strength (411 N) for similar sample sizes. However, as the biodegradability of packaging materials is gaining importance, sun-dried TPL could be used as a starting material for nature-friendly disposable plates and straws.

Keywords: *Environment friendly, Food serving, Packaging material, Tear resistance*

"DEVELOPMENT AND CHARACTERIZATION OF STARCH-BASED BIOPLASTICS FROM ELEPHANT FOOT YAM"

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Synthetic petroleum-based packaging films are difficult to recycle and are non-biodegradable, hence their use raises environmental concerns. The present study focuses on developing biodegradable films utilizing starch from elephant foot yam (EFY) and glycerol (GLY) as a plasticizer. Central composite rotatable design of response surface methodology was applied to optimize levels of EFYS (2-4%), and glycerol (1-3%) for the formation of films. Optimization was based totally on three responses which were tensile strength (TS), puncture strength (PS), and puncture deformity (PD). Both glycerol and starch content negatively affected the TS and PS of the film with the increase in level of concentrations. The maximum TS, PS, and PD were obtained at 2.00% starch content and 1.00% plasticizer concentration. SEM showed the interaction of starch with glycerol to form a complex network, while DSC demonstrated uniformity of the film produced. Intense interactions with a high degree of cross-linking were shown in FTIR, confirming the film-forming properties of EFY starch. Therefore, the behaviour of starch has revealed its potential as a food packaging material that can replace synthetic packaging materials in many food applications.

Keywords: Elephant foot yam, Biodegradable film, Starch, Glycerol

SUSTAINABLE UTILIZATION OF VEGETABLE WASTE FOR BIOPLASTICS PRODUCTION: SYNTHESIS, CHARACTERIZATION AND PROPERTIES

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Bioplastics are a type of plastic material derived from renewable resources such as plants, crops, or microorganisms. This study investigates the properties of bioplastics obtained from vegetable waste sources, of manioc, cabbage, and sweet potato. In the search for sustainable alternatives to conventional plastics, key factors such as biodegradability, chemical solubility, water absorption, and tensile strength were considered. This study revealed the unique properties of bioplastics and demonstrated their potential for diverse applications. Biodegradation rates evaluated according to European Commission standard methods show different rates of degradation for different bioplastics. Manioc-cabbage-based (MC) bioplastic showed the highest biodegradability of 94.36%±0.05% in moist soil compared to MC bioplastic, and sweet potato-cabbage-based (SC) bioplastic showed the highest biodegradability, 90.15%±6.40%., in vermicompost. Chemical solubility evaluation using concentrated sulfuric acid and organic solvents highlights the complete solubility of MC bioplastics in sulfuric acid and glacial acetic acid and partial solubility in other organic solvents, whereas SC bioplastics Plastics generally remain insoluble in these solvents. Water absorption studies have shown that hydrophilic components such as starch and cellulose influence absorption levels. SC bioplastic shows the highest water absorption rate of 83.34%±3.18%, while MC shows a lower absorption rate of 68.92%±8.76%. Tensile strength measurements using a UTM tensile testing machine revealed that different bioplastics had different strengths, with SC bioplastics exhibiting a tensile strength of 0.35±0.01 MPa and an elongation of 97.74%±19.61%, while MC-based bioplastics showed 0.25 ± 0.07 MPa and an elongation of 100.17%±31.75%. Fourier transform infrared (FTIR) spectroscopy identifies intermolecular interactions and confirms the presence of characteristic biopolymer functional groups. Structural changes during degradation were revealed by FTIR. Scanning electron microscopy (SEM) provides insight into surface morphology and degradation patterns, depicting smooth surfaces with small pores in undegraded samples and rough, porous surfaces with cracks in degraded samples. This comprehensive study provides valuable insights into the properties of vegetable waste-derived bioplastics and guides the development of sustainable packaging and product design solutions. The unique properties of MC and SC bioplastics highlight their potential for targeted applications within the realm of environmentally friendly materials.

Keywords: *Biodegradable, Manioc-cabbage-based, Sweet-Potato-Cabbage-based, Biopolymer, Sustainable packaging*

DEVELOPMENT OF A BIODEGRADABLE PLASTIC USING POTATO STARCH, BANANA PEEL ADDITIVES, AND ZnO MICROPARTICLES

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The increasing demand for sustainable and environmentally friendly materials has spurred research into biodegradable films as a viable alternative to conventional plastic films, which has become a serious environmental concern. Therefore, this study focuses on developing a biodegradable plastic film by incorporating banana peel additives, potato starch, and zinc oxide (ZnO) microparticles, aiming to enhance the mechanical and antimicrobial properties of the films while utilizing waste materials. The films were prepared through a straightforward casting method, varying the mixing ratios of banana peel additives and ZnO to the potato starch. X-ray Diffraction (XRD) analysis and Fourier Transform Infrared (FTIR) spectroscopy were employed to evaluate the film composition. The biodegradability test was carried out to analyze the decomposition patterns of the fabricated films. Then, the water uptake test was done for all sample films to investigate their water absorption capacity, which provides details about hydrophobic properties. Additionally, the antimicrobial activity of these films was evaluated, and they demonstrated promising results against both gram-positive and gram-negative bacteria. Therefore, the results demonstrate that the inclusion of banana peel additives and ZnO microparticles significantly improves the mechanical strength of the films, imparting enhanced flexibility and toughness. Moreover, the presence of ZnO microparticles exhibits antimicrobial activity, inhibiting the growth of common pathogenic bacteria. Incorporating potato starch further contributes to the film's biodegradability and overall sustainability. Although ZnO microparticles were synthesized instead of nanoparticles, their integration within the film matrix showcases promising potential for improving mechanical and antimicrobial properties. Overall, this research highlights the potential of utilizing banana peel additives, potato starch, and ZnO microparticles in the development of biodegradable films with improved mechanical properties and antimicrobial functionality. These findings can contribute to the advancement of eco-friendly packaging materials, offering a promising alternative solution to the global plastic waste crisis.

Keywords: *Biodegradable plastic, Banana peel additives, Potato starch, ZnO*

DEVELOPMENT AND CHARACTERIZATION OF A BIOPLASTIC COMPOSITE USING BANANA PSEUDOSTEM, CASSAVA STARCH AND POLYVINYL ALCOHOL: AN ALTERNATIVE FOR THE CONVENTIONAL PLASTIC PACKAGING

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Banana (Musa spp.) pseudostem (BP) has become popular owing to a variety of its usages in different industries. The current study focused on developing a bioplastic composite using BP, cassava (*Manihot esculenta*) starch (CS), polyvinyl alcohol (PVA), and plasticizers to replace the plastic packaging and identifying the ideal composition to develop the biocomposite. Initially, BP of five cultivars (Sour Plantain, Sugar Plantain, Ash Plantain, *Suwandel* and *Rath Kesel*) were obtained from harvested banana plants during the Maha season of 2022. BP, CS and PVA were used as the lignocellulosic component, binder and compatibilizer respectively in the preparation of the biocomposite. Initially, the pseudostem powders were subjected to proximate analysis using AOAC methods, followed by determination of Van Soest constituents [Acid Detergent Fiber (ADF), Neutral Detergent Fiber (NDF)] and lignin tests, mainly to determine the significant variance among the cultivars in terms of cellulose, hemicellulose and lignin compositions. The analyses revealed no significant differences ($p>0.05$) in proximate and Van Soest constituents among the cultivars. Solvent casting method was used to prepare samples with BP incorporation levels as 10%, 15%, 20%, 25%, 30%, 35% and 40% (w/w) for Sour Plantain and Ash Plantain, selected via texture analysis. The biocomposite films were characterized for tensile strength and elongation at break producing similar results and the treatments of Sour Plantain had no significant differences ($p>0.05$) while PVA/Cassava/AshPlantain25% (PCA25) had significantly lower values ($p<0.05$). The PVA/Cassava/SourPlantain40% (PCS40) had a significantly higher water absorption (%) at 24h ($p<0.05$). The treatments of both cultivars had significantly different values ($p>0.05$) for gas permeability. Using above analyses, it was concluded that 30% BP incorporation level from each cultivar contributes to the ideal composition for the biocomposite. The Fourier Transform Infrared Spectroscopy (FTIR) and Thermogravimetric Analysis (TGA) performed for the same followed significant trends for lignocellulosic composites.

Keywords: *Banana pseudostem, Cassava starch, Polyvinyl alcohol, Biodegradable composite films, Alternative food packaging*

RETAILERS' USAGE OF PLASTIC-FREE ALTERNATIVES FOR BANNED SINGLE-USE PLASTICS: A CASE STUDY OF ANURADHAPURA MUNICIPALITY, SRI LANKA

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The negative impacts of plastics on health and the environment have limited their use and production globally. Sri Lanka has recently banned the production, sales and marketing of some commonly used single-use plastics (SUP). This study aims to investigate the awareness, usage, and satisfaction of retailers with plastic-free alternatives (PFA) following the banning of single-use plastics. Primary data was collected from 102 retailers within the Anuradhapura municipality. A pre-tested structured questionnaire was employed to gather information on background details, environmental concern (EC), attitude (AT), subjective norm (SN), perceived behavioral control (PBC), awareness, usage, and satisfaction regarding the quality and availability of PFAs. Data analysis was conducted using frequency, mean, Spearman correlation and Mann-Whitney U tests on SPSS 22 software. The majority of retailers operated groceries and food shops, with a monthly turnover typically ranging from 10,000 to 50,000 LKR. They demonstrated awareness on various PFAs for banned SUPs, such as straws (58.4%), string hopper trays (52.5%), spoons (46.5%), cups (39.6%), food containers (22.8%), plates (17.8%), garlands (11.9%), forks (8.9%), knives (4%), and stirrers (4%), made from materials such as paper, cardboard, wood, metals, cloth, ceramics, glass, and processed plant materials such as leaves, flowers, or reeds. However, retailers have only substituted straws (58.4%) and plates (17.8%) with PFAs. Despite being aware, 46.1% of retailers have used at least one type of PFA, but 53.9% have not used any. Users of PFAs were dissatisfied with the quality of straws (81.4%), food containers (60%), cups (61.5%) and garlands (58.3%), but satisfied with the quality of stirrers (75%), plates (66.7%), spoons (51.1%), forks (100%), and string hopper trays (83%). Dissatisfaction was also noted with PFA's market and information availabilities. Retailers exhibited high levels of EC, AT, and PBC, and low levels of SN towards PFA usage for banned SUP, while having positive correlations between EC and AT ($r=0.427$, $P>0.01$) and EC and PBC ($r=0.205$, $P>0.05$). However, none of the factors (EC, AT, PBC and SN) significantly varied between users and non-users of PFA. In conclusion, there's a need for the promotion of PFAs, and further studies are recommended to identify the factors influencing the adoption of PFAs. These efforts can contribute to popularizing the use of PFAs in Sri Lanka, thereby addressing the environmental and health challenges associated with plastics.

Keywords: *Environmental conservation, Plastic waste, Sustainability, Theory of planned behavior*

EVALUATION OF FRESHWATER CYANOBACTERIA AS A SOURCE OF BIODEGRADABLE PLASTICS

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Conventional fossil-based plastics have become a threat to the environment worldwide due to their persistence in nature. Bioplastics including Polyhydroxybutyrate (PHB), Polyhydroxyalkanoate (PHA), Polylactic acid (PLA), and starch undergo complete degradation by natural microbial action thus present a sustainable alternative to petroleum-based plastics. Commercial production of bioplastics has been achieved using plants from land-based sources; however, the constraints of resource depletion hinder the scalability of crop-dependent bioplastic manufacturing. Cyanobacteria, with their exceptional biodegradable plastic characteristics, could be a more viable solution to address the demand for non-degradable plastics. Selected strains *Spirulina subsalsa*, *Synechocystis* sp., *Synechococcus* sp., and *Oscillatoria* sp., which were previously isolated from freshwaterreservoirs in Sri Lanka, and *Spirulina platensis* obtained from the culture collection of the National Institute of Fundamental Studies, Sri Lanka were semi-mass cultured in Zarrouk's (pH-10.5), and BG-11 (pH-7.5) media, subjecting to constant illumination at 2000 lux and shaking conditions of 200rpm. Growth rate of cultures was determined based on the absorbance measured at 680 nm at regularintervals. After 4 weeks, biomass was harvested, oven-dried, and ground into a fine powder for analysis. Total Polyhydroxybutyrate (PHB) content was analyzed using the Law and Slepecky method, while PHB in *Synechocystis* sp. was qualitatively analyzed using Raman Spectroscopy. Along with the highest growth rate, the highest total PHB content of 8.4% was recorded in *Synechocystis* sp., exceeding the previously reported PHB contents. *Synechococcus* sp. displayed thesecond highest PHB content of 7.4% followed by *Spirulina platensis* (4.9%) and Spirulina subsalsa (2.6%). *Oscillatoria* sp. exhibited the lowest PHB content of 0.9%. Raman spectroscopy revealed bands at 1725, 1443, and 1458 cm-1, consistent with criteria, affirming PHB biopolymer crystallinity. Studying native Cyanobacteria as a source of biodegradable plastics holds greater promise for sustainable bioplastic production compared to other alternatives. This is attributed to their rapid growth, efficient resource utilization, regeneration capabilities, and minimal environmental impact. Consequently, these findings indicate their substantial potential in tackling the challenges associatedwith non-degradable plastics, offering promising prospects for sustainable solutions.

Keywords: *Cyanobacteria, Polyhydroxybutyrate, Plastic pollution, Sustainable*

A REVIEW OF BIOPLASTICS AS A SUSTAINABLE APPROACH TO THE PLASTIC POLLUTION

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The growing plastic pollution impacts human health, threatens the ocean, and contributes to climate change enhancing the concern about eco-friendly bioplastic production as an alternative to plastic. This study comprehensively reviewed on (a) material use to produce bioplastic, (b) different methods of bioplastic packaging material production, and (c) technologies to enhance the quality of biodegradable packings. One hundred and twenty research articles were reviewed on bioplastics in Sri Lanka and globally. As raw materials, Food waste, algae, and plant materials become the key biological sources of biopolymers such as starch and cellulose for bioplastic production. Consequently, cassava starch is widely used as plant material, and further use of zinc oxide, plasticizer glycerol, and cassava starch together showed the developed properties of bioplastic as being transparent, flexible, and easy to handle. Bioplastics benefit the environment by reducing food and plastic waste accumulation, leading to a more cost-effective and sustainable approach. Bioplastics that are most commonly used are polylactic acid (PLA), polybutylene succinate (PBS), cellulose acetate (CA), and starch-based polymers (SBPs). The key steps for bioplastic production are raw material handling, mixing, blending, extrusion, and molding. Furthermore, using different methods such as coating, cellulose, and nanoparticles can be incorporated to advance the properties of bioplastics, such as enhancing the gas and water barrier properties. Generally, bioplastics can be blended with other biopolymers and nanofillers to increase the mechanical and water barrier properties of bioplastics. According to the study, most of the researchers (46.67%) have reviewed on materials used to produce bioplastics; a few (25%) are focused on the technologies to enhance the quality of biodegradable packings; and the rest (28.33%) have discussed the methods used to produce bioplastics. Future research is needed to expand the scale of bioplastic production and commercialization through developing technology, growing innovation, and global support.

Keywords: *Biodegradable, Bioplastics, eco-friendly, Packaging materials, Polymers, Sustainable approach*

BIODEGRADATION OF PLASTICS (LOW DENSITY POLYETHYLENE (PE)) USING MICROALGAE: A LITERATURE REVIEW

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Two of the most used plastics are polyethylene (PE) (low density (LDPE) and high density (HDPE)). They have densities less than water, which depicts their buoyancy in sub-urban water bodies in Sri Lanka. Widely spread carry bags that are used by consumers are made of LDPE. The main objective of this literature review was to find a sustainable solution for degrading plastics by exploring the capacity of microalgae in the biodegradation of plastics (LDPE) in suburban water bodies in Sri Lanka. A total of 100 articles were downloaded, and 18 articles were selected for the current review by three independent authors. Two of the most dominant microalga species in wastewater ecosystems in Sri Lanka are *Scenedesmus dimorphus* (Green microalga) and *Anabaena spiroides* (blue-green alga). Isolating microalgae from a colonized mat of plastic polyethylene sheets, the more dominant two groups of microalgae were sorted out for the biological treatment of LD (low density) polyethylene sheets. The transverse section (TS) of the polyethylene sheet has shown the multiplication of microalgae in both the outer and inner sides of the polyethylene sheet when Scanned Elecron Microscope (SEM) analysis is done. Biological treatment of the selected microalgae on the LD polyethylene sheets with their respective culture media resulted in the highest percentage (8.81%) of degradation obtained from *Anabaena spiroides* rather than the other microalga, *Scenedesmus dimorphus* (3.74%). Overall, using *Anabaena spiroides*, biodegradation of plastics could be achieved more successfully than from *Scenedesmus dimorphus*. The current review serves as an antecedent by offering insights into the biodegradation of polythene using microalgae. With the current findings, polythene degradation could be enhanced biologically using microalgae and possibly achieve practical and sustainable solutions in plastic degradation.

Keywords: *Biodegradation, Environment, Microalgae, Plastic, Pollution*

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The International Conference on Plastics and Environmental Sustainability - 2024, orchestrated by the Centre for Environmental Studies & Sustainable Development at Open University, served as a vibrant nexus for scholars, researchers, policymakers, and practitioners to convene, exchange knowledge, and foster collaboration in the realm of plastics science and conservation. Positioned at the forefront of academic excellence, this conference delved into pressing themes such as Microplastics, Environmental Impacts of Plastics, Health Impacts of Plastics, Socio-Economic Impacts of Plastics, Plastic Waste Management, Plastic Production and Legal Aspects, and Alternatives for Plastics. With contributions from esteemed scholars, scientists, and practitioners, the proceedings encapsulate cutting-edge research findings, illuminating case studies, and innovative approaches, offering a valuable resource for academics, researchers, policymakers, environmental practitioners, and stakeholders worldwide dedicated to effectuating positive change in the realm of plastics and environmental sustainability.

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