GREEN HORIZON

E-Newsletter

Volume 3 Issue 1 20 June 2022

YENEPOYA
[DEEMED TO BE UNIVERSITY]
Recognized under Sec 3(A) of the UGC Act 1956
Accredited by NAAC with 'A' Grade

Centre for Environmental Studies

Yenepoya (Deemed to be University)
University Road, Deralakatte, Mangalore - 575 018, India
greenhorizon@yenepoya.edu.in

Centre For Environmental Studies

General Information

Green Horizon is a peer reviewed e-newsletter published in English by the Centre for Environmental Studies, Yenepoya (Deemed to be University), Mangalore in two issues per year during June and December. This newsletter publishes manuscript of different categories like original articles, short communications, opinions, research communications, case study etc. We invite original contributions significantly advancing fundamental understanding and that focus on the interconnection of multiple environmental spheres of environment and nature (biodiversity, plants, animals, microbes, conservation, soil, air, water, climate, pollution, waste management, compost, environmental protection, environmental management and ecofriendly approaches). The authors, editors and reviewers need to adhere to the research and publication ethics to enhance the quality of the newsletter.

Aim and Scope
Green Horizon intends to project and share the knowledge on our environment and its protection for the benefit of society. It brings out quality and original materials exclusively on the environment and welfare of the biodiversity. Emphasis should be given to biodiversity, ecology, conservation, waste disposal, prevention of pollution and innovative ideas to protect and nurture our environment towards prolife.

Disclaimers
The statements, opinions and data contained in the newsletter Green Horizon are solely those of the individual authors and contributors and not of the publisher and the editor(s). Neither the newsletter or anyone else involved in creating, producing or delivering Green Horizon or the materials therein, any liability or responsibility for the accuracy, completeness, or usefulness of any information provided in Green Horizon, nor shall they be liable for any direct, indirect, incidental, special, consequential or punitive damages arising out of the use of Green Horizon or its contents. While the advice and information in this journal are believed to be true and accurate on the date of its publication, neither the editors, publisher, owners nor the authors can accept any legal responsibility for any errors or omissions that may be made or for the results obtained from the use of such material. The editors, publisher or owners, make no warranty, express or implied, with respect to the material contained herein.

Printed at
Yenepoya Printers & Publishers, Mangalore 575 001, Karnataka, India

Published by
Yenepoya (Deemed to be University), Mangalore 575 018, Karnataka, India

Newsletter Design:
Yenepoya Printers & Publishers

Cover page photo: Common Kingfisher perched on trash
Photo credit: Dr. Uma Kulkarni

Address
The Editor-in-chief
Green Horizon
Centre for Environmental studies
Yenepoya (Deemed to be University)
Deralakatte, Mangalore – 575018
Karnataka, India.
Mobile: +91 98459 05220
Email: greenhorizon@yenepoya.edu.in

CONTENTS

EDITORIAL COMMITTEE

EDITORIAL

I am very happy to release the first issue of Volume 3 (2022) of the newsletter GREEN HORIZON. This issue projects several basic important issues concerned to protect the planet earth. My appreciation goes to all the contributors for submitting many valuable articles and judicious reviews by the editorial committee on time.

Mother earth is in crisis owing to severe human interference and the collapse of many ecosystems by climate change. Arshad discussed different issues concerned with the advancement of technology and degradation of the environment with argument towards possible human actions required to protect our environment. Leena Pramod addressed the significance and preciousness of soil as a medium for the protection of life on earth. Protection of ecosystems against the deterioration is the need of the day to pass it on to the next generation is the concern of Prakash and Nayak in their article "Decline of the Cosmos in Intercontinental Crisis and Macrocosm Protection". Vidya Bhat and Sham Bhat projected the importance of ecoenzymes or bioenzymes produced by the biodegradable household organic wastes. Such indigenous skill in production of such products will help as a cleaning agent in our daily life without depending on the synthetic cleansing products. Divya Lakshmanan has meticulously examined the dangers of the pollutant bisphenol-A (BPA) on human life.
Three articles dealt with the problems faced by the ecosystems, humans and fauna by plastics (Shreya, Sowrabha Bhat and Geetha Suvarna). A thorough and detailed regulatory approach necessary for the management of plastic waste has been projected by Selvi et al. with facts and statistics. Every move of ours should support the protection of our environment from hazardous materials.

Saprotrophic fungi are probably involved in the degradation of plastics in the future and some articles are appearing along these lines in recent times. The last article by Sridhar deals with the importance of fungi in forensic science as an emerging discipline similar to the importance given to pollens and seeds in providing clues about the culprits.
We are optimistic that this issue of GREEN HORIZON presents many interesting pro-earth insights and obligations of all of us to save our environment from the threats.

In expectation of thought-provoking articles for the next volume of GREEN HORIZON…

Kandikere R. Sridhar
Centre for Environmental Studies
Yenepoya (Deemed to be University)
E-mail: Kandikere@gmail.com

Regulatory Approach for Attainment of Sustained Plastic Waste Management

Selvi P.K., Sowmya D. and Suresh S.

Central Pollution Control Board, Regional Directorate, Nisarga Bhawan,
Bangalore 560010, Karnataka
E-mail: pkselvi.rdb@gmail.com

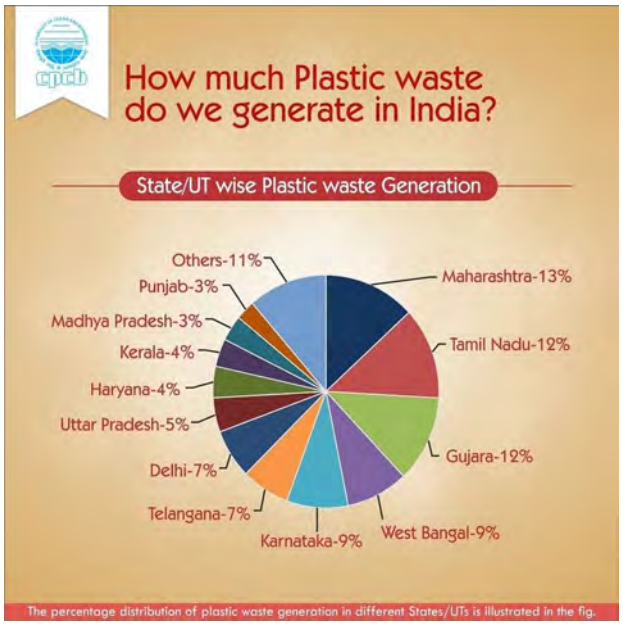
Introduction

Plastics are derived from fossil-fuel based chemicals, which constitute carbon, hydrogen, nitrogen, oxygen, sulfur, chlorine and others. These complex polymers have intruded almost every sector namely, packaging, building, construction, transportation, electronics, industries and health. India's 3.4 MMT of annual Plastic waste generation (2019-20) with 70% of the plastic packaging turned waste has led to Plastic Waste Management (PWM) an inefficient humungous task.

The United Nations Organization defines single-use plastics (SUPs), often referred to as disposable plastics, as is commonly used for plastic packaging, including items intended to be used only once before being thrown away or recycled. The PWM Rules, amended in 2021, define single-use plastic as plastic items intended to be used once for the same purpose before being disposed of or recycled. These include grocery bags, food packaging, bottles, straws, containers, cups and cutlery.

To address the issues and concerns related to single-use plastics, the country has launched the Swachh Bharat Mission for Clean and Green India with an explicit focus on Source segregation, collection, treatment and Phasing out of SUPs. The Government of India has recently launched a 75 weeks long campaign "Azadi Ka Amrit Mahatsov" to celebrate the history, culture and achievements of the country and its people. It has commenced on 12th March 2021, which starts a 75 weeks countdown to the 75th anniversary of Independence and will end on 15th August 2023.

In the program, Ministry of Culture allocated a week of 4th to 10th October 2021 to Ministry of Environment, Forest and Climate Change (MoEF & CC) as an iconic week for holding paradigmatic and impactful events. Keeping in view of the clarion call of the Hon'ble Prime Minister to phase out SUPs by 2022, "Awareness programs to avoid the use of single-use plastic" was identified by the MoEF & CC as one of the themes for the Iconic week celebration named "Azadi Ka Amrit Mahotsav".



Central Pollution Control Board (CPCB) conducted an intensive mass awareness campaign on phasing out of SUPs in association with State Pollution Control Boards, Government Departments, NGOs, Institutions and several industry associations. Awareness was focused on the recently notified PWM Amendment Rules, 2021 and the assessment to enhance the ban on SUPs. The reason behind completely phasing out SUP is the high littering

rate due to its easy access and high use. While it is inexpensive, strong and hygienic for transporting goods, but it is most difficult to recycle.

Regulatory Norms:

According to a report on PWM released by the Ministry of Housing and Urban Affairs, the global average of plastic per capita consumption is 28 Kg and India has a per capita plastic consumption of 11 Kg. Maharashtra and Gujarat generated about 12 % of Plastic waste as per CPCB annual report for the year 2019-20.

The MoEF & CC notified the law on waste management in the form of the Municipal Solid Wastes (Management and Handling) Rules in the year 2000.Since then, the country's waste management regulations have developed in several aspects and undergone a massive transformation.

The Central Government reviewed the existing rules and notified Plastic Waste Management Rules, 2016 to give thrust on plastic waste minimization, source segregation, recycling, involving waste pickers, recyclers and waste processors in the collection of plastic waste fraction either from households or any other source of its generation or intermediate material recovery facility and adopt polluter's pay principle for the sustainability of the waste management system.

The PWM Rules, 2016 and 2018, mention the Extended Producer Responsibility (EPR) approach, which gives producers substantial responsibility (financial and/or physical) for the treatment and disposal of post-consumer plastic waste. The Indian Government has taken steps to mandate EPR under the Plastic Waste Management Rules, 2016. EPR incorporates circularity by making producers responsible for the collection and processing of a product till the end of its life.

The MoEF & CC has recently notified PWM Amendment Rules, 2021 on 21stAugust 2021, wherein, identified single-use plastic items, which have low utility and high littering potential, will be phased out by 2022. The Rule provisions are reproduced, as below: -

"(1)©carry bag made of virgin or recycled plastic, shall not be less than seventy-five microns in thickness with effect from the 30thSeptember 2021 and one hundred and twenty (120) microns in thickness with effect from the 31stDecember 2022; (j) non-woven plastic carry bag shall not be less than 60 Gram Per Square Meter (GSM) with effect from the 30thSeptember 2021.

(2) The manufacture, import, stocking, distribution, sale and use of the following single-use plastic, including polystyrene and expanded polystyrene, commodities shall be prohibited with effect from the 1stJuly 2022:- (a) ear buds with plastic sticks, plastic sticks for balloons, plastic flags, candy sticks, ice-cream sticks, polystyrene [Thermocol] for decoration; (b) plates, cups, glasses, cutlery such as forks, spoons, knives, straw, trays, wrapping or packing films around sweet boxes, invitation cards, and cigarette packets, plastic or PVC banners less than 100 micron, stirrers.

(3) The provisions of sub-rule (2) (b) shall not apply to commodities made of compostable plastic.

(4) Any notification prohibiting the manufacture, import, stocking, distribution, sale and use of carry bags, plastic sheets or like, or cover made of plastic sheets and multilayered packaging and

single-use plastic, including polystyrene and expanded polystyrene, commodities, issued after this notification, shall come into force after the expiry of ten years, from the date of its publication."

It is prudent to mention that 22 States/UTs have imposed a complete ban on plastic bags whereas 09 States/UTs have imposed a partial ban on plastic bags as per provisions of PWM Rules.

Case Studies

Karnataka

As reported by CPCB, the estimated plastic waste generation in the state is approximately 296380 TPA during 2019- 20. The Government of Karnataka has imposed a complete ban on the manufacturer, use and sale of carry bags.At selected Material Recovery Facilities, 100 kg of dry waste was sampled and 12 categories of prohibited SUPs were segregated and weighed. In Bengaluru, the study was carried out in association with M/s Saahas Zero Waste Management in their Material Recovery Facility operated by Jigani. The outcome of the study showed that the total percentage of SUPs in dry waste accounted for 13.5 %. Percentage of prohibited SUPs in dry waste and Percentage of permitted SUPs in dry waste accounted for 4 % and 9.5 % respectively.

The government of Karnataka issued notification No. 373 dated 11/03/2016 imposing a blanket ban on the manufacture, supply, storage, transport, sale and use of certain SUPs (disposable plastics). Bruhat Bengaluru Mahanagara Palike (BBMC) under section 431(A) of Karnataka Municipal Corporation (Amendment) Act, 2013 issued a circular dated 04/06/2016 imposing the following penalties on violators in its jurisdiction.

Saahas Waste Management Pvt. Ltd. is a social enterprise, offering integrated waste management services to Bulk Waste Generators (BWGs), Corporations, Apartments and Government Institutions. The model currently provides consultancy services to help implement a holistic, decentralized waste management system, enabling the recovery of maximum value from waste. SZW has an ongoing project being implemented in these four locations: Udupi, Ramanagara, Mangalore and Ballari. This project entails the design and construction of Material Recovery Facility (MRF), a semi-mechanized facility that receives and processes

Category	Penalty for 1st offence	Penalty for 2nd offence
Manufacturer of banned products	Rs. 200,000/-	Rs. 500,000/-
Storage of banned products	Rs. 100,000/-	Rs. 200,000/-
Retailers for trading and selling banned products	Rs. 50, 000/-	Rs. 100, 000/-
Commercial users and consumers found using the banned products	Rs. 25,000/-	Rs. 50,000/-
Domestic users and consumers found using the banned products	Rs. 500/-	Rs. 1,000/-

dry waste from Bulk Waste Generators (BWGs), gram panchayats and Urban Local Bodies (ULBs). The set-up of the MRF entails capital expenditure, including investments in infrastructure, monitoring devices, material handling and safety equipment etc. The operating expenditure is recovered through collecting a user fee from waste generators, which is charged by the municipal corporation. SZW engages with ULBs towards the implementation of EPR by securing authorizations for the collection of plastic waste pan-India.

Goa

As per the CPCB Annual Report, approximately 26086.3 TPA of plastic waste was generated in the state during 2019-20. Rule 4 of the PWM Rules, 2016 regarding thickness criteria the state has implemented. Single-use plastic is banned under the Amendment made in the Goa non-biodegradable Garbage Control Act.

As an urban tourist city, Panaji generates around 42 TPD of waste. After segregation, the wet waste is composted, while the recyclable dry waste is sent to recyclers and the non-recyclables to cement factories as refuse-derived fuel for co-processing. The city has implemented an innovative model for 16-way segregation at the source. Once segregated, the waste goes through different streams of recycling and resource recovery, therefore drastically reducing the waste that ends up in landfills. This system is cheaper, requires minimal manual or mechanical sorting, reduces the burden on the environment and the stretched waste system. More importantly, this innovative system reduces the occupational health risks for waste pickers who segregate the waste at MRFs.

The Panaji Municipal Corporation (PMC) in collaboration with the recycler, 21 Century Polymers, Mineral Foundation of Goa (organizations) and UNDP have targeted and on boarded 152 BWGs under the program. Subsidies have been worked out with ULBs to reduce the capital cost of the infrastructure required for 16 bins. A buy-back system of dry waste has been introduced to incentivize those undertaking 16-way segregation. This will help offset implementation costs and generate a long-term return on investment. In October 2020, the PMC made 16-way segregation a part of the Solid Waste (Management and Handling) bylaws of the city, making it mandatory for all BWGs to follow the model.

Kerala

The estimated plastic waste generation is approximately 131,400 TPA during 2019-20. CPCB carried out the studyin three of the Material Collection Facilities under the Thrissur Corporation. The outcome resulted in the Percentage of SUPs in dry waste accounting

between 16.9 to 33.6 %. Most of the SUPs in dry waste are unbranded/branded retail plastic packs, plastic-coated cups, plastic decorative items and plastic carry bags.

A complete ban has been imposed on single-use plastic items including plastic carry bags irrespective of thickness in the state wef. 01/01/2020 vide G.O.(Ms) No. 6/2019 Env dated 27/11/2019; G.O.(Ms)No. 2/2020/ENVT dated 27-1-2020 and Envt dated 16/02/2020.

An effort to manage solid waste generated by BWGs in Trivandrum was undertaken by the Clean Kerala Company Limited (CKCL). As a pilot, CKCL started servicing three major BWGs in the city: the Vikram Sarabhai Space Centre, the Trivandrum Central Railway Station and the Government Secretariat. All three institutions generate large quantities of wet and dry waste, most of which were either dumped in common grounds or burnt in the open air. CKCL entered formal partnerships with these organizations and implemented decentralized, on-site waste management systems for them. CKCL entered into agreements with private organizations as part of this model. It manages operations and maintenance of the facility, and the organization bears the finances of the program (staff wages, stationery, safety equipment for staff, etc.). This arrangement is mutually beneficial and involves sharing profits as well as disposal costs.

Issues and Challenges

Only one-fourth of the total plastic waste generated in the country is currently recycled in the country. Enforcement & Awareness are major concerns for phasing out Single-Use Plastic with High-value waste such as PET bottles, flags, banners, Cutlery items although sold is not found in waste as per the assessment of CPCB. Plastic waste in litter contains mostly carry bags & packaging integrated packaging. Enforcement of Provisions and achieving targets for phase-out of SUPs made under PWM (Amendment) Rules, 2021 has become a major challenge.

The major issues include lack of proper source collection and segregation system on the ground and Lack of proper infrastructure, processing efficiency and skilled manpower for collection and transportation of waste processing plastic waste. Besides, PWM is yet to be initiated in most of the Gram Panchayat. Registration of Producers/ Brand Owners under EPR will enhance the recyclability and PWM in a holistic way. Phasing out of Single-Use Plastic has to gain momentum to achieve desired targets set.

Measures to Phase-Out Single-Use Plastics

The most problematic SUPs to be targeted by conducting a baseline assessment to identify the most problematic SUPs, as well as the current causes, extent and impacts of their mismanagement. Consider the best actions to tackle the problem (e.g. through regulatory, economic, awareness, voluntary actions) viz., (a) Effective enforcement and implementation of Regulations by SPCBs/ ULBs including the imposition of fine on the defaulter producers, retailers, sale and use of SUPs; (b) Industries be encouraged and supported for manufacturing an alternate materials to SUPs using biodegradable materials and agricultural waste; (c) Increased knowledge among the customers about the availability of alternative to SUP in the State/City vis-a-vis it manufacturing/reachability to customers/public in the market shall be increased.

Identifying and engaging key stakeholder groups such as retailers, consumers, industry representatives, local government, manufacturers, civil society, environmental

groups, and tourism associations for carrying out evidence-based studies, which are also necessary to defeat opposition from the plastics industry. Cut down Plastics (SUPs) in a phased manner by reducing its production vis-a-vis demand by increasing its price. Public to take steps/actions not to use SUPs and Industries to lead by example by banning its production and dissuading its use. Initiatives by NGOs be encouraged to create awareness about Plastics ban/ actions needed to clean up plastic pollution in their own community on a large scale.

The Educational Department and Ministry to make Pilot scale projects in Schools/ Colleges/Universities, a mandate to address the real-time issues in the environment. State-level Action Plan and Proactive Measures in collaboration with Public Sectors, Community-driven Organizations, Industries and Others is the need of the hour.

Concluding Remarks

Plastic Waste Management being a major problem in India, Ministry of Environment and Forests & Climate Changebrought out amendments as the Plastic Waste Management (Amendment) Rules, 2021 with the salient features as (i) Carry bags or recycled plastics shall not be less than seventy-five microns in thickness and one hundred and twenty (120) microns in thickness; (ii) Jurisdiction of applicability of Rules expanded from the municipal area to rural areas; (iii) Responsibility of collection of plastic waste under extended producers responsibility assigned to Producers, brand owners who introduce plastic into the market; (iv)Responsibility assigned to waste generators for payment of user charge as prescribed by the local authority; (v) Responsibility assigned to the institutional generator, event organizers for collection and handing over of waste to authorized waste processing/disposal facilities; (vi) Promotion of the use of plastic waste promoted for road construction as per Indian Road Congress guidelines or for energy recovery, or for waste to oil and others; (vii) Issuance of Certification of manufacturers of compostable bags by Central Pollution Control Board.

An important aspect on this 'waste' is that it is being actively used as an 'additive' in the road making across the country besides in recycling. Further, the science on biodegradable plastics is opening doors to phase out the use of non-biodegradable plastics in the packaging industry. Promoting Research & Development activities for the development of Product Alternatives (Compostable, Biodegradable, Paper, Wood, Cloth and others). Recognizing more labs to certify and approve biodegradable and compostable products. Amidst keeping at the pace of manufacturing capacity, cost economics, awareness of single-use plastic alternatives, single-use plastic Alternatives usage is increasing.

References

Annual Report 2019-20 on Implementation of Plastic Waste Management Rules, 2016

NITI AAYOG - UNDP Handbook on Sustainable Urban Plastic Waste Management Notification of Plastic Waste Management (Amendment) Rules, 2021

Plastic Waste Management - An Approach to minimize environmental degradation Newsletter

Human Exposure to Bisphenol-A in Paper Products by Dermal Contacts

Divya Lakshmanan M.
Yenepoya Research Centre, Yenepoya (Deemed to be University),
Mangalore 575018, Karnataka
E-mail: divya@yenepoya.edu.in

Abstract
Bisphenol-A (BPA) is a compound used widely in thermal papers as a color developer. Classified as an endocrine-disrupting chemical (EDC) by US Environmental Protection Agency (EPA), its human exposure has been attributed to occur mainly through the consumption of food and beverages stored in plastic wares, plastic wrappers, plastic liners, and sealants. The absorption of BPA, through dermal contact, while handling different thermal papers and recycled papers had been ignored till recently. This chapter provides information on the use of BPA in thermal paper, it is possible exposure through contact with thermal papers, currencies, and recycled papers such as kitchen tissues and food storage cartons. In addition, the chapter also gives a glimpse of the day-to-day consumables, like hand sanitizers and skin products, which enhance the rate of intake of BPA via skin contacts.

Keywords: Endocrine disruptor, thermal paper, recycled paper, dermal exposure

Introduction
Bisphenol-A (BPA), classified as an endocrine-disrupting chemical (EDC) by US Environmental Protection Agency (EPA), is one of the chemicals with the highest production volume in the world with a total production of 5,160 kilotons annually (Chemical Weekly, 2009; Vandenberg et al., 2009; ICIS, 2011). Although human exposure to BPA has been attributed to occur mainly through the consumption of food and beverages stored in plastic wares, plastic wrappers, plastic liners, and sealants, only less than 5% of the BPA produced globally, is used in food contact applications (US EPA, 2010). Non-food sources that are presumed to be important sources of exposure include inhalation and dermal absorption, especially in occupational settings. BPA is found in a diverse array of products manufactured using polycarbonate plastics, epoxy resins, and polyester resins in addition to its use in thermal papers (Vandenberg et al., 2007; Vandenberg et al., 2009; Schecter et al., 2010; Liao and Kannan, 2011a,b; Divya et al., 2013). BPA is also present in some cigarette filters and there exists an association between smoking and urinary BPA concentrations (Li et al., 2007; NTP-CERHR, 2007; Vandenberg et al., 2010; Liao et al., 2012b).

The use of BPA in the thermal paper may contribute to its occurrence in the recycled paper products including kitchen tissues and cartons besides its leakage into water bodies and landfills (Rudel et al., 1998; Gehring et al., 2004; Ozaki et al., 2004; Liao and Kannan,2011b; JRC-IHCP, 2010; Staples et al., 2010). Although there are currently no estimates for the amount of BPA used in thermal paper, it is believed to account for roughly 0.2% of the total use of BPA (US EPA, 2014).The use of BPA in thermal paper is considered comparatively more hazardous and more prone to human exposure than BPA polymerized into a resin or plastic due to its occurrence as free BPA, i.e., discrete, non-polymerized BPA (US EPA, 2010) coated onto the paper surface as thin powdery film.

Bisphenol-A in Paper Products
BPA as a developer in thermal papers
Thermal paper is a special fine paper coated with a thermal sensitive layer that reacts in the presence of heat to create printed images. As illustrated inFigure1, the thermal layer is composed of three main components: a leucodye

(also referred to as a color former); a developer (also referred to as a co-reactant); in some special papers a sensitizer (also referred to as a modifier) and a binder, which facilitates these coatings to adhere onto the paper.

The colorant typically used in thermal paper is a leuco dye, which is colorless at room temperature (Biedermann et al., 2010). Leuco dyes used in thermal paper undergo a structural change when protonated in the presence of heat and a proton donor (i.e., developer). The structural change results in the production of color. During printing, the thermal head of the printing unit pulses heat to the paper, which causes the components to melt, triggering the transfer of the proton from the developer to the dye, causing the leuco dye molecule to change structure to form a visible color (Biedermann et al., 2010). When used, the sensitizer has a lower melting point, thus acting as a solvent, promoting the interaction of the developer with the dye.

The spironolactone compounds are the most regularly used dyes in thermal paper manufacturing, with Black 305 and ODB2 among the most common ones. BPA and recently its analogs (Table 1) are commonly used as developers in several thermal paper applications (ERA) (U.S EPA, 2014; Liao & Kannan, K, 2012b). The developer also referred to as a co-reactant, is normally a weakly acidic molecule and functions in transferring protons to the dye, triggering color formation. In selecting a developer, its solubility, pKa, melting point, color, odor, purity, and vapor pressure are considered. Sensitizers, also referred to as modifiers, are used for lowering the melting point of the dye/developer, and/or by acting as a type of solvent in which a dye and developer dissolve below their melting point, thus enhancing the dye coloration process. Sensitizers normally have a melting point between 45-65ºC (Mendum et al., 2011). The sensitizer helps to provide the optimal conditions for the developer to transfer protons upon heating, which enhances the color formation thus increasing printing speed or making a product suitable for low-energy printers.

BPA use in printing inks

The BPA is used in toners and printing ink for office copiers, fax machines, and printers. Toners are used commonly in copying and non-impact printing processes, such as office copiers, plain paper fax machines, digital printers, and copiers (European Consumers' Organisation (BEUC) 2011). Various manufacturers (Xerox, Lexmark) use BPA derivatives in these toners, for example, in the form of BPA polyester resin. Printing inks are applied as thin films on paper, paper board, metal sheets, metallic foil, plastic films, and molded plastic articles, textiles, and glass. Some may not contain BPA, however many others do (European Consumers' Organisation (BEUC) 2011; U.S. EPA 2007).

Bisphenol-A Exposure through Handling Paper Products

Paper products based on BPA

Thermal papers are one of the major BPA-based products, coming in frequent contact with our day-to-day life, in the form of, point-of-sale (POS) receipts, self-adhesive labels, tickets, and print-outs from recording devices (US-EPA, 2014). POS receipts include sales receipts from cash registers, ATMs, and banks; Labels printed on thermal paper include labels on prescriptions, industrial barcodes, shipping labels, luggage tags, packaged items such as supermarket foods, and retail shelf labels; Tickets include the ones used for transportation (e.g., airlines, trains, and buses), entertainment, parking tickets, and tickets from kiosks (Nashua Corporation 2008); print-outs from grocery, medical devices such as Ultrasound, electrocardiogram (ECG), and other analytical laboratory recorders such as ELISA or Microplate readers and spectroscopic devices are examples of some thermal papers. While POS receipts account for the usage of almost 50% of the total thermal paper manufactured, 30% of thermal paper is utilized in self-adhesive labels and nearly 10% is used for lottery tickets, and another 10% for fax paper printing (JRC-IHCP, 2010).

Thermal receipt papers collected from different parts of the world including the US, Japan, India, Korea, Belgium, and Vietnam had a quantifiable amount of BPA present, with BPA levels ranging

from below the level of quantification (1 ng/g in this study) to 13.9 mg/g (geometric mean: 0.211 mg/g) of BPA (Liao and Kannan, 2011; Mendum et al., 2011; Geens et al., 2012; Divya et al., 2013;Fan et al., 2015). Thermal papers from Belgium had an even higher concentration of BPA ranging between 9 and 21 mg BPA/g paper (Fan et al., 2015). In a study conducted in India, the amount of BPA for a $1cm^2$ receipt extracted in methanol was estimated to be 96 μg, which is approximately equal to 6.65 mg of BPA per gram of thermal paper (Figure2) (Divya et al., 2013). Based on the concentration of BPA present, thermal papers are categorized as, full BPA content (9-19mg/12 inches), low BPA content (1-3 mg/12 inches), and BPA-free paper (below the detection limit) (Mendum et al., 2011).

BPA contamination in paper currencies

The BPA is applied on thermal papers as a powdery film, and thus it is transferred from receipts to paper currencies every time a receipt is placed near the currency in a cash register or wallet or whenever one handles a receipt before handling money. Liao and Kannan (2011a; 2011b), have done extensive studies on BPA contamination in paper currencies. In their work, paper currencies from 21 countries (N = 156) were analyzed for BPA, which was measured in 19 mm punches taken from three spots on the paper currencies. BPA was found in all paper currencies at concentrations ranging from 0.001 to 82.7 μg/g (mean 4.94; median 1.02) and the concentration of BPA in samples taken from the middle portion of the currencies were higher than those taken from peripheral portions. Transfer of BPA from thermal receipt paper to currencies, when currencies were in contact with thermal receipt papers for 24 h in a wallet, wasdramatically highwhen compared to the initial,suggesting that thermal receipt paper is an important source ofBPA in paper currencies.The rate of transfer of BPA from thermal receipt paper to currency bills can vary depending on the original concentration (or level of saturation) of BPA in currency bills and receipts. Although thermal receipt paper is a source of BPAcontamination of paper currencies, the use of BPA as an ink developer in paper currencies cannot be ruled out.

BPA contamination in recycled paper products

The BPA contamination in recycled paper products arisesmainly from the recycling of thermal receipt paper, along with other papers, and to an extent from the use of BPA for the elastification of phenolic resins in printing inks.Since these papersare used in the production of a wide range of paper products, from toilet papers, paper towels, newspapers to cartons for snack foods and cardboard boxes, recycling of thermal papers and printed papers, along with other papers, poses a high risk of human exposure to BPA via cross-contamination of foods stored in recycled paper products (Vinggaard et al., 2000; Gehring et al., 2004; Ozaki et al., 2004 Terasaki et al., 2007). The level of BPA found in recycled paper towels and other food-contact papers are much higher than that found in virgin papers. The majority of non-thermal paper products including recycled paper products, such as flyers, magazines, tickets, mailing, envelopes, newspapers, food contact papers, food cartons, airplane, boarding passes, luggage tags, printing papers, business cards, napkins, paper towels, and toilet paper, collected from various cities of US, Japan, Korea, and Vietnam, contained BPA at concentrations ranging from below the LOQ (1 ng/g) to 14.4 μg/g (geometric mean: 0.016 μg/g). The BPA was found in all types of paper samples, at concentrations ranging from 3.2 to 46.1 μg/g (GM: 18.9 μg/g) for toilet paper and from 0.09 to 5.1 μg/g (1.24 μg/g) for other waste paper types. Ozaki et al. (Ozaki et al., 2004) collected paper and cardboard products in Osaka, Japan, which have been used as food containers (e.g., cereal boxes), almost half of which were made from recycled paper and the remainder from virgin pulp. BPA was present in both virgin and recycled paper samples (67%), at a concentration range of <LOQ to 0.36 μg/g (GM: 0.044 μg/g) and <LOQ to 26 μg/g (GM: 0.255 μg/g), respectively. The knowledge that napkins and toilet paper, madefrom recycled papers contained microgram-per-gram concentrations of BPA raises serious health concerns in using these products (Ozaki et al., 2004).

Exposure through handling paper products

Exposure to BPA concerning its use in the

thermal paper can occur during manufacturing, through consumer use, and after recycling. In manufacturing, the primary concern is worker exposure during batching of BPA, for which the inhalation exposure was estimated to be 100 mg/kg BW/day (NTP-CERHR, 2008). The NTP expressed "some concern" based on effects in laboratory animals administered 10 mg/kg BW/day, but considered 5 mg/kg BW/day as the recommended no observed adverse effect level based on animal studies (NOAEL) (NTP-CEHR, 2008)

Alarmingly, holding a BPA containing cash receipt in hands for just five seconds leaves roughly 1 µg BPA on the skin of the forefinger and the middle finger if the skin is dry and about ten times more when the fingers are wet or greasy (Biedermann et al., 2010; Zalko et al.,2011). Compared with that in water, the migration speed of BPA was doubled in the synthetic sweat (Fan et al., 2015). Washing hands could reduce BPA dermal exposure, and washing hands with lotion was the most efficient way. However, about 19–47% of BPA was still found on hands after different washing methods. This may lead to problems for workers and consumers alike, while handling, the receipt and unpacked food such as vegetables and other greasy foods simultaneously, due to dermal absorption or the residues on hands being ingested through incidental hand-to-mouth contact (Xue et al., 2007; Biedermann, et al., 2010; Zalko et al., 2011).Studies estimate between 10% and 60% of BPA from receipt paper is absorbed through the skin. Sincethermal paper is a feedstock for paper recycling processes, contamination of other "BPA-free" papers canoccur. An estimation of human exposure through thermal paper results in a median intake of 445 ng BPA/dayreported for the general population, which corresponds to an exposure of 6.4 ng/kg BW/day for a person of 70 kg, in a study conducted in Belgium and 17.5 and 1300 ng/day for the general population and occupationally exposed individuals, respectively in a small study conducted in China (Fan et al., 2015). In one small sample of pregnant women, cashiers had higher urinary BPA levels than women in other occupations. Among all paper products reported so far, thermal receipt papers contributed to the majority (>98%) of the exposures.

During the process of recycling, papers are often bleached with sodium hypochlorite which may lead to the formation of chlorinated BPA derivatives. These derivatives are 28 times more estrogenic than the non-chlorinated BPA products (Fukazawa et al., 2001; Fukazawa et al., 2002). However,no studies are showing how readily the body absorbs BPS or BPA from recycled paper goods. Since chemicals in these products are mixed in with the paper rather than coated on top, there may be less opportunity for dermal absorption. Still, there aresome concerns aboutrecycled paper products, like facial and toilet tissues, that come into contact with the mucous membranes of our body and often with our food. Though the reported values through dermal exposures are below the maximum dosesrecommended by the US Environmental Protection Agency and the European Food Safety Authority, its uncertain adverse effects on human beings in conjunction with its long-term BPA exposure throughdermal absorption should be paid more attention to, particularly for some occupational populations. Exposure to BPA from thermal paper goes beyond just transdermal exposure and consumption of food that is picked up and eaten with a BPA-contaminated hand. The transfer of any chemical directly from hand-to-mouth (mouthing behavior) has been proposed to be an important variable for estimating total chemical exposure in humans, particularly in young children (Xue et al., 2007; Fanet al.,2011).

References

Biedermann, S., Tschudin, P. and Grob, K. 2010. Transfer of bisphenol A from thermal printer paper to the skin. Anal. Bioanal. Chem., 398, 571–576.

Brand, R.M., Charron, A.R., Sandler, V.L. and Jendrzejewski, J.L. 2007. Moisturizing lotions can increase transdermal absorption of the herbicide 2,4-dichlorophenoxacetic acid across hairless mouse skin. Cutan. Ocul. Toxicol., 26, 15–23

Chemical Weekly. 2009. Bisphenol-A: A

Techno-Commercial Profile., 205-211. http://www.chemicalweekly.com/Profiles/Bisphenol_A.pdf

Divya, L., M., Prasanth, G.K. and Sadasivan, C. 2013. Elimination of Estrogenic Activity of Thermal Paper Using Laccase from Trichoderma sp. NFCCI-2745. Appl. Biochem. Biotechnol., 169, 1126-1133

European Consumers' Organisation (BEUC). 2011. Bisphenol A should be phased out from consumer products. www.beuc.eu/publications/2011-00248-01-e.pdf

Fan, R., Zeng, B., Liu, X., Chen, C., Zhuang, Q. et al. 2015. Levels of bisphenol-A in different paper products in Guangzhou, China, and assessment of human exposure via dermal contact. Environ. Sci. Process Impacts, 17, 667-673.

Fukazawa, H., Hoshino, K., Shiozawa, T., Matsushita, H. and Terao, Y. 2001. Identification and quantification of chlorinated bisphenol A in wastewater from wastepaper recycling plants. Chemosphere, 44, 973-979.

Fukazawa, H., Watanabe, M., Shiraishi, F., Shiraishi, H., Shiozawa, T. et al. 2002. Formation of Chlorinated Derivatives of Bisphenol A in Waste Paper Recycling Plants and Their Estrogenic Activities. J. Health Sci., 48, 242-249.

Gayrard, V., Lacroix, M.Z., Collet, S.H., Viguie, C., Bousquet-Melou. A. et al. 2013. High bioavailability of bisphenol a from sublingual exposure. Environ. Health Perspect, 121, 951-956

Geens, T., Apelbaum, T. Z.., Neels H. and Covaci, A. 2010. Intake of bisphenol A from canned beverages and foods on the Belgian market. Food Addit. Contam., 27, 1627-1637.

Gehring, M., Vogel, D., Tennhardt, L., Weltin, D. and Bilitwski, B. 2004. Bisphenol A contamination of wastepaper, cellulose and recycled paper products. Waste Management and the Environment II. V. Popov, H. Itoh, C. A. Brebbia and A. Kungolos. Billerica, WIT Press. 78, 293-300.

IBISWorld. 2012. Hand sanitizer manufacturing in the US: Market research report. February 2012. http://www.ibisworld.com/industry/hand-sanitizer-manufacturing.html

ICIS. 2011. Bisphenol A (BPA) Production and Manufacturing Information. Joint Research Centre-Institute for Health and Consumer Protection (JRC-IHCP) (2010).

Li, D.-K., Zhou, A., Miao, M., He, Y., Wang, J. et al. 2011. Urine bisphenol-A (BPA) level in relation to semen quality. Fertility and Sterility, 95, 625-630.

Liao, C.2012a. Bisphenol S in Urine from the United States and Seven Asian Countries: Occurrence and Human Exposures. Environ. Sci. Technol., Epub, May 23, 2012.

Liao, C. and Kannan, K. 2011a. High Levels of Bisphenol A in Paper Currencies from Several Countries, and Implications for Dermal Exposure. Environ. Sci. Technol., 45, 6761-6768.

Liao, C. and Kannan, K. 2011b. Widespread Occurrence of Bisphenol A in Paper and Paper Products: Implications for Human Exposure. Environ. Sci. Technol., 45, 9372-9379.

Liao, C., Liu, F. and Kanna, K. 2012b. Bisphenol S, a New Bisphenol Analogue, in Paper Products and Currency Bills and Its Association with Bisphenol A Residues.

Environ. Sci. Technol., Epub., May 16, 2012.
Mendum, T., Stoler, E., VanBenschoten, H.and Warner, J.C. 2011. Concentration of bisphenol A in thermal paper. Green Chem. Lett. Rev., 4,81-86.

Nashua Corporation. 2008. Label Products.http://nashua.com /prodandservices/labelproducts. National Toxicology Program-Center for the Evaluation of Risks to Human Reproduction (NTPCERHR) (2008). NTP-CERHR Monograph on the Potential Human

Reproductive and Developmental Effects of Bisphenol A. U.S. Department of Health and Human Services.

Organisation for Economic Co-operation and Development (OECD). 2002. SIDS Initial Assessment Profile. Existing Chemicals Database SIAM, 14, 26-28.

Ozaki, A., Yamaguchi, Y., Fujita, T., Kuroda, K. and Endo, G. 2004. Chemical analysis and genotoxicological safety assessment of paper and paperboard used for food packaging. Food and Chem. Toxicol., 42, 1323-1337.

Rudel, R. A., Melly, S.J., Geno, P.W., Sun, G. and Brody, J.G. 1998. Identification of Alkylphenols and Other Estrogenic Phenolic Compounds in Wastewater, Septage, and Groundwater on Cape Cod, Massachusetts. Environ. Sci. Technol., 32, 861-869.

Schecter, A., Malik, N., Haffner, D., Smith, S., Harris, T.R. et al.2010. Bisphenol A (BPA) in U.S. food.Environ. Sci. Technol., 44, 942-9430.
Singh, I. and Morris, A.P. 2011. Performance of transdermal therapeutic systems: Effects of biological factors. Int. J. Pharm. Investig, 1, 4–9

Staples, C.,Friederich, U., Hall, A.T., Klecka, G., Mihaich, E et al. 2010. Estimating potential risks to terrestrial invertebrates and plants exposed to bisphenol A in soil amended with activated sludge biosolids. Environ. Toxicol. Chem., 29, 467-475.

Terasaki, M., Shiraishi, F., Fukazawa, H. and Makino. M.2007. Occurence and estrogenicity of phenolics in paper recycling process water: pollutants originating from thermal paper in waste paper. Environ. Toxicol. Chem., 26, 2356-2366.

U.S. Environmental Protection Agency (U.S. EPA). 2010. Bisphenol A Action Plan.

US Environmental Protection Agency. 2014. Bisphenol A Alternatives in Thermal Paper. Jan. 2014.http://www.epa.gov/dfe/pubs/ projects/bpa /bpa-reportcomplete.pdf.

Vandenberg, L.N., Chahoud, I., Heindel, J.J., Padmanabhan, V., Paumgartten, F.J. and Schoenfelder, G. 2010. Urinary, circulating, and tissue biomonitoring studies indicate widespread exposure to bisphenol A. Environ. Health Perspect., 118, 1055-1070.

Vandenberg, L.N., Hauser, R., Marcus, M., Olea, N. and Welshons, W.V. 2007. Human exposure to bisphenol A (BPA) Reprod. Toxicol., 24, 139-77.

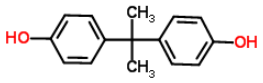
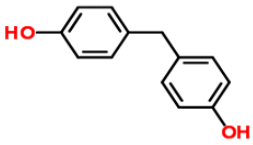
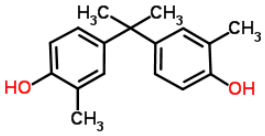
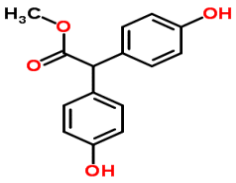
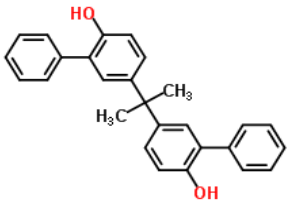
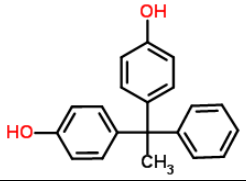
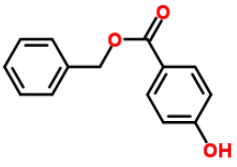
Vandenberg, L.N., Maffini, M.V., Sonnenschein, C., Rubin, B.S. and Soto, A.M. 2009. Bisphenol-A and the great divide: A review of controversies in the field of endocrine disruption. Endocr. Rev., 30, 75-95.

Vinggaard, A.M., Körner, W., Lund, K.H., Bolz, U. and Petersen, J.H. 2000. Identification and Quantification of Estroggenic Compunds in Recycled and Virgin Paper for Household Use As Determined by an in Vitro Yeast Estrogen Screen and Chemical Analysis. Chem. Res. Toxicol., 13, 1214-1222.

Xue, J., Zartarian, V., Tulve, N.S., Moya, J., Freeman, N. et al. 2007. A Meta-Analysis of Children's Hand-to-Mouth Frequency Data for Estimating Nondietary Ingestion Exposure. Risk Anal., 27, 411-420.

Zalko, D., Jacques, C., Duplan, H., Bruel, S. and Perdu, E. 2011. Viable skin efficiently absorbs and metabolizes bisphenol A. Chemosphere, 82, 424-430.

Table 1. Bisphenol A and its Alternatives used in Thermal Paper Manufacturing

Sl. No.	Chemical Name	Chemical Structure
1	Bisphenol A 2,2-Bis(4-hydroxyphenyl)propane)	
2	Bisphenol F Bis(4-hydroxyphenyl)methane	
3	Bisphenol C 4,4'-Propane-2,2-diylbis(2-methylphenol)	
4	MBHA Methyl bis(4-hydroxyphenyl) acetate	
5	BisOPP-A 5,5'-Propane-2,2-diyldibiphenyl-2-ol	
6	Bisphenol AP 4,4'-(1-Phenylethylidene)bisphenol	
7	PHBB Benzyl 4-hydroxybenzoate	

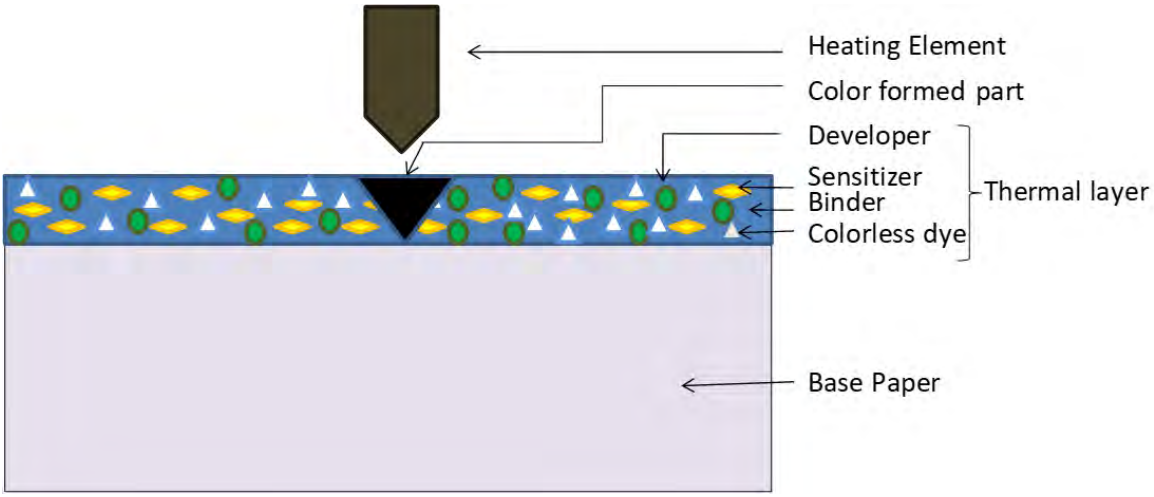


Fig. 1. Representative illustration of a thermal paper.

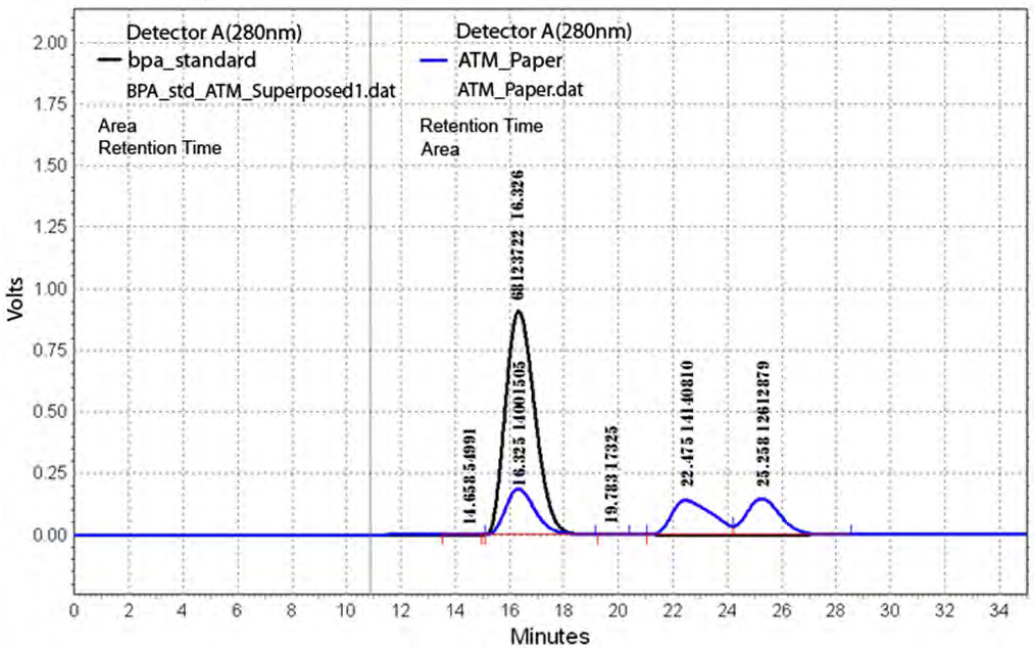


Fig. 2. HPLC chromatogram showing detectable amount of BPA in thermal paper compared to standard BPA. The concentration of BPA in the sample was extrapolated from the curves in peak area (Divya et al., 2013).

Plastic Menace! What are the Solutions?

Shreya, V.K.

Department of Anatomy, Yenepoya Medical College, Yenepoya (Deemed to be University), Mangalore 575 018, Karnataka
E-mail: shreyavikranthkumar@yenepoya.edu.in

Plastics, the word in general means a collective sum of many different types of products that vary in their effect on the environment. In 1862 Alexander Parkes introduced "Parkesine", which is considered the world's first man-made plastic from an organic compound. The mark of modern plastics began with the synthesis of Bakelite in 1907. The period preceding and succeeding World War II era paved major contribution in research and innovation in plastics leading to the synthesis of polyethene, polystyrene, nylon and others, since then it has been a boon as well as bane for mankind.

The popularity of plastic products is because of their mouldability, flexibility, durability, convenience and cost. Since we all inhabit this earth and make use of plastic in one way or the other, it is our responsibility to solve the problems caused by it.

The problem can be tackled from two ends: the production end and the consumption end. The government bodies can give incentives to manufacturing units producing recyclable products. Recyclable units can be set up by private bodies that themselves can generate profits by recycling the collected waste products. They should be subsidised generously. The new government policies of 2022 on plastics in India look promising if implemented and executed effectively.

Moving on to the consumer end, what can we do? The foremost thing is to stop using single-use plastics like plastic bags, straws, coffee stirrers, bottles and most food packaging as much as possible. Instead, keep a cloth bag and metal water bottles handy in your bag or vehicle. Utensils used in the kitchen almost all of it can be replaced by metal, glassware, earthenware and stoneware. This will also have a positive impact on our health as plastics are common endocrine disruptors causing an array of health-related issues.

Fig. 1. Eco-friendly products for daily use

Almost 62% of clothing that has flooded our markets is mainly made from synthetic fibers like polyester, nylon, acrylic, elastane and polypropylene. The seepage of the microplastics into our body with long-term use of these fibers is one of the major health concerns. This can be easily taken care of by switching on to natural fibres. A gradual replacement in your wardrobe from synthetic to natural fibers like cotton, jute, linen and so on can be carried out. The main thing to note is to have a change in our mind set. It's always better to purchase one cloth of natural fiber rather than ten clothes of synthetic fiber which is very cheap but destructive in every way.

From furniture to footwear the list goes on, we can gradually shift to a place where plastic is the last option and not the only option. This will take time but with a conscious effort, we can prevent the ubiquitous use of plastic.

Fig. 2. Alternatives for plastic ware

We as a generation have probably generated more wastage than the entire mankind since the beginning of time. And most of this wastage is plastics, the one thing that lives longer than any human. Any product that can be recycled numerous times is a boon for mankind and the environment. Therefore, banning plastic can never be effective as it will only lead to seepage of it through illegal ways. But reduced demand for plastic will surely reduce production. As a generation of people having access to comfort and technology let's all pledge to reduce the use of plastic and make it a better place for our generations to come in terms of health and wellbeing.

Glimpses of Forensic Mycology

K.R. Sridhar

Centre for Environmental Studies, Yenepoya (Deemed to be University), Mangalore 575018, Karnataka, India
Department of Biosciences, Mangalore University, Mangalagangotri, Mangalore 574199, Karnataka, India
E-mail: kandikere@gmail.com

Introduction

Forensic science is a discipline of the scientific method used to understand the motives of a crime. It has applications in the context of human catastrophes, conflicts, medico-legal cases, violence, poisoning, hallucinations and war. Appropriate procedures are necessary to answer the questions that pertain to a crime (e.g., what, where, when, who and how). Three types of forensic evidence are required are experimental, analytical and digital (NRC, 2009). There are five fundamental criteria to interpret the evidence of a crime based on the stage of decomposition of the human body (Payne, 1965). These phases are: 1) Fresh; 2) Bloat; 3) Active decay; 4) Advanced decay; 5) Skeletonization. Such stages are characterized sequentially by the failure of the immune system (propagation of gut microbes and invasion of other organs); autolysis of tissues (which leads to nutrient release facilitates the growth of anaerobic bacteria and gas accrual by fermentation); pressure developed by gas inside the body (leads to rupture of skin leads to proliferation of aerobic bacteria); reduction of nutrients (decline the microbial action); microbes in the dehydrated body remains (comparable to the microbes in the soil) (Speruda et al., 2022).

Forensic ecology is one of the contemporary disciplines that provide evidence of a crime in a broader context using botanical and mycological investigations (Wiltshire, 2010, 2019). Steps of investigations to be followed include: body deposition time, time since death or post-mortem interval (PMI), events around an offense, a trace of evidence, location of human remains, kill site vs. deposition site, cause of death and challenging witness testimony (Wiltshire, 2010). A range of fungi useful in forensic evaluation include molds, mildews, yeasts, smuts, rusts, mushrooms and lichens. Depending on the prevailing conditions (nature of the habitat, temperature, humidity, availability of light and status of the corpse), a specific organism invades or shows preponderance. Subject to the situation, various indicators could be used to prove the location and PMI using pollen, seeds, fungi and others as fingerprints. One of the important requirements of criminal investigation is to draw information pertaining to PMI. In the recent past, the application of mycology in forensic science has been visualized as fungal growth and sporulation is dependent on the specific ecological conditions prevailing in the crime sight or elsewhere (Hawksworth and Wiltshire, 2011, 2015; Ambrosio et al., 2016; Celia and Noemi, 2017).

Mycology in Forensic Science

Forensic mycology is an important discipline of applied mycology and it provides a significant supporting indication in the criminal examination. Initially, fungal diagnosis in buildings and their impact on human health and death was attempted (Hawksworth et al., 2011, 2016; Wiltshire, 2016). Subsequently, mycological research supported many forensic investigations (to link people and objects in a specific place) especially in deciding the PMI based on fungal growth on the dead body, intoxication by mushrooms and presence of psychoactive compounds (Hawksworth and Wiltshire, 2011, 2015). Fungal spores are present on some of the objects (e.g., plants, litter, soil, sediments and bark or tree trunk) and their capacity to grow on the objects (e.g., cloth, rubber, plastic, leather, wood, stone and tiles) provides a trace of evidence as fungal spores fastening to some of the materials used in a

criminal investigation (Hawksworth and Wiltshire, 2015). Fungal spores will be useful to provide evidence when palynological evidence is insufficient or fail. In many instances, the pollen evidence will be strengthened by mycological evidence. Similar to seeds, many fungal spores adhere to metal surfaces, clothes, tyres, footwear, fur, carpet and so on. Similarly, several fungi will grow on body fluids (e.g., blood, saliva and urine). Presence of specific fungal spores in a dead body, location of deposition and wearable (clothes, footwear and weapons) provide important clues to a crime.

Fungi and Post-Mortem Interval

The presence of fungi in soil, skin and intestines is important to assess the PMI. The PMI could be traced using fungal evidence as some of the fungi start growing on the body surface, which is dependent on environmental conditions (e.g., temperature, humidity and others). Early-stage decomposition of the skin supports a specific group of fungi like non-septate sugar fungi (e.g., *Mucor* and *Rhizopus*). Growth of *Mucor* (colony size, mature and immature colonies) will predict PMI as they grow on the skin about a week after death (Hawksworth and Wiltshire, 2011). Similarly, the diurnal growth rings of microfungi on the body surface also predict the time since death. In advanced decay and skeletonization, some of the specific lichens will grow on the skeleton (*Caloplaca* and *Lecanora* spp.) and skull (*Parmeliasaxatilis*) (Hawksworth and Wiltshire, 2015).

Sidrim et al. (2010) carried out a mycological survey of different stages of 60 human corpses in Brazil. A maximum number of fungal isolates were found in bloated (143 cultures) followed by skeletonized (26 cultures) and putrefied (12 cultures) stages. Samples subjected to this study included hair, skin, mucosa and lungs. Procopio et al. (2020) studied the succession of fungi in animal bodies using metabarcoding and found growth of Ascomycota (after 2 months) followed by Mortierello mycota (after 4-6 months) and a decrease in Basidiomycota in early as well as late time points. Based on the diameter of the fungal colonies (*Mucor* and *Penicillium* isolated from skin) in artificial culture simulating the conditions prevailing on the spot (4°C) coincided with colonies on the skin proved the death caused about 3-4 weeks (Evans, 1996). The degree of fungal growth in cooked food remains also indicative of time since death (Filho et al., 2010; Hawksworth, 2013). The colony diameter of *Aspergillus* and *Geotrichum* on food remains was revealed the food was left for about 10-14 days (Hawksworth and Wiltshire, 2015). Filjo et al. (2010) provided evidence of the growth of *Trichophyton metagrophytes* on hair samples of a corpse scalp at the bloat stage as an indication of decomposition owing to degeneration of cuticle after death within two weeks. The bag consists of weapons that were buried consist to the growth of the fungus *Thermomyces lanuginosus*, which requires a high temperature (range, 47-52°C) giving a clue that they were smuggled from North Africa (Hawksworth et al., 2016).

The lichen *Xanthoria parietina* grown on the twigs shows different color shades depending on the availability of light (e.g., natural light, deep shade and full illumination) will provide good evidence of the conditions prevailing in different situations (Hawksworth and Wiltshire, 2011). Lichens growing on buildings, rocks, tree trunks and bark also provide traces of evidence and the diameter or annual rings of lichens will predict the time scale. Pieces of lichen (*Lecanora dispersa*) found in the clothes also proved the trace of evidence in a criminal case (Galloway and James, 2014).

Mushrooms and Intoxication

Mushroom poisoning (amanitin by *Amanita*; gyromitrin by *Gyromitra*; muscarine by *Conocybe*; orellanine by *Cortinarius*), hallucination (psilocin and psilocybin by *Psilobybe*) and neurotrophic or psychoactive drugs (by *Psilobybe* spp.) may be deliberate or accidental is also another important issue of clue in forensic analysis (Hawksworth and Wiltshire, 2015; Sharma and Singh, 2016) (Fig. 1). The use of mushrooms containing psilocin and psilocybin has been prohibited in the UK (Hawksworth and Wiltshire, 2011). Hence, the psychoactive fly agaric (*Amanita muscaria*) serves as an alternative to *Psilocybe*. The remaining pieces of mushrooms or their spores

may provide evidence of poisoning or hallucination.

Fig. 1. Poisonous *Amanita angustilamellata* (a) on soil, arboretum, Mangalore University Campus; Poisonous *Amanita griseofarinosa* (b) on soil, horticulture garden, Mangalore University Campus; *Conocybe crispa* (c) on soil, playground lawn, Yenepoya (Deemed to be University) Campus; *Coprinus disseminates* (d) on *Areca* wood, Yenepoya (Deemed to be University) Campus; *Psilocybe coprophila* (e) on elephant dung, Makutta reserve forest, V'Badaga, Kodagu; *Marasmius androsaceus* (f) on humus and rotting leaves, Yenepoya (Deemed to be University) Campus; *Volvariella volvacea* (g and h) on paddy husk, B'Shettigeri, Kodagu (Photo credit: Dr. N.C. Karun, The Western Ghats Macrofungal Research Foundation, Bittangala, Kodagu).

After disturbance during burial, some macrofungi will not produce fruit bodies till 1–2 years (e.g., *Coprinus comatus* and *Morchella* sp.) provide good evidence of duration (Hawksworth and Wiltshire, 2011). Orientation of the stipe and pileus of mushrooms also provide some evidence of the time of the crime (e.g., *Marasmius* spp.). *Hebeloma vinosophyllum* has been considered a 'corpse-finder' fungus growing shallowly buried dead bodies (Sagara, 1976). This ammonia mushroom referred to as a post-putrefaction mushroom grows after 3–4 months of ammonium or urea application to the soils (Carter and Tibbett, 2003).

Truffles grow beneath the soil as mutualistically associated with the roots of several tree species (as ectomycorrhizas). Association of sporocarp or spores of truffles (e.g., *Choiromyces meandriformis*) helped as evidence to prove the crime by a suspect (Hawksworth and Wiltshire, 2011). The mushroom *Flammulina velutipes*is known to grow after the first frost during the winter providing some clues. The seasonal appearance of some fungi will also provide specific evidences to tracing suspects. Ectomycorrhizal *Scleroderma* being extremophiles, their remnants and basidiospores in different extreme habitats may serve as ideal candidates in forensic investigations.

Conclusions

Mycology provides appreciable contributions to elucidate and fine-tune the resolution of criminal and forensic examinations. Application of mycology in criminal investigations needs to consider fungi in crime scenes including association or growth of fungi in buried soil; on clothes and a dead body; the presence of fungal spores; the presence of fungi in the food or drink and gut. Molecular tools for explicit identification of fungi are also necessary to prove the incidence unequivocally as to verify the occurrence of non-sporulated (or early stage of growth) fungi associated with the crime scene. Developing a realizable output of forensic mycology requires skilled technicians, mycologists and ingenuity in interpreting results to link the crime consequences.

Acknowledgements

The author is thankful to Dr. S. Mahadevakumar, University of Mysore, Dr. C.K. Pradeep, JNTBGRI, Trivandrum and Dr. N.C. Karun, The Western Ghats Macrofungal Research

Foundation, Bittangala, Kodagu for helpful discussion and suggestions.

References

Ambrosio, E., Zotti, M., Nucci, G., Gabbrielli, M. and Venezis, P. 2016. The usefulness of cadaveric fungi as an investigation tool. *Am. J. Forensic Med. Pathol*., *37*, 23.

Carter, D.O. and Tibbett, M. 2003. Taphonomic mycota: fungi with forensic potential, *J. Forensic Sci.*, *48*, 168-171.

Cecilia, T.M. and Noemí, C.M. 2017. The mycology as forensics Tool. *Adv. Tech. Biol. Med., 5*, 226. 10.4172/2379-1764.1000226

Evans, E.G/V. 1996. *Regina V. William Kerr/Christopher Moody. Statement of Emlyn Glyn Vaughan Evans*. Report to West Yorkshire Police, Leeds.

Filho, R.E.M., Sidrim, J.J.C., de Cordeiro, R.A., Caetano, E.P., Rocha,M.F.G. and Brilhante, R.S.N. (2010) *Trichophyton mentagrophytes* perforates hair of adult corpses in the gaseous period. *Journal of Forensic Sciences*, 55, 1359-1361.

Galloway, D.J. 2014. Peter James (1930-2014) and forensic lichenology. *Bull. Br. Lichen. Soc*., *115*, 32–35.

Hawksworth, D.L. 2013. *Operation Jasmine Hill: Report on Mould Growth on Exhibits Recovered from the Property*. Report to the Metropolitan Police, London.

Hawksworth, D.L. and Wiltshire, P.E.J. 2011. Forensic mycology: The use of fungi in criminal investigation. *Forensic Sci. Int*., *206*, 1-11.

Hawksworth, D.L. and Wiltshire, P.E.J. 2015. Forensic mycology: Current perspectives. *Res. Rep. Forensic Med. Sci*., *5*, 75-83.

Hawksworth, D.L., Wiltshire, P.E.J. and Webb, J.A. 2016. Rarely reported fungal spores and structures: an overlooked source of probative trace evidence in criminal investigations. *Forensic Science International*, 264, 41-46.

NRC. 2009. *National Research Council: Strengthening forensic science in the United States: A path forward*. National Academies Press, Washington DC.

Payne, J.A. 1965. A summer carrion study of the baby pig *Susscrofa*Linnaeus. *Ecology*, *46*, 592–602.

Procopio, N., Ghignone, S., Voyron, S., Chiapello, M., Williams, A.et al. 2020. Soil Fungal Communities Investigated by Metabarcoding within Simulated Forensic Burial Contexts. *Front. Microbiol*., *11*, 1686. 10.3389/fmicb.2020.01686

Sagara, N. 1976. Presence of a buried mammalian carcass indicated by fungal fruiting bodies, *Nature*, *262*, 816.

Sharma, S. and Singh, R. 2016. Mushroom poisoning: From toxicity to forensic analysis. *J. Ind. Soc. Toxicol*., *12*, 43-48.

Sidrim, J.J.C., Filho, M.F., Cordeiro, R.A., Rocha, M.F.G.,Caetano, E.P. et al. 2010. Fungal microbiota dynamics as a postmortem investigation tool: focus on *Aspergillus*, *Penicillium*and *Candida* species. *J. Appl.Microbiol*., *108*, 1751-1756.

Speruda, M., Piecuch, A., Borzęcka, J., Kadej, M. and Ogórek, R. 2022. Microbial traces and their role in forensic science. *J. Appl. Microbiol*. 10.1111/jam.15426

Wiltshire, P.E.J. 2010. Forensic ecology. In: *Crime Scene to Court: The Essentials of Forensic Science*, 3rd Edition.White, P. (Ed.). RSC Publishing, UK, pp 54-85.

Wiltshire, P.E.J. 2016. Mycology in palaeoecology and forensic science. *Fungal Biol.*, *120*, 1272-1290.

Wiltshire, P.E.J. 2019. Introduction to the special issue for forensic ecology. *Forensic Sci. Int*., *299*, 238. 10.1016/j.forsciint.2019.01.024

Impact of Plastics on Seabirds

Geetha Suvarna

Centre for Environmental Studies
Yenepoya (Deemed to be University), Mangalore 575018, Karnataka
E-mail: geesuvarna@gmail.com

Introduction

Seabirds are the avian fauna that lives primarily on the ocean and have unique adaptations such as waterproof feathers and a desalination system. A seabird's desalination system allows them to drink seawater safely by changing it into freshwater. They are an integral link between ocean and terrestrial ecosystems (Fig. 1). Excreta of seabirds (guano) can provide a significant amount of nutrient supply and thus are vitally important to coastal and island habitats. Many isolated islands around the world play host to seabirds, where their excreta are built into a solid mass the guano (Fig. 1B). As nutrients leach from guano into the surrounding seas, it helps to support coral reefs and associated communities.

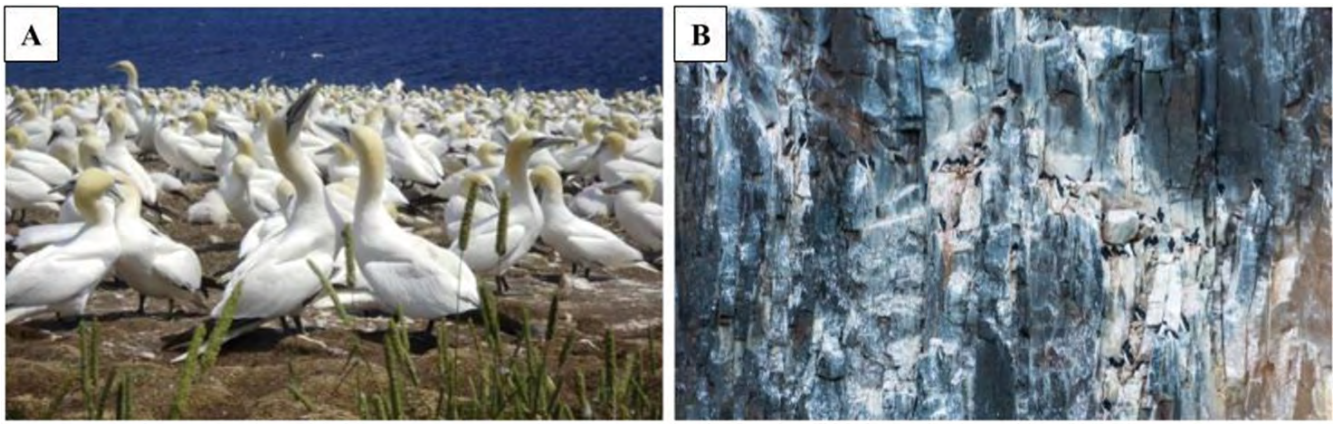


Fig. 1. A - Northern Gannet birds (https://www.britannica.com/);
B - Seabird Guano (https://www.shutterstock.com/)

Islands with seabird populations have higher nitrogen and phosphorous levels, contributing to the growth of the plant and invertebrate populations. While generally found to be beneficial, seabird guano can also have negative impacts on ecosystems. In addition to causing eutrophication at particularly high densities, the presence of heavy metals and other toxins including plastics in the excreta of these birds was also detected.

Threats to Seabirds

Seabirds are one of the most globally threatened groups of avian fauna. It is estimated that almost half of the species are in decline, with a third of species considered to be threatened with extinction. Seabirds face a myriad of threats, including overfishing, food shortages, plastic pollution, climate change and habitat loss. As bird populations decline, the flow of nutrients such as nitrogen and phosphorus from the sea to land will be severely impacted.

Plastic Pollution and its Impact on Seabirds

Since its invention in 1907, plastics have fulfilled the needs of humans. The true cost of this man-made problem is seen today in the form of plastic waste. Plastic is beginning to fill land and sea. It can entangle animals, block their airways or digestive tracts and damage their internal organs (Fig. 2).

Every year, hundreds of thousands of seabirds

ingest plastic and around one million birds die as a result. It is projected that by 2050, 99% of seabird species will be ingesting plastics. Plastics reduce the volume of the stomach, which often leads to starvation. Plastic waste is found in the stomachs of dead seabirds. Seabirds that survive to adulthood are smaller, have shorter wings, bills and smaller body mass. Surface-feeding seabirds are more likely to ingest plastics. For example, albatross eat fish eggs, which are laid on floating debris and hence consume plastics. However, diving seabirds such as puffins have also been found with plastics in their stomachs.

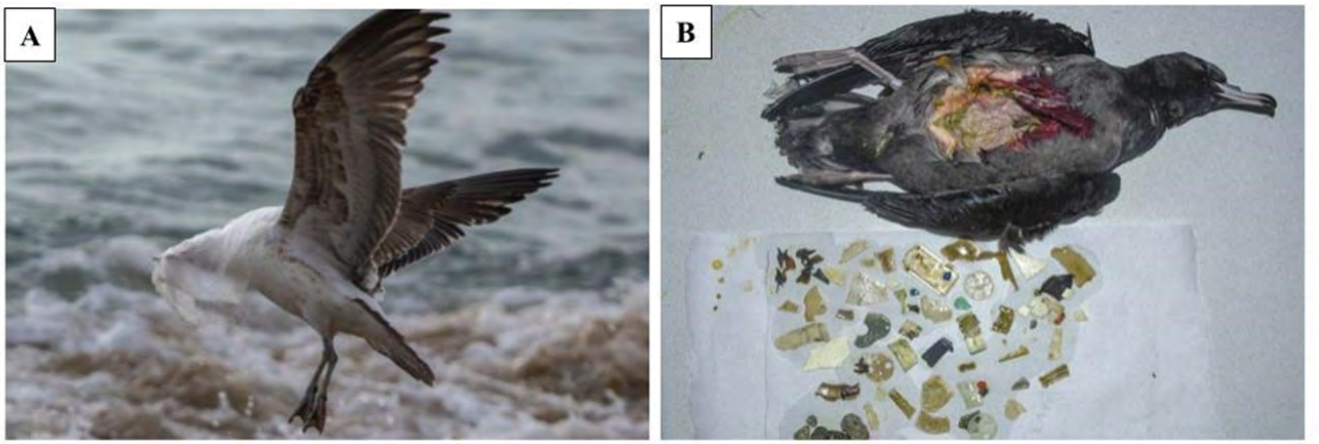


Fig. 2. Impact of plastic on seabirds:
A - Plastic bag obstructing the flight of a Seagull (https://www.gettyimages.in/);
B - Plastic found in flesh-footed shearwaters chicks (https://www.nhm.ac.uk/discover/the-chicks-choking-on-a-toxic-diet-of-ocean-plastic.html)

A study on flesh-footed shearwaters revealed the impact of plastic on the health and physiology of these birds. It was discovered that rather than feeding the usual diet, adult birds have been feeding their chicks with shards of plastic. It was revealed that between 80 to 90% of chicks had at least one piece of plastic in their stomach (Fig. 2B). The birds also showed changes in their blood chemistry such as high cholesterol, more uric acid, amylase and lower dissolved calcium.

Seabirds as an Indicator of Plastic Pollution

Researchers have found that the birds can act as indicators of the extent of plastic pollution in the ocean. The brown booby birds build little nests on the ground in colonies, often along beaches. Normally they use seaweed and leaves found on the shoreline to create the nests. But in recent times it is noticed that a lot of booby nests had plastic in them (Fig. 3). At some sites, every nest had plastic in them, while at others none of the nests had plastic implying that the birds are responding to the amount of plastic that is available locally. Hence the researcher suggests that the nesting material of the boobies could be used as an indication of the local extent of marine plastic. Additionally, the examination of plastic inside seabirds is also a measure of plastic pollution on an international scale.

Fig. 3. Brown boobies nest on the ground using marine debris
(Image retrieved from Grant *et al*., 2018)

Protection of Seabirds

Reduction in the input of plastic debris to the sea is an effective way to at least begin solving the plastic pollution problem and thereby protecting seabirds. Awareness programs can help to restrict the giant tide of plastic. The international community needs to take urgent action to mitigate unnecessary injuries and mortality of birds due to plastic pollution.

References

Grant, M.L., Lavers, J.L., Stuckenbrock, S., Sharp, P.B. and Bond, A.L. 2018. The use of anthropogenic marine debris as a nesting material by brown boobies (*Sula leucogaster*). *Marine pollution bulletin*, *137*, 96-103.

Parker, L. 2019. The world's plastic pollution crisis explained. https://www.nationalgeographic.com/environment/article/plastic-pollution

Lavers, J.L., Hutton, I. and Bond, A.L. 2019. Clinical pathology of plastic ingestion in marine birds and relationships with blood chemistry. *Environ. Sci. Technol.*, *53*, 9224-9231.

Schnug, E., Jacobs, F. and Stoven, K. 2011. Guano: The white gold of the seabirds. In: *Seabirds*, IntechOpen, https://doi.org/10.5772/intechopen.79501

Smith, J.L., Mulder, C.P.H. and Ellis, J.C. 2011. Seabirds as ecosystem engineers: nutrient inputs and physical disturbance. Seabird islands: Ecology, Invasion, and Restoration. 10.1093/acprof:osobl/9780199735693.003.0002

Broholm, T. The Effects of Plastic Pollution on Seabirds. https://oceanblueproject.org/the-effects-of-plastic-p-on-seabirds/

Decline of the Cosmos in Intercontinental Crisis and Macrocosm Protection

Vandana S. Prakash and Sharmila P. Nayak

Yenepoya Institute of Arts, Science, Commerce and Management,
Yenepoya (Deemed to be University), Mangalore 575018, Karnataka
E-mail: sharmilanayakp@gmail.com

Introduction

The environmental catastrophe is really a cerebral crisis. Most people are aware that the natural world is facing significant problems and deterioration, but few are aware of the real scope of the changes and deprivation that the environment is experiencing, as well as the long-term consequences for human welfare and all other life on Earth. But, the number of difficulties the environment faces on all fronts and the level of awareness most people have on these concerns are vastly different.

Our generation has been given the urgent task of reversing the damages of industrial civilization and overcoming perhaps the greatest challenge humanity has ever faced: uniting as one conscious, sustainable force to secure the environmental, economic, and social stability of our future is needed because we cannot trash the planet, destroy its biodiversity, change the climate, and continue to live the wealth of future generations. The environmental movement is the world's fastest-growing drive, with over one million environmental, social justice, and indigenous organisations. Every living organism on the planet is in a steady, accelerating decline, and environmentalism has become a bigger, unifying human concern. So far, the Earth has already faced five catastrophic mass extinction of biodiversity. According to Kolbert (2014), the Earth is in the beginning or amidst the sixth major biodiversity extinction.

One of the largest world illusions, which are responsible for most of the devastation that we witness today, is that we are distinct from all of the forests and oceans including, every other species on the Earth. We think we're better than nature. However, we are, in fact, a part of nature. That is what we are, above all is nature. It can be difficult to understand or remember that we are completely connected to nature because we live in concrete jungles that obscure the surrounding earth in a society where products and services are constantly replenished, creating the illusion of endless abundance, and whose general culture is based on the assumption that we are separate from the natural world and have complete control over it and everything in it.

Statement of Problem

In the guise of bettering, one's lifestyle, the environment has been ruined.

Climate change is the most important issue of our time, and it is unfolding far faster than we anticipated. But, in the face of this global menace, we are far from helpless. "The climate emergency is a race we are losing, but it is a race we can win," - UN Secretary-General Antonio Gutterus said in September 2021.

Thereby this Climate change is wreaking havoc on people and ecosystems all around the world. The result of climate change include environmental degradation, natural disasters, weather extremes, food and water insecurity, economic instability, conflict, and terrorism are all exacerbated by rising temperature. Sea levels are rising, the Arctic is melting, coral reefs are dying, oceans are acidifying, and forests are burning as a result of these factors. It is obvious that business as usual would not suffice.

The extraction of coal, oil, and gas releases billions of tones of carbon dioxide into the atmosphere every year. Human activity is producing record-high levels of greenhouse gas emissions, with no indications of slowing down. We are on course to maintain a "business as usual" trajectory, according to a ten-year

summary of UNEP Emission Gap assessments.

The last four years have been the hottest in recorded history. We are at least one degree Celsius beyond preindustrial levels, according to a September 2019 World Meteorological Organization (WMO) assessment, and near to what scientists warn would be "an unacceptable risk". The 2015 Paris Climate Agreement pledges for keeping global warming "well below" two degrees Celsius and pursuing efforts to reduce it.

The 2015 Paris Climate Agreement advocates for keeping future warming "well below" two degrees Celsius and pursuing measures to keep it even lower, at 1.5 degrees Celsius. However, if global emissions do not drop, temperatures could rise above three degrees Celsius by 2100, causing lasting damage to our ecosystems.

In the arctic and mountain regions, glaciers and ice sheets are melting at a quicker rate than ever before, causing sea levels to increase. Almost two-thirds of the world's cities with populations of more than five million are in areas at risk of sea - level rise, and almost 40% of the world's population lives within 100 km of a coast. If nothing is done, entire districts in New York and Shanghai will be destroyed.

Conclusion

We have been destroying the nature and our environment in the pursuit of bettering our lives, which we only realize when we look at it in the long run. Our lives could have been far better and the earth could have been protected if we actively took care of the little things about nature; it is the small contributions in life that can vastly improve our lives.

Further reading

https://www.weforum.org/agenda/2019/09/humans-have-caused-this-environmental-crisis-it-s-time-to-change-how-we-think-about-risk/

https://www.un.org/en/un75/climate-crisis-race-we-can-win

Kolbert, E. 2014. The Sixth Extinction. An Unnatural History. Henry Holt and Company, New York.

Cowie, R.H., Bouchet, P. and Fontaine, B. 2022. The sixth mass extinction: fact, fiction or speculation? Biol. Rev., 10.1111/br

Conserving the Planet Earth

Sowrabha Bhat

Department of Endocrinology, Yenepoya Medical College Hospital
Yenepoya (Deemed to be University), Mangalore575018, Karnataka
E-mail: sowrabhas@gmail.com

"To each their own"? Well, maybe, but not when it comes to caring for the one and only earth we share! Our planet's environment and resources continue to be threatened by the human race more than ever before in today's dog-eat-dog world. Most individuals are concerned about taking from the environment rather than giving back. It seems time we look around and see where we could contribute to protecting our environment. Waste generation and deforestation seem to be happening at an alarming rate.

The COVID third wave thankfully seems to be receding. With its relief it has left with us a mammoth task of managing the medical waste that the 'COVID saga' has generated! In a recent report WHO estimated that supplies dispatched between March, 2020, and November, 2021, included 1·5 billion units of PPE, weighing approximately 87,000 tonnes, more than 140 million test kits, with a potential to generate 2600 tonnes of general waste (mainly plastic), and 731 000 L of chemical waste! (Zarocostas, 2022). What concerns me most is the disposal of used masks, be it surgical masks, N95 masks or cloth masks! The PPE kits that land in the doffing room also adds to the already overwhelming load of hospital waste. Not to mention the recent addendum of the home testing COVID kits that has sadly created more foci of infective waste. Patient education must probably now focus on not just masking up but also on how to safely dispose of the used masks and self-testing kits (Ilyas et al., 2020O).

Another less talked about the area of concern for the environment is the waste contributed by the rapidly piling up bulk of sanitary pads. The hospital could greatly contribute to spreading awareness about 'green menstruation'. The use of menstrual cups and reusable sanitary pads could be promoted. Menstrual cups are not only environmentally friendly as one cup lasts about 10 years as opposed to the innumerable disposable sanitary pads that a woman may use in her menstruating years, they're also comfortable and safe to use. A sanitary pad could take more than 500 years to decompose leading to seemingly inevitable non-biodegradable waste generation from every household. The use of menstrual cups can be inculcated into agendas for camps by the gynaecology team. The impact of this on the environment may be huge.

The third cause for concern is the use of disposable paper cups for coffee and tea served at the hospital café. A simple albeit significant step towards reducing this bulk of waste generated at the hospital campus could be the use of personal porcelain mugs such as the ones being used in many technical institutions and offices. Each of the hospital staff could be given a mug with the hospital logo that could be used at any of the coffee shops in the campus. This would also prevent the possible consumption of small amounts of wax from the paper cups coated with wax to make them leak-proof.

Something I wondered about of late was the negative impact of the current high demand for wooden pencils on the environment. A large number of pencils are exchanged by children as gifts at birthday parties and children seem to have stocks of pencils that would last for years but would the trees they were made from last that long? About 82,000 trees are cut down every year to make traditional wooden pencils! (Lynette, 2016).That seems to be a huge price nature is paying. One way of reducing the overuse of pencils would be to try and use them longer by

using a handle when they become shorter with use (Fig. 1).

Little changes in our lives can bring about great changes in our environment. Let us preserve this beautiful planet that our children deserve.

Fig 1. Longer usage of pencils with handles

References

Zarocostas, J.2022. WHO concerned over COVID-19 health-care waste. Lancet., 399 (10324), 507. 10.1016/S0140-6736(22)00225-2.

Ilyas, S., Srivastava, R.R. and Kim, H. 2020. Disinfection technology and strategies for COVID-19 hospital and bio-medical waste management. Sci. Tot. Environ., 749, 141652.10.1016/j.scitotenv.2020.141652

Lynette, R. 2016. Pencils. Weigl Publishers, Canada.

The Mother Earth

Arshad

III MBBS, Yenepoya Medical College, Yenepoya (Deemed to be University),
Mangalore 575018, Karnataka
E-mail: arshadshidu@gmail.com

Our Mother Earth is burning, crying out loud. The climate crisis, as it is called now, is destroying our homes. It seems our carbon footprint will not fade away quickly enough to avoid the collapse of our ecosystems and human civilization. And so, our future looks grim and hopeless. Young people are aware of the climate crisis and feel very anxious about the forthcoming rise in temperature and its consequences (1).

In fact, instead of looking for a life filled with opportunities, they are wondering if they will even have a future. Some even think about their kids and the bleak future they will be leaving for them. So, in this age of doom and hopelessness, giving up seems the only sensible thing to do, which may mark humanity's end (2). But that's not true, we are not doomed. We are making progress somehow and there is hope for a future on this planet.

Today every individual on this earth is aware of the climate crisis, environmental pollution, deforestation and threat to marine life. Maybe everyone was taking their time to acknowledge it. Still, now most people have realised the importance of conservation of nature as they are witnessing the climate change which is the result of human activities. Maybe because of the widespread awareness, especially from the younger generation, most countries including India have implemented policies related to environmental protection thereby helping in tackling the climate crisis.

Although the government is not meeting the desired goal, some actions are still taking place for a better environment for our future generations (3, 4). Environmental Science has now become a compulsory subject in all undergraduate curricula all over India, thereby we are making newer generations aware of the climate crisis and along with necessary action to be taken as soon as possible. By implementing technologies like electric cars, solar roofs and windmills, we can tackle this issue to some extent. These are just a few examples of renewable sources of energy that are trending and slowing the process of the climate crisis. The contribution of such renewable energy sources and the availability of the same to the general public are making a huge impact in our actions against the climate crisis.

Earth is a reservoir of untapped resources. The need of the hour is to identify and utilize them judicially for the welfare of the individuals. Energy resources like solar energy, geothermal

energy, hydroelectric energy and biofuels can be alternatives to conventional sources of energy. The Cochin International Airport is running entirely on Solar energy and the same example is being followed across different airports of the world (5).

We shall hope that every individual on this earth will contribute their share in saving Mother Earth. All the countries in this world should also join hands together to make this happen. We have to make the earth a better place for future generations (6).

The famous quote from Stephen King states "Remember, hope is a good thing, maybe the best of things and no good thing ever dies". Ecosystems support all life on earth. Let's hope to have healthier ecosystems; for a healthy planet for all biodiversity on earth.

References

https://sites.google.com/view/sources-can-we-fix-climate/

https://sites.google.com/view/sources-can-we-fix-climate/https://nymag.com/intelligencer/2017/07/climate-change-earth-too-hot-for-humans.html

https://iopscience.iop. org/article/10.1088/1748-9326/ab842a

https://ourworldindata.org/explorers/co2?stackMode=relative&time=2000..2019&facet=none&country=ITA~DNK~EU~EU~EU~EU~EU~EU~EU~EU~EU~EU~GBR~Europe&Gas=CO%E2%82%82&Accounting=Production-based&Fuel=Total&Count=Per+country&Relative+to+world+total=false

https://ukcop26.org/global-coal-to-clean-power-transition-statement/

https://books.google.de/books?id=5SU7utP8PIMC&pg=PA172&redir_esc=y#v=onepage&q&f=false

Image Courtesy : https://blog.justlife.com/a-few-things-you-can-do-to-thank-mother-earth-ce9b0df9a038

Saga of Soil

Leena Pramod

Department of Forensic Medicine, Yenepoya Medical College
Yenepoya (Deemed to be University), Mangalore 575018, Karnataka
E-mail: leens.pr73@gmail.com

I am not a stranger to you all Alas!!! Seeing the current scenario I would like to reintroduce myself. I am "SOIL", you all have taken me and my services for granted to such an extent that today, I am in need of a health card. Humans!! Are you listening? Please do something to save me I am at your mercy. Because of deforestation and excessive tree felling, I am unable to hold on and reluctantly forced to move with the strong wind and water.

Though some people in this world have realised my worth and doing their best to protect me by creating awareness, some still chose to be ignorant - "Typical human behaviour" (not my concern as long as I am not affected).

Soil has multilayer, each layer is unique but similar in color, texture, structure, reaction, consistence, mineral and chemical composition and labelled as O, A, B, C and R (Fig. 1 and Fig. 2). The first two layers are the most important. The O is the soil horizon that is made up of organic materials while Soil horizon A is the layer that is made up of minerals.

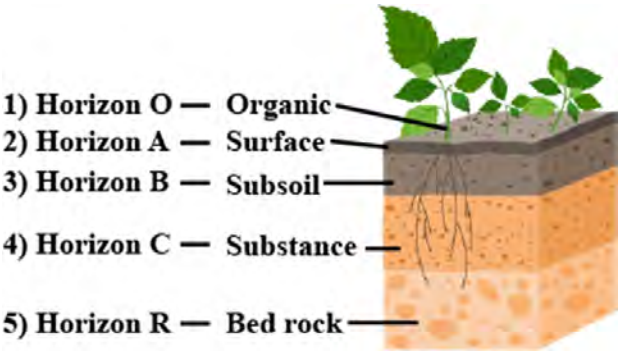


Fig. 1. Layers of Soil (Source: Google images)

Fig. 2. Soil (Source: Google images)

Soil formation is a very slow process; the rate at which the topsoil is getting destroyed is very fast while it takes thousands of years to replenish it. Why are the humans like this? The one and only destructive creation of God! First, they do everything to destroy the gift of nature like the trees by cutting them down, polluting the water bodies threatening the aquatic life, poaching and killing animals threatening their existence on earth thereby disturbing the balance of the ecosystem. Then they start campaigns to save trees, save wildlife, and the latest in the list is me "the Soil". Nowadays all the WhatsApp messages are full of "Save Soil" issues.

I am remembering the good olden days when the elders especially in the agriculture field used to inculcate and teach the importance of soil to their younger generations, the importance of 'Bhoomi Pooja' & to respect the mother earth for providing them with good harvest, I loved their care and attention. How they carefully used to choose the seeds to be sown in the field so that I am not completely drained of the nutrients and taking care of the little microbes (my friends) is very

useful for my wellbeing. These crop rotation methods helped me to replenish the nutrients utilized without losing my fertility. Today the use of industrial fertilizers has more or less made me like a barren woman, Unproductive.

How I miss the caressing from small children when they used to touch me with their little hands, giggling, playing and rolling on my back and getting scolding's from their mother for entering the house with their dirty feet. In the present situation, children are busy playing games on their electronic gadgets like mobiles, tablets or laptops. They are very far from the beauty of nature, not realising what they are missing in life. The parents are busy with their ever-demanding job and have no time to explain the good old things. Another respite for these children is their grandparents who will tell them interesting stories from their past but Alas!! Most families today are nuclear families where the child finds himself/herself alone and thus takes refuge in the mobile.

Box 1. Source: Watts Jonathan. Third of Earth's soil is acutely degraded due to agriculture. The Guardian, September, 2017.

The ever-increasing demands of food and in turn pressure on the land to produce has resulted in its intensive degradation causing depletion of fertility of topsoil at the rate of 24 bn/tonne per year. According to the Joint Research Centre (JRC) of the European commission 20% of the World's Cropland, 16% of the Forest Land, 19% of Grassland and 27% of rangeland are showing decreased productivity. Greatest challenges will be faced by, the sub – Saharan Africa, South Asia, the Middle East and North Africa in 2050 (Fig. 3).

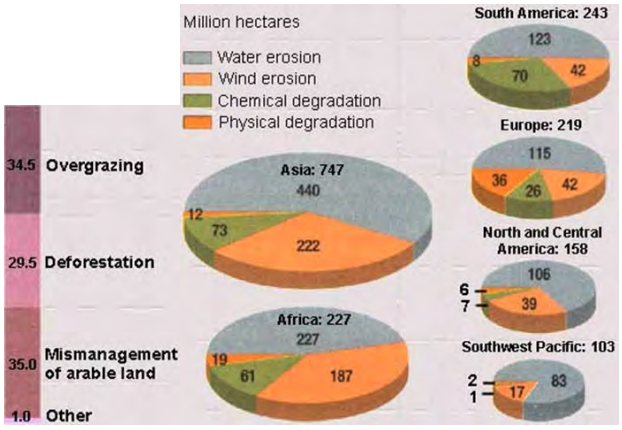


Fig.3. Soil degradation by type plus major causes and area (Source: Worldometer_ https://www.fao.org/3/u8480e/U8480E0D.htm)

The earth is bleeding; it is in urgent need of a health card to fix its problem and the solution to all its problems is with you humans. There is a need to come out of the urban concrete jungle created around you and contribute your share to its healing process as any change to be implemented should start from you at the individual level, from one's home then only the venture will be successful. All the countries in this world are working towards this cause; it's high time that you too play your part.

Your grandparents had a very green way of life / Very sustainable.... today's humans have lost it somewhere in the light of modernization. However, after economic growth and environmental degradation comes environmental awareness...So I hope one day something's will click back again!

With that positive note, let's hope all of us work together in conserving and preserving the biodiversity and natural resources on earth and allow our future generation to relish, explore and enjoy the beauty of this beautiful planet EARTH.

Ecoenzymes - An Experience

Shobha Shankarnarayan[1], Vidya Bhat S[2]*, Sham S Bhat[3]

[1]53 Simei Rise, Singapore – 528794,
[2]Dept. of Prosthodontics, [3]Dept. of Pedodontics, Yenepoya Dental College
Yenepoya (Deemed to be University), Deralakatte, Mangalore - 575018, Karnataka, India
*Corresponding author: vidya.bhat@yenepoya.edu.in

Introduction

Along with population growth waste generation is also increasing which has a direct or indirect influence on the environment. Biodegradable or organic wastes consist of organics that can be utilized for food by naturally occurring microorganisms within a reasonable length of time. Part of the kitchen waste can be converted into "ecoenzyme" (EE). This was first introduced by Dr. Rosukon Poompanvong, who is the founder of the Organic Agriculture Association (OAA) in Thailand. It is a multipurpose liquid that is produced by the fermentation of organic wastes. The disinfectant property of EE is due to the production of alcohol and organic acids. (e.g., acetic acid).

Production of Ecoenzyme

About four years ago, we began to get more insight into the production of EE from organic wastes as a cleaning solution produced from organic wastes generated from home and designated as EE. Production of EE is a straightforward method. Pool 1:3:10 (v/v or w/w) ratio of sugar, fruit or vegetable peels and water. Once the container has the required amount of ingredients, cover the mouth with a cloth and fasten with a string. After one month, the lid can be used to close the container followed by mixing the content in the container now and then. Further, this setup needs to be left to ferment for three months and the contents of the container should be strained. The strained solution is nothing but EE.

Table 1. Some simple rules and tips to follow while preparing and use of EE.

Use	Do not use
Use a mix of citrus, banana, watermelon, papaya, pomelo, kiwi, pear, apple, mango, chikoo and other assorted fruit scraps and peels	Do not use only a single type of fruit peels/waste. The efficacy of such a solution is less, compared to the EE made with a mix of peels/waste.
Use scraps/waste of "neutral" vegetables such as carrots, beans, potato, chayote, pumpkin etc. Maintain at 80% fruits and 20% vegetable waste	Do not use smelly vegetable wastes like cabbage, cauliflower and broccoli or even leafy greens like jackfruit and durian peels
Use over-ripe fruits, parts of fruits, fruits that have been left in the fridge too long or tasteless fruits	Do not use rotten fruits. If part of the fruit has gone bad, cut off those part before using to get EE
Loosen the lid of your EE container or burp to let the excess gas to exit up to the first 3-4 weeks	Do not tighten the lid of the container to make it air-tight. The built up gases will cause the container to explode
Give a shake to container every few days	Do not leave it unattended for the first 3-4 weeks, else there are chances that you may find maggot /black spider fly larvae floating in the EE

Give the bottle a good shake if you see white yeast on the surface. You can even strain it away, but it will resurface after a while	Do not panic and throw away your EE, it is totally harmless
Give the bottle a good shake if you see maggots in the EE, they will die after a few days and can be strained away when harvesting the EE. One could also add 1 extra part of sugar and let the EE ferment for another 3 months, before harvesting	Do not be panic and throw away your EE
Remove the black or green mould carefully, add 1 extra part of sugar and let the EE ferment for another 3 months, before harvesting	Do not panic and throw away your EE
Take precautions and use gloves while harvesting or handling EE. The strength of the EE increases with age of fermentation	Do not apply undiluted EE to your skin without testing your skin's sensitivity. Please also do not use EE on surfaces that are sensitive to vinegar (marble, granite and others)
Harvest only as much enzyme as you need. The EE has no expiry date and can be left to ferment for any length of time	Do not harvest EE before the 3 months in tropics and 6 months in cooler regions

Our Experience

We have had the experience of using EE in our house for about the last four years. To be honest, the smell takes a little while to get used to. The EE is almost like vinegar and the smell will dissipate soon into the atmosphere. The floors, kitchen sink, hobs and chimney could be perfectly cleaned by EE after appropriate dilution. We find that the grapes and berries are cleaner and taste sweeter after cleansing with EE as fruit wash. The biggest and most evident benefit was visible in our house in potted plants are brighter and healthier on the application of slurry after EE extraction. Our bed linen fragrance is pleasing, so also the floor and mats by EE application. We have seen a few cockroaches and ants in the interior after the application of EE.

Applications of EE and Dilution Guide

Table 2. Rough guidelines for dilution and application of EE.

Purpose	**Dilution**
Plants (fertilizer)	Water frequency 2-4 times a week depending on whether the plants are indoors or outdoors in the ratio of 1ml EE: 1000ml water
Plants (pesticide)	Water frequency 2-4 times a week, 1ml EE: 700-800ml water
Dishwashing	1 part EE: 1 part dishwashing liquid
Laundry	a) 30-50ml EE: Half a cup of required laundry detergent
	b) 150-300ml EE without detergent. Please try this on bed linen or towels first before washing your expensive clothes. Some people have reported staining (depending on the peels used for the EE)
Fruits and vegetable wash	10 ml: 500ml water. Soak the items for up to 45 minutes, rinse well before using veggies/fruits

Choked/smelly drains	Pour 250ml or more into your drainage directly. Add 1table spoon baking soda + 20ml EE. Repeat 4-5 times
Pets/ Human shampoo and shower gel	a) 1 part EE : 1 part shampoo : 10 parts water
	b) 1 part ginger enzyme : 1 part shampoo
Floor mopping	1.5 ml EE : 1000ml water
General cleaning	Dilute 10ml EE in a 100ml spray bottle for general kitchen/bathroom counter cleaning. Make sure that enzyme is finely filtered to avoid blockage of spray nozzle
Bathroom / kitchen	For tough stains and grease, spray directly and then clean
Window panes, glass shower stalls and mirrors	Dilute 1 part of EE with equal part of water, spray, leave on for a while and wipe clean

There are various versions of the EE floating around the internet that have a quicker turnaround, but we prefer to stick to the original version and let nature take its time. We prefer to make our EE at home, as we can use and recycle the kitchen waste.

Further Reading

https://waste4change.com/blog/eco-enzyme-multipurpose-liquid-from-organic-waste/

Rungta, S., Ojha, A. and Mishra, S.K. 2022. Study of physico-chemical property of bioenzymes produced from organic household waste and their application in daily life. Discovery, 58, 228-234.

Vama L. and Cherekar, M.2020. Production, extraction and uses of eco-enzyme using citrus fruit waste: wealth from waste. Asian J.Microbiol. Biotech. Env. Sci., 22, 346-351.

Green Horizon

Instructions to authors

All manuscripts (Original articles, Short communications, Reviews etc.,) are to be submitted by email to greenhorizon@yenepoya.edu.in Articles submitted should not be published earlier and after acceptance it should not be considered to be published elsewhere. Articles found unsuitable in terms of the requirements of the newsletter will be declined and informed to the authors. The suitable articles will be reviewed and notified of acceptance, need for revision or rejection of the manuscript. Photos, figures, images and other illustrations to be reproduced in the manuscript must be duly credited.

Manuscript preparation:
All the manuscripts in English should be typed in Microsoft Word with 1.5 Line space, Font size 12 point, Times New Roman. All the text pages should be numbered at the bottom of the page in the centre. The submitted document should have title page, text, acknowledgements, Statement of conflict of interest and references. Title should be brief and specific. The title page should contain title, author's name/names, affiliations and corresponding author with address and email Id and telephone number.

Text: All papers should have a brief introduction and the text should be intelligible to readers. Article should not exceed 1500 words (excluding tables and figures). Tables and Figures with title or caption should be incorporated at relevant place in the text and referred to in numerical order.

Tables/Figures should be submitted separately along with the text file. An inserted photo, image, graph or chart is called a figure. You must create a caption for it, directly below the photo/image/graph/chart in your manuscript. Figures should be in jpg format with a minimum 300dpi resolution. The caption follows this format:

Fig. X. Description of the figure from: Citation for source figure was found in (e.g. a website, a magazine article with date and page number; permission is required from the publisher if it is copyrighted).

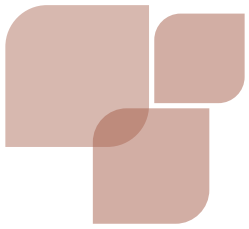
References:

References should be numbered in superscript, serially in the order in which they appear, first through the text and then through table and figure legends. References should not include unpublished source materials. The list of references at the end of the text should be in the following format.

1. Lindley ST, Estimation of …….. data. *Ecol Appl.*, 2003; 13: 806813.
2. Martin H, The Archean grey ……..of continental crust. In *Archaean Crustal Evolution* (Ed. Condie, KC), Amsterdam: Elsevier; 1994. pp. 205259.
3. Rao KN, Vaidyanadhan R, Geomorphic …….. and its evolution. In Proceedings of the National Symposium on Morphology and Evolution of Landforms, Department of Geology, Delhi University, New Delhi, 1978.
4. The URL of web reference should be given with date of access.

Review Procedure

All submissions to Green Horizon undergo double blind peer review and editorial check for appropriateness and suitability. Authors should respond to the reviewer suggestions and revert with modifications. All modifications should be marked in red. The decision of the editorial board is final in acceptance or rejection of the revised manuscript.



YENEPOYA
[DEEMED TO BE UNIVERSITY]
Recognized under Sec 3(A) of the UGC Act 1956
Accredited by NAAC with 'A' Grade

Yenepoya (Deemed to be University)
University Road, Deralakatte, Mangalore - 575 018
Karnataka, India.