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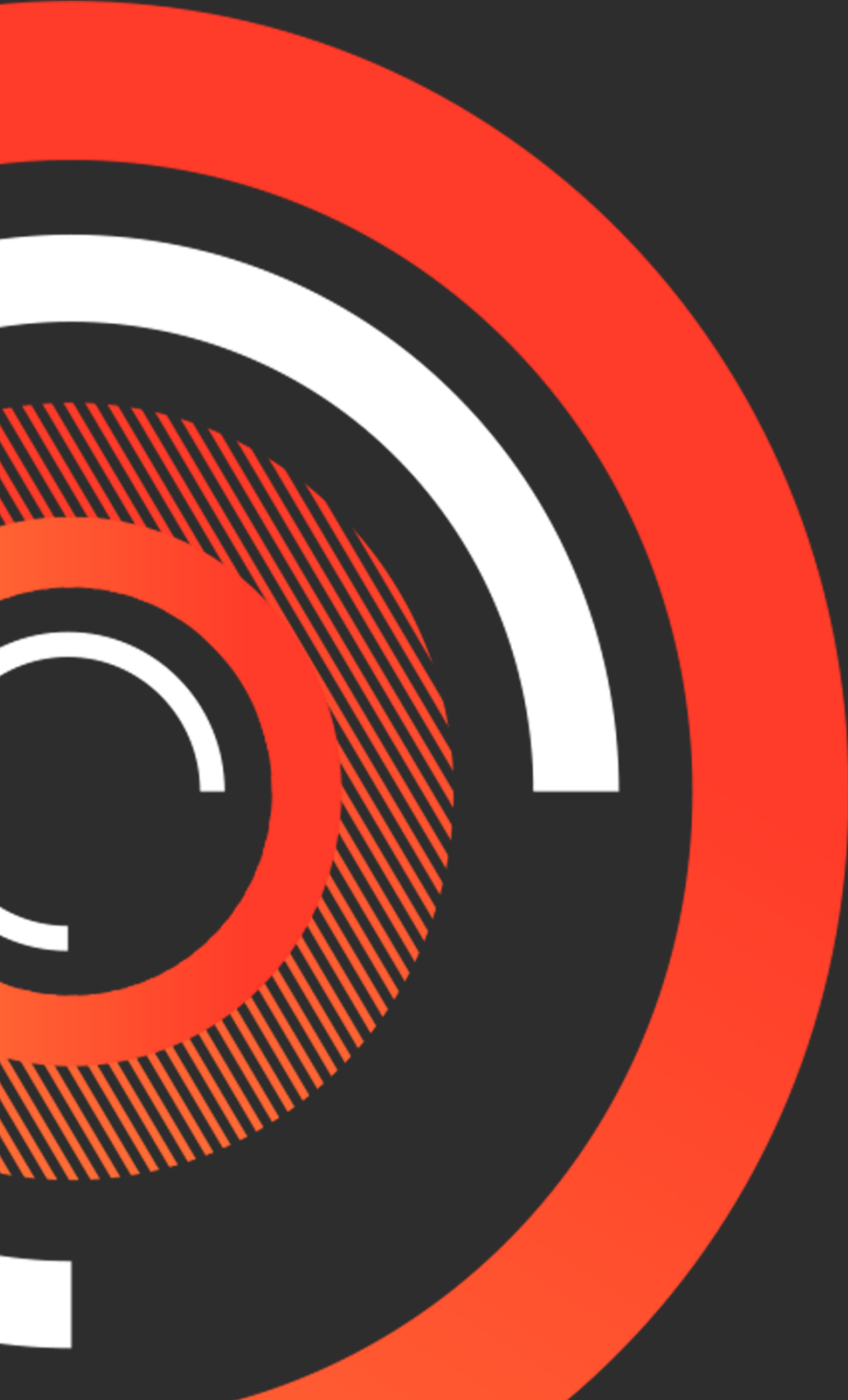
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COMEXUS



About Conexus

Conexus is a multidisciplinary microjournal published annually by the Department of Basic Sciences & Humanities of Rajagiri School of Engineering & Technology (Autonomous), Kochi. It is an amalgamation of the disciplines of the department in order to exchange ideas across multiple fields of study. It focuses on concise and brief reviews on a specific theme drawn from disciplines such as Physics, Chemistry, English, Economics, Psychology and Physical Education. It signifies the belief that even brief entries can reveal meaningful connections among various disciplines.

The first volume of Conexus includes a collection of articles written by the students and faculty members of RSET pertaining to the theme 'Sustainability'. By focusing on this theme, the microjournal encourages individuals to be more mindful of their impact on the environment. It prompts reflection on daily choices and actions that can contribute to a more sustainable lifestyle. Sustainability is not only about environmental consciousness, but also encompasses personal well-being and ethical considerations. By sharing thoughts and ideas related to sustainability, this microjournal can inspire others to adopt sustainable practices and spark conversations about environmental and social issues. The theme aligns with the growing importance of environmental consciousness and personal responsibility.

This microjournal can be a source of education and inspiration for both the student and the faculty community. By documenting ecofriendly practices, sharing tips for reducing wastes, and highlighting sustainable initiatives, this volume of Conexus can inspire them environmentally conscious behaviors. This collective shift towards sustainability can contribute to a healthier planet and more sustainable society.

Editor's Message

In recent years, sustainability has emerged as a pressing global concern. As we witness the consequences of climate change, resource depletion, and environmental degradation, it becomes evident that our current trajectory is unsustainable. It is imperative that we shift our focus towards embracing sustainable practices, not just for the sake of our planet, but for the well-being of present and future generations.

The devastating fire at the Bhramapuram Waste Treatment Plant in Kochi in early 2023 serves as a poignant reminder of the urgent need to prioritize sustainability in waste management practices. So, in this first volume of our department's micro journal, Conexus, we sought to emphasise the critical role that sustainability plays in safeguarding our ecosystems, human health, and future generations.

In an era where our planet is grappling with environmental challenges, the significance of sustainability cannot be overstated. As we witness the depletion of natural resources, the escalating threat of climate change, and the alarming loss of biodiversity, it is obvious that we must immediately shift our focus towards sustainable practices. Sustainability cannot be a mere buzzword; it is a moral obligation. By embracing sustainable choices in our daily lives, businesses, and policies, we can forge a path towards a healthier, more resilient planet. It is time to prioritize renewable energy, conserve water, promote eco-friendly technologies, and foster a circular economy. Every individual has the power to make a difference. We must start by adopting sustainable habits in our daily lives. Small actions, such as reducing water and energy consumption, adopting eco-friendly transportation options, and recycling, can have a significant collective impact.

Sustainability lies at the heart of preserving our environment. The Earth is our home, and it is our responsibility to protect and nurture it. By adopting sustainable practices, such as reducing greenhouse gas emissions, conserving water and energy, and promoting biodiversity, we can mitigate the impact of climate change and safeguard fragile ecosystems.

Just like how the Bhramapuram incident has served as a catalyst for proactive measures that promote sustainable waste management for the local government and citizens, we must all come to the realization that sustainability is not a choice; it is our responsibility.

The journal theme sustainability gives a platform where the exploration, analysis, and dissemination of innovative ideas and practices converge to shape a more sustainable world. Various articles in the present volume emphasize the pressing need for sustainable solutions and promote a collective effort towards nurturing a resilient planet.



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Dealing with the Issue of Space Debris

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Abstract

Space explorations have always been at the cost of a deteriorating space environment. Today, there are millions of tiny pieces of debris orbiting the earth at high velocities, which can cause serious damage to future and ongoing missions in case of a collision. Furthermore, it could set off the production of more debris until the earth's orbit becomes unstable. This article deals with finding innovative and sustainable solutions to this issue so that we can continue our explorations without compromising the quality of space for our future generations.

Keywords

Space junk; Kessler syndrome; Sustainability; Debris; Collisions

1. Introduction

The skies have always been a source of man's curiosity and wonder and have instilled in us this inherent drive to explore and unravel more about the mysteries of the vast universe that we are a part of. Therefore, the advent of Space age has marked an important milestone in human history. But ever since the deployment of the first satellite into space back in 1957, there has been an ever-increasing number of debris left over from past space missions, which are no longer useful. Based on the statistic models released by the European Space Agency (ESA), there are about 35,000 objects being tracked and monitored and many millions of objects that are too small to be tracked; less than 10cm in size [1]. These objects range from machinery of dead satellites, rocket bodies, remnants of

explosions and breakups to much smaller components like lens cap, bolts, paint flecks etc. Since these components travel at exceptionally high velocities at well over 22,300mph, they prove to be extremely disastrous for ongoing and future space missions in the case of a collision [2]. Recent missions like the multi-satellite constellation- Starlink satellites by SpaceX, which aims to provide high speed internet access globally [3] and kinetic anti-satellites by different countries to incapacitate their own satellites, though useful, risk the possibility of realizing the scenario described in Kessler syndrome, which says that the overpopulation of certain earth orbits especially the low earth orbit (LEO), may lead to self-sustained cascading collisions that result in an exponential increase in the amount of space debris leaving the orbit unstable for further use [4]. Many collision maneuvers are performed by satellites including the ISS and Cryosat every year to avoid impacts and this number is only set to increase if we do not act fast enough [5].

The current situation has left us with no choice but to come up with innovative and effective solutions to counter this issue. Studies have shown that the faster it is addressed, the more effective it will be, in terms of cost and outcome as compared to a few years later when the situation will have become more out of hand. Even though there is no shortage of ideas, the process of filtering through them and choosing the best ones is a tedious task as many of them may be far-fetched or too costly to be of any practical use [6]. It is imperative to keep in mind the fact that if it's wielded by the wrong hands, the ideas developed can also be doubled up and used as anti-satellite weapons if need be and is therefore one that must be carefully treaded upon [7].

2. Approach

While objects in lower earth orbits can re-enter the atmosphere in a few years and burn up, the ones in higher orbits, such as the geostationary orbits, which are at altitudes of 36,000km, continue to orbit the earth for thousands of years. Therefore, it is important to put proper mechanisms in place to de-clutter these orbits and make space for newer ones. The ideas so far proposed and developed include nets, harpoons, lasers, tethers, sails and specialized vehicles. These mainly aim at nudging the objects to either re-enter the earth's

atmosphere or pushing them into not so important, less congested orbits called graveyard orbits via onboard propulsions, laser nudging, or other methods.

Onboard propulsions are achieved by using additional reserved fuel or by retaining just enough fuel before the end of the satellite's life to generate thrust for deorbit; used in Lithium-ion Battery Deorbiter. Once the satellite's altitude is lowered to about 500 km, the atmospheric drag acting on it will aid its break down. But the disadvantage of end-of-life deorbiting is that the alumina and soot particles created during its burn down as a result of the friction caused by the earth's atmosphere can damage the ozone layer that protects us from harmful ultraviolet radiations from the sun. If the space junk is big enough, it will reach the earth's surface without completely burning up and pollute land and oceans.

Another strategy used is passivation of satellites and launch vehicles (LVs) at the end of its mission. It refers to the process of removing the internal stored energy present in its propulsion systems, pressure vessels, etc. to prevent the risk of accidental blow up, which may result in fragmentation and more debris. However, passivation reduces the possibility of reusing the satellites or LVs. Though hard passivation can be done completely, it is practically feasible to achieve soft passivation, which in turn represents partial removal of stored energy from the satellite parts, thus enabling them to be reused.

3. Methodology

- 1) Laser Orbital Debris Removal makes use of giant ground-based lasers which are focused and pulsed to slow down the targets and revert them to the atmosphere. The main challenges faced include the high cost involved, difficulty in tracking the object and look-ahead, which refers to accurately pointing the laser at the spot where the target will be and the time the light takes to get there [8].
- 2) Sails and balloons made of extremely thin material are inflated and attached to the debris to increase its aerodynamic drag so that it enters the atmosphere faster and burns up. This idea is used by Gossamer Orbit Lowering Device (GOLD) for removal of junk from Low Earth Orbit (LEO). It is developed by the Global Aerospace Corporation [9].

- 3) Compact satellites called CubeSats are being used for the purpose. It is equipped with a chaser and robotic arms which can cling and tether onto the targets and then deorbit together [10]. ClearSpace-1 developed at the Federal Institute of Technology is one such initiative.
- 4) Sticky boom developed by Altius Space Machines initially to be used as a docking mechanism for launch vehicles can also be used to attach to any target object due to the difference in electrostatic charges induced on the object it comes in contact with. It uses the principle of electro adhesion. It can then be maneuvered back to the atmosphere.
- 5) DARPA's Phoenix program takes a different approach to the traditional development process of geosynchronous earth orbit (GEO) satellites, which are expensive and profligate. They use independent modules called Satlets which can combine in different combinations to achieve different results. These are cost effective, reusable and easy to put together.
- 6) NASA has come up with the Active Debris Removal Vehicle (ADRV) which can help remove debris from LEO by approaching the object, assessing its motion, and determining an initial capture trajectory. It then matches its rotation rates and executes a capture maneuver. The object is deorbited after that. It is so compact that eight such vehicles can fit in a single payload.
- 7) Many organizations like SSN by the US military's joint space operations center (JSpOC) have come up with debris detecting mechanisms which offer collision warnings 72 hours in advance to satellite operators for close approaches based on highly accurate predictions made from astronomical observations and deep learning algorithms. These are vital for performing timely maneuvers that can save the on-going mission from destruction and creation of more debris [11].
- 8) Implementation of Orbit tax has also been discussed, which is an internationally coordinated orbital fee to be paid annually by the government for each satellite put into orbit. This will encourage more responsible use of orbit and removal of the satellite from the orbit at the end of its mission [12].

Conclusions

Space debris poses significant threats to the sustainability of space environment. Though many promising solutions have been proposed, the best way is always to encourage responsible behavior among all the stakeholders in space exploration. This includes reducing the number of unnecessary launches, making even the smallest of changes in the design of a mission, which will help prevent the release of unnecessary parts of machinery into space. For example, the protective lid of a camera or other equipment could be hinged so that it does not float away in space to add on to the already increasing amount of space debris. The tracking of debris is another serious concern, which needs to be addressed wisely. Many erratic and ignorant decisions have been taken by the authorities and have resulted in serious issues affecting the biosphere globally. Therefore, it is necessary to work together to be responsible and keep coming up with sustainable, yet innovative ideas that will help reach newer heights without curbing the dreams of future generations.

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Design and Development of Metal Nanoparticle Incorporated Scaffolds from Biomaterial for Tissue Engineering Applications

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Abstract

Biomaterials find wide applications in biomedical field especially in wound healing, tissue engineering and drug delivery. They are corrosion and wear resistant, durable, non-toxic along with having excellent mechanical strength. Biomimic materials can be employed in place of heart valves or arteries. Polyester, polypropylene, Chitosan, Nanocellulose, Polyglycolic acid etc. are a few polymers that are extensively employed in medical field. This review offers an overview of current research in scaffolds from biomaterials, their fabrication, challenges and importance in the biomedical field.

Keywords

Tissue engineering; Scaffolds; Hydrogels; Biodegradable nanomaterials

1. Introduction

Modern science uses a wide range of biomaterials for the treatment of various diseases. Over the past two decades, the research interest in biodegradable polymers has rapidly increased and thousands of publications and patents dealing with their preparation and characterization have been reported [1]. The biodegradable polymers, allow for a broad

variation of their structure and properties, and thus, enable optimization for diverse applications. Resorbable medical sutures, drug-delivery and encapsulation, resorbable and transparent films for wound dressing, or films designed for agricultural applications should be mentioned as representative examples. With advancements in tissue engineering, it has become necessary to develop polymers that meet more demanding requirements [2]. In the design of biodegradable biomaterials, many important properties must be considered. These materials must (1) not evoke a sustained inflammatory response (2) exhibit a degradation time in correlation with their application (3) excellent mechanical properties for their specified use (4) expel non-toxic degradation products that can be readily resorbed or excreted and (5) include appropriate permeability and processability for designed usage. These properties are greatly affected by a number of features of degradable polymeric biomaterials [3].

Proteins and amino acid-derived polymers have been utilized as biomaterials in sutures, scaffolds and drug delivery devices. While amide bonds are hydrolytically stable, the body possesses a wide-array of proteases that can rapidly degrade proteins. Collagen has been extensively researched for various medical applications due to its biocompatibility, mechanical strength and enzymatic degradability [4]. Due to collagen's fibrous nature, it is largely used in tissue engineering scaffold, specifically in load bearing applications. In order to improve collagen's potential as a biomaterial, it has often been modified or combined with other degradable polymers. It is mainly done in the form of polymeric blends.

2. Chitosan as a biodegradable natural polymer for tissue engineering

Metal nanoparticles can be effectively synthesized from the self-assembly of star block copolymers containing biodegradable natural polymers like chitosan. By incorporating metal nanoparticles in scaffolds from biomaterial, antibacterial activity can be enhanced. Metal nanoparticles have catalytic properties also, which trigger their degradation rate. Due to their small size, they can easily penetrate through cell membranes

causing damage to the building blocks and inhibit the ATP production. Nanoparticle incorporated scaffolds are more efficient than nanoparticle attached on the surface of the biomaterial [5].

The most reliable technique for the preparation of scaffold includes the use of electro spinning method (Figure 1). Due to the number of reaction sites, surface to volume ratio, and porosity, polymer nanofibres are better used in the fabrication of scaffolds. Developing a scaffold from biomaterial, mainly chitosan grafted with other biodegradable polymers such as polyglycolic acid, polycaprolactone, polylactic acid, polyethylene glycol with the incorporation of metal nanoparticles coated with collagen, can effectively improve their mechanical properties, antibacterial properties and the hydrophilic nature of the scaffold. Chitosan is also known for its wound healing by regenerating new tissues, better transmission of oxygen, increased blood coagulation rate and preventing microorganisms. The drawback of chitosan when employed in such applications include its poor solubility and it can be overcome by incorporating hydrophobic moieties in its structure [6].

3. Nanoparticle embedded hydrogels for tissue engineering

Hydrogels embedded with nanoparticles is a new approach in the tissue engineering applications. Polyvinylcaprolactam polymer is a better choice due to its biocompatibility and lower critical solution temperature nearly around the human body temperature. Apart from these properties, it has high water content and porosity resembling a living tissue. Due to lack of mechanical strength, its application as a drug delivery vehicle has some limitations. Highly stretchable hydrogels can be prepared by incorporating inorganic materials such as SiO₂, clay etc. as fillers.

4. Other biodegradable nanomaterials for tissue engineering

Nanoparticle incorporated nano polymeric films exhibit better therapeutic effects and represent better option for skin tissue engineering. Curcumin incorporated PVA composite film has been recently developed for wound dressing. Chitosan/gold films were also developed, which increase the antimicrobial property of the film.

A better understanding of the mechanism of cells is needed for the development of skin repair scaffolds [6]. The efficiency of the nanoparticle incorporated scaffolds depends on several factors such as size of nanoparticles, roughness of the scaffolds etc. [7]. The uncontrolled release of nanoparticles to the cells, diffusion of nanoparticles to other organs creating toxicity and a more active biocompatibility test are some other factors, which will improve the use of biomaterial scaffolds in tissue engineering.

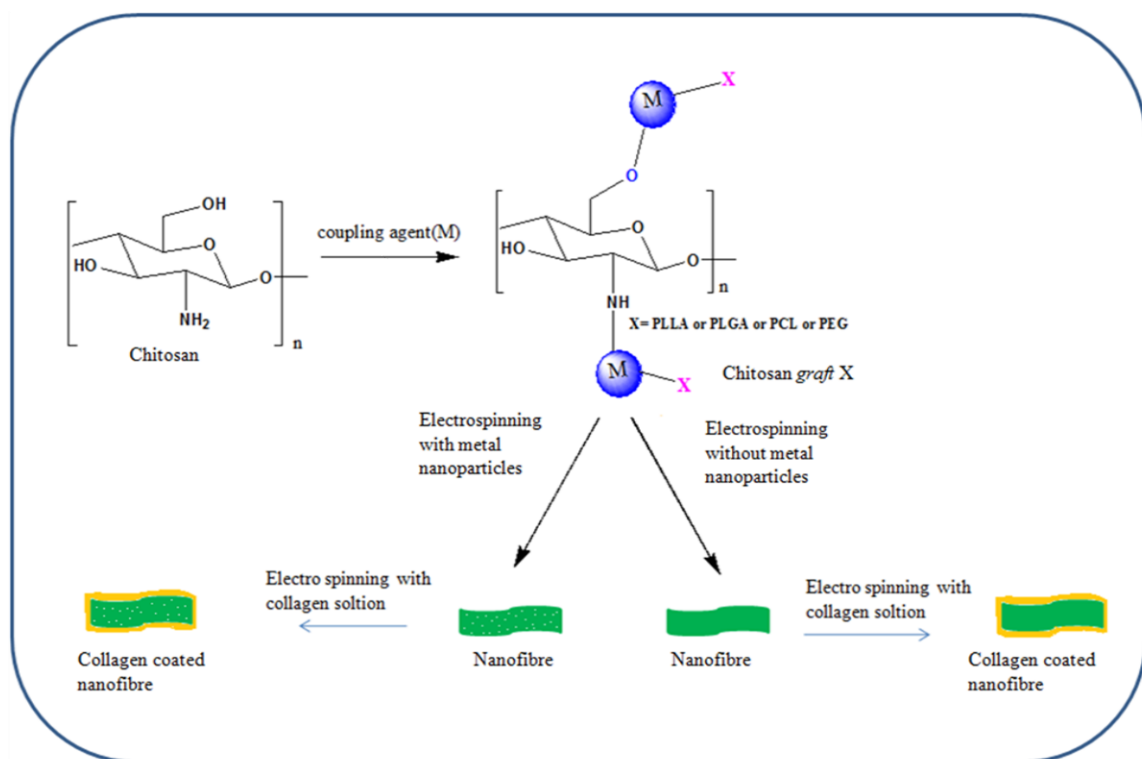


Figure 1: Schematic representation of the metal nano particle incorporated scaffolds

5. Outlook and future perspectives

Numerous advanced strategies were developed in preparing scaffolds in tissue engineering. Still several challenges have to be overcome before the scaffolds are clinically used and commercialized. The mechanical, structural and chemical properties have to be tuned for the use of scaffolds to increase the biodegradation rate and cell proliferation. The

degradation rate of scaffolds used in tissue engineering depends entirely on composition, polymeric structure and method used in fabricating the scaffold. The incorporation of nanoparticles and crosslinking have an opposite effect on degradation that need to be optimized.

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Sustaining the Essence of Cultures

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Abstract

This article throws light on the significance of having an in-depth understanding of culture and norms rather than blindly following them as they have a huge impact on people's daily life and the pillars of sustainability. Cultures have the potential to act as both a catalyst and poison in progress. The paper discusses how the lack of mindfulness and ignorance toward the roots of each culture causes them to lose their meaning, converting them into shackles that bind down the wings of betterment. Hence, it's vital to preserve the right essence of various cultures, which calls for deep thinking and comprehension on an individual level and not just shallow campaigns and institutions that claim the importance of cultures and heritage.

Keywords

Formation/ Roots; Culture; Essence; Understanding; Situations; Effects; Choices; Well-being; Restructuring

A young stream originates as per the landscape. It flows in the convenience of the terrain, entertaining young lives as forgotten fables. As it grows deeper and vaster, it becomes a mighty river capable of creating and transforming landscapes and terrains far from its origin. So is the formation of Cultures, where thoughts, choices, and observations of individuals or groups of individuals grow and transform over time, moulding today's norms. The mighty river is capable of both nourishing and devouring the surroundings at the same time.

Over the past decade, the concept of sustainability has gained importance. With major institutions like UNESCO and other Universities emphasizing the importance of preserving one's culture and initiatives of governments all over the world to promote cultural heritage, it is essential to know the effects of culture on the everyday life of people, how it affects choices and why we need to preserve the essence of each culture. Culture is believed to be the fourth domain that supports and cyclically connects all three pillars of sustainability. They are the Economical, Environmental, and our field of interest, the Social (human) pillar. Every piece of information we encounter subconsciously carves our perspective; even details we forget are retained as patterns in our brains that become the rolling stone that ultimately dictates our course of decisions. One's brain can also unconsciously bend their perception of reality to match their expectations. Therefore, it is vital to recognize if the essence of a culture is being sustained or just the empty shell is being passed down to generations, keep in check our thoughts, and become mindful of their implementation.

Experiments on animals prove that if they are raised within the boundaries of glass walls, even after those walls are removed, they will not move out of the fixed boundary as their brains are conditioned not to cross that area. Humans too are conditioned over time by blindly following customs and norms not knowing why, without questioning the systems or thinking outside the box, and not even daring to violate them. Deeply rooted cultures and the expectations generated from them are capable of exerting high invisible pressure on an individual forcing them to make choices against their will so that they wouldn't be criticized by the community and deceive individuals to assume it was their original decision. Being mindful of cultures and values followed around oneself, contemplating their origins, and understanding their maturation is essential to make ethical decisions and accepting and respecting people for who they are, and for appreciating the past and its relation to the present. Shared Family meals and differences in expectations from both genders are two of the most commonly found part of various cultures and their origins are hypothesized in this article to shed light on how cultures can grow in both beneficial and detrimental directions.

On traveling back in time to when humans sought shelter in caves, there was no method to preserve the hunted food. Hence, it was essential for all family members to gather around the meal and have their part to prevent starving or consuming rotten food. As time progressed, methods to preserve food materials were found, however, the norm of gathering around the meal while eating passed down from generation to generation continued as it had already become a part of the unquestioned custom, and due to the sense of oneness it provided. Studies have proven that in today's world where humans are expected to produce flawlessly like robots while being mentally drained and emotionally neglected, having family meals regularly reduces the chances of developing CMD (common mental disorders) and improves nutritional levels. Over the past decade, mealtime routines as daily traditions have changed significantly, with a progressive decline in the frequency of meals shared in a social model comprising three family meals a day, due to demanding schedules, cultural issues, geographic location, and options for fast foods. Family meals greatly impact the mental well-being of all members of the family irrespective of age. The study shows how regular family meals positively affect self-esteem, and school performance and reduces the risk of drug use, eating disorders, and depressive symptoms in children and adolescents. The presence of parents and the elderly at mealtimes facilitates language development, communication skills, and school involvement, thus reducing the risk behaviors and conduct disorders in children and increasing the sense of belonging to mainstream for the elders.

The rotation of the Earth around its axis was converted into the institution of time by humans to make it convenient for them to travel, meet loved ones, coordinate roles, and much more. Now, the same time separates family and friends and inconveniences the humans who formulated it. This lack of time is the major contributor to failing regular family meals and co-dependency, lack of communication, degrading community values, etc. People start considering family meals as a waste of time and inconvenience unaware of their benefits. On the contrary to this, the Greece culture holds it customary to have regular family meals (Greek Sunday tradition) to nurture the bond between family members and also promotes community gatherings and meals to increase the societal harmony and

brotherhood. This culture has been followed and valued throughout generations in the nation.

Rewinding to the stone age, we can visualize the roots of the current-day dilemma, Gender inequality. In the age where hunting and gathering were sources of meals, it was essential for both men and women to hunt. However, in the presence of offspring, leaving them alone in caves makes them easy targets for predators. Women, the only ones who can feed the babies, chose to temporarily stay back for hunting and gathering within the cave's proximity as an act of affection, consideration, and partnership. To aid the process of traveling, running, jumping, etc while hunting, male clothing evolved to resemble today's pants, and to aid females in gathering, carrying infants, climbing trees, etc. they wrapped a larger piece of clothing around them. Babies learn through imitation, be it humans or other life forms. As offspring grew, over the centuries, they observed who stayed farther from home and who stayed closer. Being in an era with no outside knowledge, they believed what they saw to be the Right and re-enacted it without knowing why in a similar way to the famous story of the formation of 'The Cat Temple'. Hence, as time progressed and tribes started forming, it became customary for females to stay within the walls of the house and for males to lead outside. As civilizations grew and walls became sturdy, women no longer needed to stay home and protect the family. However, the culture for women to stay in the house submissively prevailed because its reason for origin was long lost amongst the ravages of time. From the early 14th to late 17th centuries, the number of women who excelled in their botanical and zoological knowledge increased allowing them to carry out treatments and cures. They were labeled as witches, tortured, fed to animals, and publically burned on stakes for allegedly causing disruption in societal harmony, spreading false insights, forming contracts with the devil, or trading their souls to the darkness, because the medicines and drugs they made shook religious institution's authority over treatments. This caused those who supported these studies to go into hiding, rampant witch hunts, false accusations, and homicides of hundreds of lives, 80% of which were women.

Similarly, when the importance of wealth and clothing gained momentum, people focused on adding more layers to the existing hunting and gathering costumes creating

skirts and suits instead of designing clothing that met the needs of the present. Those caveman costumes traveled through time unharmed and persist in the 21st century as mandatory forms of dressing for each gender. This forces both genders into wearing inconvenient and uncomfortable clothes even in demanding workplaces and lays restrictions on individuality. Anyone who tries otherwise faces harsh backlashes, criticisms, insults, and abandonment that leaves them questioning themselves and crumbles their self-esteem and confidence. This has grown to the point where actors, idols, influencers, models, and icons enter rigorous contracts with organizations that controls even their clothing, speech, appearances, etc. ensuring that the skewed public sees only what they desire to see and the safety of the artists. What was once an innovative choice for convenience has now evolved into obligations that must be satisfied to survive in society.

We can infer that Cultures were formed based on the general thoughts, advice, situations, and opinions of people of a given demography and geography of a certain time or period of time which was taken as gospel by following generations instilling the want to protect the virtue of those words despite the visible change of conditions. Each individual's situation varies from another, hence, following cultures without knowing their valuable core in depth may create more problems than solutions. It also hinders one's self-awareness, understanding, growth, goals, empathy, ability to comprehend situations, and ethics which may also lead to hopelessness, impulsiveness, rebellions, grief, depression, unhealthy coping mechanisms, risky behaviors, etc. leading to aimless and sorrowful life. This enlightens us about the need to restructure cultures while sustaining their essence (non-visible aspects of culture) to hold their roles as a resource for the betterment of human lifestyles instead of being transformed into neurotoxins or meaningless shackles that bring down human capabilities.

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Developing Green Logistics to Reduce Carbon Footprints

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Abstract

Significant amounts of greenhouse gas emissions are generated by logistics transportation. By implementing sustainable practices, productivity can be increased across a business and the carbon footprint (CFP) can be decreased. Green logistics is the practice of reducing the harmful impacts that delivery and logistics networks have on the environment. This study looks at the measures that can be used to reduce carbon emissions and the total environmental cost of logistical activities.

Keywords

Green logistics; Carbon footprint; Sustainability; Environment; Carbon emissions

1. Introduction

The greenhouse effect, climate change, and global warming are the most pressing environmental concerns. There has been an increase in cumulative carbon dioxide emissions from 9.35 billion tonnes in 1750, at the beginning of the industrial revolution, to 1.44 trillion tonnes in 2021 [2]. Many organizations have endeavored to improve the design of their commodities or implement more energy efficient equipment, facilities, and carbon-reducing methods in response to government regulations on carbon output and concerns regarding the environment from the customers. Due to this, green logistics that represents the study of environmental effects of all activities involved in the transport, storage, and

handling of goods as they travel through supply chains, has gained popularity among people [6].

This research will examine the concept of green logistics and its potential to significantly reduce carbon emissions. It will also explore the importance of reducing carbon footprints and the challenges that may be encountered in implementing green logistics. Case studies of companies that have successfully implemented green logistics practices will be examined in the process. The aim of this research is to provide a comprehensive understanding of the potential and limitations of green logistics as a means of reducing carbon emissions.

2. Green logistics

Logistics refers to the movement of goods from one location to another, and it encompasses all of the activities involved in this process, from production and storage to transportation and delivery. Green logistics is a specific approach to logistics that aims to reduce the environmental impact of these activities. Its goal is to create a more sustainable and efficient transport and distribution system, while also offering high-quality products at an affordable price [5].

To achieve this goal, green logistics relies on a number of strategies and technologies. For example, it may involve the use of eco-friendly materials in handling, packaging, and transportation, such as reusable or recycled materials. It may also involve the adoption of energy-efficient technologies such as electric vehicles or sustainable fuel sources. In addition, green logistics may involve the use of advanced technologies like real-time tracking and predictive analytics to optimize the flow of goods and information, improving efficiency and reducing waste.

3. Carbon emissions

In order to combat climate change, carbon dioxide (CO₂) and other greenhouse gases must be reduced since they trap heat in the Earth's atmosphere, raising average world

temperatures. Fossil fuels including coal, oil, and natural gas combustion are a major contributor to this phenomenon, also known as the greenhouse effect. The majority of human-produced CO₂ emissions are produced by these actions, which support global warming and its adverse effects. These effects include an increase in the frequency and severity of extreme weather events, a rise in sea levels, and a decline in biodiversity.

Carbon emissions must be controlled, and there must be a transition toward a more sustainable, low-carbon economy, in order to offset these effects and avert the worst effects of climate change. This involves moving away from fossil fuels in favor of renewable energy sources, which provide electricity with little or no carbon emissions, such as solar, wind, and hydropower. Besides the generation of electricity using renewable sources, there are a variety of alternative strategies to reduce carbon emissions such as improving the energy efficiency in infrastructure, transportation, and industry; conserving and sustaining trees, which eliminate CO₂ from the atmosphere; and implementing low-carbon farming and land-use practices.

Climate change can be slowed down and the Earth can be safeguarded for the next generation by undertaking measures to decrease carbon emissions. Individuals, communities, and institutions across the world must address this issue and join to initiate change that will allow the world to make the transition toward a more sustainable, low-carbon future.

4. Logistics and emissions

Traditional logistics practices, such as single-occupancy vehicle usage and air freight, tend to have a higher ecological footprint due to their reliance on fossil fuels and the associated greenhouse gas emissions. However, by utilizing economies of scale and minimizing the number of individual journeys necessary, more eco-friendly and sustainable modes of transportation like rail and shipping can lower carbon emissions.

Traditional logistics methods can be improved in a number of ways to limit their adverse effects on the environment, including:

1. Using automobiles that are more fuel-efficient and operate on alternative fuels, such as biodiesel or compressed natural gas. This can also include using electric or hybrid vehicles.
2. Using sustainable packaging can cut down the amount of energy needed for transit by using reusable, lightweight packaging and reducing material waste.
3. Employing more than one mode of transportation: Combining several modes of transportation such as using trucks for shorter, local deliveries and trains or ships for longer distances, can be more cost-effective and environmentally friendly.
4. Route and schedule optimization: Logistics firms can cut down the distance travelled as well as the carbon emissions produced by using information and software analytics to make better decisions about routes and schedules.
5. Using intermodal shipping: Intermodal shipping is the process of moving goods from one point to another by using a variety of modes of transportation, including trucks, trains, and ships. Relatively speaking, this may be more effective and less harmful to the environment than using only one method of transportation [4].

In general, the logistics sector is crucial to lowering carbon output and lessening the effects of climate change. Logistics providers can lessen their ecological effect and help to foster a more environmentally friendly future by using more responsible strategies.

5. Green logistics strategies

Green logistics refers to strategies and procedures that are intended to lessen how damaging moving goods is to the environment. These can involve utilizing non-renewable energy-saving technology, such as switching to hybrid cars or using recyclable packaging, as well as bettering transportation administration and planning to boost the effectiveness of goods movement and lower GHG emissions. In addition, green logistics can encompass more significant commercial objectives, like expanding reverse logistics activities, which

involve bringing products back to their original location or reusing them as opposed to discarding them.

There are a variety of ways to apply eco-friendly practices of logistics in businesses, such as using environmentally friendly packaging materials and reducing plastic usage, adhering to production procedures that prioritizes environmental management (such ISO 14001), optimizing transportation fleet management to boost efficiency and reduce emissions, using vehicles with fewer emissions, implementing efficient delivery route planning and load sharing, and maintaining sustainable practices. In order to reduce waste overall, these techniques can also improve stock management and reverse logistics procedures, reduce paper usage through the application of IT solutions, and recycle garbage in warehouses through sorting and recycling operations [3].

Some strategies of green logistics are:

- Green manufacturing: It refers to the use of industrial techniques that reduce resource use, waste, and pollution. This can entail adopting eco-friendly materials and cutting-edge manufacturing techniques to lessen the impact of production on the environment, which will lead to lower costs for raw materials, lower environmental costs, and an enhanced public image. Green manufacturing aims to develop a more ecologically responsible and sustainable industrial method.
- Green distribution: It involves factoring environmental concerns into the logistics, packaging, and shipping of products. In order to cut waste and expenses, this may entail employing ecologically friendly packaging materials and methods, such as recycled content and enhanced designs. Implementing strategies like order consolidation and route optimization that conserve energy and lower CO₂ emissions in transportation is another possibility. Green distribution aims to diminish the effects of commodities movement on the environment.
- Reverse logistics: It is the retrieval of goods for reuse, recycling, or remanufacturing. The collecting, examination, cleaning, sorting, and recycling or

redistribution of unwanted goods and packaging are all considered reverse logistics techniques. These processes can happen in places where the products are repaired, reused, reconditioned, reassembled, or repackaged. Reverse logistics seeks to reduce waste by identifying uses for products and materials that may be reused or recycled [3].

6. Case Studies

There are many examples of successful green logistics initiatives that have helped to reduce carbon emissions. Here are a few examples:

1. DHL's GoGreen programme: DHL is a global logistics corporation that uses carbon-neutral shipping and has put in place a variety of green initiatives, including the GoGreen programme. Through a variety of strategies, including route and schedule optimization, the use of alternative-fuel vehicles, and financial investments in renewable energy sources, this initiative seeks to lower the company's carbon emissions. Through these approaches, DHL has significantly reduced its emissions and saved money in the process [1].
2. UPS: In June of 2021, UPS declared its intention to become carbon neutral in all of its international operations by 2050. Additionally, using 2020 as the baseline year, the corporation promised to cut its CO₂ emissions by 50% for each parcel delivered by 2035. However, UPS intends to have a significant influence by 2025 through the use of alternatively fueled cars. The corporation has spent more than 20 years investing in alternative fuels to power its fleet, and it currently runs more than 13,300 cars that use alternative fuels.
3. IKEA: They have introduced numerous eco-friendly measures, such as switching its supply chain's hardwood pallets for paper/cardboard ones and using plastic legs instead of metal ones. This method has considerably decreased the requirement for transportation, CO₂ emissions, and packing space. IKEA encourages its transportation partners to utilize low-CO₂ equipment by using its IWAY monitoring system. The

objectives of IKEA's green logistics programmes include switching to non-wooden pallets for 60% of its overall flow by 2012, 100% of its overall flow by 2014, and guaranteeing that all transport partners satisfy IWAY standards by 2015.

The deployment of a variety of emission-reduction strategies, the use of cutting-edge technologies and analytics to optimize operations, and the companies' dedication to sustainability were the major elements that made each of these green logistics efforts successful.

7. Limitations

When adopting green logistics projects, businesses may run into a number of difficulties and restrictions. These may consist of:

- **Financial obstacles:** Putting green logistics into practice frequently necessitates expensive investments in new technology and equipment. If businesses are unsure of the financial return on investment or are operating on a tight budget, they may be reluctant to make these investments.
- **Logistical obstacles:** Making the switch to green logistics might be difficult logistically because it may require altering current procedures and systems. For large businesses with intricate supply chains, this can be particularly challenging.
- **Limited accessibility to eco-friendly technologies:** In some circumstances, the tools and technology required to execute green logistics may not be widely accessible or may not yet be in their final stages of development. Companies may find it challenging to implement these technologies as a result.
- **Reliability:** The paramount significance of service reliability is at the core of logistics. While the least polluting modes are typically seen as being the least reliable in terms of on-time delivery, lack of breakage, and safety, its success is founded on its capacity to convey freight with the least chance of breakage or damage. The logistics sector is based on air and truck shipments, the two least eco-friendly modes of transportation, while ships and railways have a history of low customer satisfaction.

In conclusion, it is critical for businesses to carefully weigh the costs and advantages of green logistics projects and to build plans for overcoming any potential logistical or financial challenges.

Conclusions

Green logistics is a viable tactic for decreasing the negative environmental effects of shipping and distributing while simultaneously enhancing effectiveness. Businesses may drastically lower their carbon emissions and increase the sustainability of their supply chain by using eco-friendly practices and materials, utilizing cutting-edge technologies, and optimizing operations. However, implementing green logistics also comes with a variety of difficulties and restrictions such as logistical and financial obstacles. Overall, adopting green logistics methods can have a positive impact on the environment and the bottom line, making it an essential area of focus for enterprises and logistics professionals.

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The Impact of Sports and Games on Engineering Education

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Abstract

This article explores the impact of sports and games on engineering education. The use of sports and games has been found to be an effective way of enhancing students' learning experience. By incorporating sports and games into engineering education, students are able to develop essential skills such as teamwork, problem-solving, and critical thinking. Furthermore, sports and games create a fun and engaging learning environment that motivates students to participate actively in the learning process. The article presents various studies that highlight the positive impact of sports and games on engineering education. Overall, the article concludes that sports and games have a significant impact on engineering education. By incorporating these activities into the classroom, educators can create a fun and engaging learning environment that promotes essential skills and enhances students' interest in the subject matter. However, to maximize the benefits of sports and games, it is essential to address the associated challenges and develop appropriate assessment methods.

Keywords

Sports and games; Physical activity; Engineering education

1. Introduction

Sports and academics are often seen as two distinct spheres of a student's life, but the reality is that there is a strong connection between both. The academic performance and well-being of pupils can be affected positively via engagement in sports activities. One

study published in the Journal of School Health found that students who participated in sports had higher grade point averages (GPAs) than those who did not participate in sports [1]. The study also found that student-athletes were more likely to attend school regularly and less likely to drop out of school. Another study published in the Journal of Educational Psychology found that participation in sports was positively associated with higher academic achievement, including better performance on standardized tests and higher levels of academic motivation [2].

Studies have shown that participating in sports and games can have a positive impact on the cognitive and physical development of individuals in engineering fields. Engaging in sports and games can help to improve physical fitness, coordination, and dexterity, all of which are important skills for many engineering fields. The impact of sports and games in engineering education can be significant and far-reaching.

2. Impacts of sports and games

Here are some of the ways in which sports and games can positively impact engineering students.

2.1. Physical fitness

Physical fitness refers to the existence of a state of health and well-being and, in specific, it represents the capability to do aspects of sports, occupations and daily activities. It is possible to attain physical fitness via proper nutrition, moderate-vigorous physical activities, and enough rest along with a formal recovery plan. Physical activity, especially sports, has been shown to improve focus and mental alertness. When students engage in sports, they improve their physical fitness and build healthy habits that can carry over to the classroom. This increased physical activity leads to increased oxygen flow to the brain, which can help students concentrate and retain information better. Regular participation in sports and games helps to promote physical fitness, which is important for engineering students, who may spend long hours sitting and working in front of a computer [3].

2.2. Leadership, Teamwork and Collaboration

Leadership, teamwork and collaboration can foster a healthy work culture and environment, where teams of individuals can achieve goals through powerful skills and effective work. Collaborative teamwork can promote innovation, increase job satisfaction, find solutions to resolve problems and develop excellent soft skills. Sports can be a great opportunity for students to develop leadership skills. For example, students can learn how to work with others, communicate effectively, and take initiative via serving as a captain or simply leading a team. These skills are critical for success in school, work, and life [4]. Many sports and games require teamwork and collaboration, which can help students learn important skills in these areas. These skills can then be applied to their engineering projects and studies, where teamwork and collaboration are often essential for success.

2.3. Problem-solving skills

Problem solving is the process of achieving a goal by overcoming obstacles, a frequent part of most activities. Engineering students are often called upon to solve complex problems, and participating in sports and games can help them develop their problem-solving skills. In many sports and games, players must analyze their opponents, strategize, and make quick decisions in order to be successful [5].

2.4. Time management

Time management is the method of planning and balancing your time between different activities. Good time management helps you to complete a given task in a specific time frame amidst challenges and tight schedules. Balancing academics and sports can be a challenge, but it is also a valuable opportunity to develop time management skills. By juggling practices, games, and college works, students learn to prioritize tasks and use their time more effectively. This skill is especially important for success in college and the workplace. Engineering students often have a heavy course load, and participating in sports and games can help them learn how to balance their time and prioritize their work.

2.5. Self-confidence and Self-esteem

Self-esteem is the confidence in one's own worth or abilities. Self-esteem encompasses beliefs about oneself as well as emotional states, such as triumph, despair, pride, and shame. Participating in sports can boost the self-confidence and self-esteem of students. When a student is successful in sports, he/she develops a sense of pride and accomplishment that can carry over into other areas of their life, including academics. Additionally, being part of a team and working towards a common goal can help students feel more connected and invested in their own success.

2.6. Stress relief

Stress is a physical reaction to a person's emotions. Both positive events (e.g., an upcoming wedding) and negative events (e.g., the loss of a loved one) can cause stress. Stress is just one of the many hurdles college students face. Short-term stress can help learners raise a grade, polish an essay, or pursue a coveted career opportunity. But long-term stress, if left unaddressed, can have detrimental side effects. According to the American Institute of Stress, 4 in 5 college students experience frequent stress. Unchecked stress can lead to physical side effects like trouble concentrating, irritability, a lack of energy, appetite changes, a weakened immune system, and trouble sleeping. Sports can provide a much-needed outlet for stress and anxiety. Exercise has been shown to have a positive impact on mental health and can help students manage stress and reduce the symptoms of anxiety and depression. When students feel better mentally and emotionally, they are more likely to perform well academically. Engineering students often experience high levels of stress, and participating in sports and games can provide a much-needed outlet for stress relief and help them to maintain a healthy work-life balance.

Furthermore, participating in sports and games can also help to develop important personal skills such as teamwork, communication, leadership, and problem-solving, which represent valuable traits for engineers [6]. In team sports, individuals learn how to work together towards a common goal, and in games, they learn how to strategize and make quick decisions. These skills can be directly applied to engineering projects that require teamwork and problem-solving.

Conclusions

In conclusion, participating in sports can have a profound impact on an engineering student's academic success and overall well-being. From increased physical fitness and focus to improved time management skills and boosted self-confidence, the benefits of sports are many. By encouraging students to get involved in sports, we can help them develop the skills and habits necessary for success in college and beyond.

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The Psychological Link between Human Mind and Sustainability

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Abstract

A healthy connection between one's own mind and body is necessary for effective survival of an individual. Similarly, a connection between humans and their environment is necessary for ensuring and maintaining sustainability. Observing psychological behavioral patterns, especially ones that could be linked to the environment, might provide us with an insight into an interesting dynamic of dependency and also, how the world functions. Examining these dynamics would give an idea about how behavioral patterns might give a solution to sustainability issues. Since human beings are a vital part of the functioning of the world, these observations might help to create a better future, which starts right from us.

Keywords

Behavioral patterns; Psychology; Sustainability

1. Introduction

Sustainability issues mainly arise due to human habits that are to be changed and are of concern to nature. Psychological analysis of human behavioral patterns may give one an idea about why human beings act the way they do and also, the possible reasons for refraining from changing existing behavioral patterns despite of being aware of the harm caused by it. It is evident that most of the sustainability issues that we are aware of can be progressively made better with changes in day-to-day habits of the human population. It

could be something as simple as lessening the use of non-biodegradable materials like plastics [1]. But as we can clearly see, there is still a vast majority of the population using such materials rather than switching to eco-friendly materials despite knowing the damage caused by it. This is where psychological analysis comes into play.

Climatic changes are widely observed across all regions of the globe. Even a phenomenon like climate change that has been a rising concern for environmentalists and activists all over the world has a relation to the topic of sustainability. It would be good to develop an understanding of this subject by taking a very familiar example of Kerala floods that will be discussed briefly in the upcoming lines. Over the years climate change has become more prominent and its effects remain to have a hurtful grip on earth and its living organisms. There have also been other underlying calamities, whose traces lead to the factors relating to climate change. It is observed that the past few years have not been easy for the residents of Kerala due to the frequent occurrences of flood in the state. In 2018, people all over Kerala were struggling to stay safe due to the unexpected flooding that caused severe damage to property and life throughout the state. The vicious flood wrecked thousands of shelters and took lives of hundreds of people. The floods did not stop by marking its infamous presence by spreading its treacherous wings in mid-2018, it also caused widespread destruction the very next year as well. The year 2019 also witnessed severe losses and damages due to another flood. **Table 1** represents the statistics of floods that occurred in the years 2018 and 2019 in Kerala.

Table 1: Statistics of flood in Kerala in 2018 and 2019 [Data taken from the Disaster Management Authority of Kerala, as published in the newspaper, The Hindu]

Time period of flood in Kerala	Death rate	Financial Loss (in Rs.)
July 2018 – Aug 2018	433	31000 crores
8 August 2019 – 26 August 2019	102	2101.9 crores

2. Sustainable Development Goals

The United Nations (UN) has defined 17 sustainable development goals, which are as follows: no poverty; no hunger; good health and well-being; quality education; gender equality; clean water and sanitation; affordable and clean energy; decent work and economic growth; industry, innovation, and infrastructure growth; reduction in inequality; sustainable cities and communities; responsible consumption and production; climate action; life below water; life on land; peace, justice, and strong institutions; partnerships to achieve the goals [2].

In an era of advancing technologies, we are driven by the desire to be a product of modernized practices. More often than not, these practices have an inclination to be of destructive nature. This is not necessarily done while the individual is completely aware of the consequences, it could also be a series of events or practices that might seem rather harmless on the outside but have underlying consequences. Habits that our ancestors from a long time ago had practiced tend to be a lot easier on nature than our existing practices. This could be due to the fact that advancements in technology have led us into following whatever practices are assumed to be required to keep up with it. It could also be impacted by societal pressure, peer pressure or other such factors that are related to complex human behaviors like development of inferiority or superiority complexes etc. An example of this would be the use of wooden furniture. A lot of people find it prestigious to own furniture made out of expensive and rare wood. While some furniture could be made from fallen trees, it is true to say that it is clearly not always the case. The rate of deforestation has been rapidly increasing over the past few decades and, directly or indirectly, human beings are the major cause of it [3]. As discussed earlier, the desire to come across as better than the people around us by doing such activities are a major cause of concern. A few common examples of destruction of habitat or the life associated with it includes the collection of elephant tusks, owning multiple cars that lead to excessive burning of fossil fuels which in turn leads to global warming, procurement of wild animal skin (Eg:- tigers) etc. It is necessary to keep certain egos and other unwanted issues aside to act as responsible citizens and individuals.

3. Psychological Measures to attain Sustainability

Even after multiple calamities become a recurring phenomenon, people seem to have a reluctance to take a direct and strong step to approach issues related to climate change, which in turn is linked to lack of habits that promote sustainability. Experts say that this is due to internal fear or anxiety and is deeply engraved within the minds of people that are perhaps unknown even to the individuals themselves [4]. This fear may subconsciously prevent the individual from taking any further action due to a fear of it not being as effective, or things that are to be implemented simply not going as planned. Human mind is generally fearful of failures and this might be one of the reasons for the lack of implementation of new strategies or even trials of some new remedial measures that could be of use.

It would be accurate to say that the Newton's law of inertia also applies to individuals and their behavioral tendencies. Humans are creatures driven by habits and it is hard to break out of it unless one is forced to do so due to some alarmingly concerning consequence. Human beings are generally observed to have a slower approach to problems that may arise in the future, when compared to problems in their present lives that require immediate action [5]. Most often, these consequences also have to be foreseen and predictable to take an effective action against them, that in turn requires the implementation of some form of change. It is noticeable that even scientific laws of physics or mathematics can be metaphorically linked to human psychological behaviors and this is pointing to the fact that everything is interconnected and life cycles and patterns of living are indeed circular in nature and not necessarily linearly linked.

4. Role of Psychologists in Ensuring Sustainability

The key roles that psychology play in the act of sustainability has been discussed. Now the question is why psychologists cannot simply do the tasks required for maintaining and ensuring sustainability. But in the real-world scenario that is rarely ever the case. While there may be psychologists voicing the need for it, it is difficult for them to carry out these

tasks by themselves. Most psychologists are specialized in dealing with their respective profession and actions, and, implementations of these actions on a large-scale population are something that stretches way beyond the professional boundaries and streamlined specialization of trained psychologists [6]. While this might remain the case for psychologists, on the other hand, it could be noted that, it is common for environmentalists to talk about the rapidly increasing need and awareness for sustainable habits while simultaneously acting on it. But while analyzing the case of an average citizen or an “environmental psychologist” or an “ecopsychologist” the efficiency of pursuing an action-oriented path for an effective outcome is different and often difficult to successfully execute on a large-scale population.

Conclusions

It is important to realize that even the smallest of actions can have unexpectedly huge consequences. So, it is indeed a necessity to understand sustainable habits and their functioning thereby implementing some simple yet effective key changes to one's daily practices. Since it is difficult to change the day-to-day habits or behaviors of individuals, it is important to try and incorporate subtle yet effective mechanisms into the life systems of people so as to reach to them in a personal way while paving the way to a sustainable future. It is wise to say that the future begins with oneself.

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Bioregional Existence of the Indigenous Occupying the Sundarbans

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Abstract

The majority of the world's indigenous population has always had a strong relationship with their land, which is reflected in their daily activities and through their reverence for the deity that they believe in. By bringing in the various bioregional features, this paper attempts to throw light upon the sustainable practices that are still practiced in the ever-evolving Sundarbans which is also the world's largest archipelago.

Keywords

Sundarbans; Indigenous; Sustainable living; Ecology

The term bioregion was first coined by the Canadian writer, Allen Van Newkirk, and was popularised by Peter Berg, who along with Raymond Dasmann, a renowned ecologist introduced it in an essay titled "Reinhabiting California." To Berg,

A bioregion is defined in terms of the unique overall pattern of natural characteristics that are found in a specific place. The main features are generally found throughout a continuous geographic terrain and include a particular climate, local aspects of seasons, landforms, watersheds, soils, native plants, and animals.

People are also counted as an integral aspect of a place's life as can be seen in the ecologically adaptive cultures of early inhabitants, and in the activities of present-day reinhabitants who attempt to harmonize in a sustainable way with the place where they live. (Bioregionalism)

While a biome is a biotic community having its own distinct fauna and flora, a bioregion includes human beings and their cultural activities in the region. The basic characteristics of a bioregion are naturalness, particularity, territoriality, decentralized governance, and self-sufficiency. The people occupying a particular space have numerous experiences with that space and ultimately it becomes a 'place'. "These experiences are something that people know through their senses and not just through their cerebral understanding". (Selvamony, *A Bioregional Reading of Some Australian Texts*) The bioregion ceases to be a mere backdrop for human survival. "It is a place where human beings dwell by "following the necessities and pleasures of life as they are uniquely presented by a particular site, and evolving ways to ensure long-term occupancy of that site". (Berg and Dasmann 217)

The Sundarbans, the world's largest mangrove forest area is situated on the delta where the three rivers, Ganges, Brahmaputra, and Meghna meet the sea. Covering an area of 10,000 square kilometers, it sprawls across India and Bangladesh. The name 'Sundarbans', meaning 'the beautiful forest', is believed to have been derived from a common species of mangrove – the "sundari tree, *Heriteria minor*" (*The Hungry Tide* 8). According to UNESCO, Sundarbans is situated in a unique bioclimatic zone within a typical geographical situation in the coastal region of the Bay of Bengal, forming the landmark of ancient heritage of mythological and historical events. The site supports exceptional biodiversity in its terrestrial, aquatic, and marine habitats; ranging from micro to macro flora and fauna. It supports a wealth of animal species including the single largest population of Bengal tiger and a number of other threatened aquatic mammals such as the Irrawaddy and Gangetic River dolphins. The Sajnakhali area, listed as an important Bird Sanctuary, contains a wealth of waterfowl holding high importance for migratory birds. The Sundarbans provides a significant example of ongoing ecological processes as it

represents the process of delta formation and the subsequent colonization of the newly formed deltaic islands and associated mangrove communities. These processes include monsoon rains, flooding, delta formation, tidal influence, and plant colonization. A terrain that keeps evolving once in a few years, Sundarbans is highly eco-sensitive and the inhabitants are aware of this fact and live their life accordingly.

The Sundarbans are been maintained by the inhabitants with a perfect bifurcation of the wild and the inhabited. The people who accept the harsh realities adhere to the division of the land of eighteen tides into two halves and this reveals the compulsion of the indigenous to give a rightful share to the non-human world as they have an equal need to exist as the humans do. This adherence occurs without questioning and the first tenet of ecopsychology which claims that “unconscious processes exist ... not only in relation to other people, but to the earth itself” (Hasbach 119) is evidenced here. For the inhabitants of Sundarbans, Bon Bibi, the guardian deity of the forests is the protector of the villagers. The relationship between the human settlers and the predators is nowhere more clearly verbalized than in the legend of Bon Bibi. This deity along with her twin brother Shah Jongoli becomes the cultural artifact that binds together culture and conservation. They protect the villagers from the demon king Dokkhin Rai who takes the form of a tiger devouring humans who venture into his territory.

Bon Bibi is portrayed as a deity who is well aware of the frictional relationship that exists between the human world and the natural world. Nature can be detrimental to humans, as men could be killed by wild animals, and in turn, man could be greedy by usurping more than what he needs from the forest. Hence the covenant of mutual respect is always expected. The legend insists that self-provisioning is legitimate, but profit is not because if every human who ventures into the forest is keen on profit-making, the forest would be plundered off its resources as it happens in various parts of the world. Frederick Turner posits, “the (human) species’ ancient wisdom (as it) is preserved in myths, rituals, fairy tales, and the traditions of the performing arts” (49). The Indigenous instincts reveal the fact that the protection of Nature is very much in the hands of the one who uses it. As

Vandana Shiva postulates, “In the indigenous setting, sacredness is a large part of conservation. Sacredness encompasses the intrinsic value of diversity; sacredness denotes a relationship of the part to the whole—a relationship that recognizes and preserves integrity” (*Ecofeminism* 169).

Despite these raging storms that affect the settlers’ life tremendously, people still continue to live in the storm-tossed islands. The indigenous have adjusted their lifestyle in such a way that they take in only the required quality of food for survival and any greed is considered to be against the wish of their ruling deity. Here “the sacred, natural, and human entities coexist in the same place nurturing an integrative relationship with each other” (Selvamony, *Oikopoetic method* 44) The main livelihood of the settlers are extraction of honey and catching of fish from rivers, lakes, and rivulets. There are quite a few sustainable conservation practices carried on by the indigenous people of the Sundarbans.

People who consider the wild as sacred allude to the ecological belief that, “Environment is not an ‘other’ to us but part of our being” (‘The Place of Place’ 55). Although their income is very meager, their biological adaptation, together with their spiritual beliefs, demand that they utilize the forest in a sustainable manner. To Annu Jalais, an environmental anthropologist, “... the forest is seen as the realm where all are welcome to partake in its ‘food’ as long as this does not act to the detriment of those who need it most—whether tigers, deer, or small fishers and crab collectors” (75). Since forest equalizes, the little shelters erected in Bon Bibi’s honour are rarely located in a person’s homestead but along tracks or pathways to protect, to ‘show the way’, to all who travel along those paths. The most important shrines though are located within the precinct of the forest, in small clearings along the banks of rivers. It is to be noted that humans belonging to Paleolithic and Neolithic period lacked the hierarchical order and they possessed an evolutionary history that was formed through, “coevolving with nature” (Hasbach 123).

The settlers are also very keen on keeping the forest in its pristine beauty by not leaving behind any trace of human intrusion. Annu Jalai’s interaction with the natives reveals that to have a ‘pure heart’ one has to respect some very specific rules such as:

keeping quite in the forest, not defecating, urinating or spitting directly on jungle land or in the river, nor throwing *bidi* butts or burnt pieces of wood either in the river or in the forest, nor washing the soot off utensils nor combing hair, nor dropping one's axe, nor inadvertently making any mark on a tree. The islanders also have to eat up any cooked food in the boat before alighting on the forest territory as a symbol of penury. Entering the forest on certain days such as on the new moon or the full moon, or before 7 a.m. or after 4 p.m. is seen as 'disturbing' animals. (84).

The inhabitants are seen to adhere to a very important tenet of ecopsychology which states that, "wildness in the natural world often involves what is big, untamed, unmanaged, not encompassed, self-organizing, and unencumbered and unmediated by technological artifice. We can love the wild. We can fear it. We are strengthened and nurtured by it" (Hasbach 124). They never try to tame the wildness of the Sundarbans but love it along with the fear that strengthens and nurtures them.

Although life in Sundarbans is too tedious and uncomfortable when compared to the plains of Bengal, the settlers prefer the flood-drenched landscape because they have a thorough knowledge of the riverine land and they are used to the humid climate that the plains rarely offer. The indigenous have always had a strong relationship with the natural elements around them, which is reflected in their social and religious life. These values have triggered the sustainable co-existence of people and Nature, which modern man, who is overtly exposed to industrialization, has failed to recognize and respect. As Nietschmann states,

The vast majority of the world's biological diversity is not in gene banks, zoos, national parks, or protected areas. Most biological diversity is in landscapes and seascapes inhabited and used by local peoples, mostly indigenous, whose great collective accomplishment is to have conserved great variety of remaining life forms, using culture, the most powerful and valuable human resource, to do so (7).

Indigenous communities are dependent upon Nature, and the wisdom of not depriving future generations is to be found only in the culture of those people who are

dependent upon earth's natural resources, the forests. Although the people of the farming community place their lives in accordance with the crops cultivated, they are forced by various factors to use pesticides, insecticides, and other harmful chemicals in order to reap profit. The constant usage of unnatural growth instigators leads to the depletion of the soil's fertility and the future generation is left to use the most unfertile and corrupted earth, thus making it unworthy to cultivate. The concept of 'now or never' is flourishing in the industrial and agricultural sectors that portray the self-obsession of the present generation. The thought of what would be left for the future, as our ancestors have left behind for us to benefit, rarely occurs in today's ever-greedy world.

The native settlers of Sundarbans emphasize that they never exploit the natural resources of the tidal country beyond their basic need and never dare to cross the line of control set by Bon Bibi, in the same way as the animals in Kipling's stories avoid killing for choice because they consider it demeaning as seen in the case of Sher Khan, the tiger. Though Sher Khan speaks of his right to kill for choice [he had killed a man], the Jungle is of an entirely different opinion and the other animals felt that Sher Khan, by this very act, had "tainted the good water" (18). The natives of the Sundarbans kill animals only out of necessity or defense and at other times they are quite aware to veer away from unlawful hunting. But the outside forces, fail to achieve harmony when they poach animals and slaughter trees for commercial needs in order to satisfy their gluttonous greed. The bioregional existence thus contributes to a sustainable living that is beneficial for healthy survival and the indigenous people are stewards of the world's highly threatened biodiversity.

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Transition to Low-Carbon Energy Systems by Following the Three Pillars of Sustainability

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Abstract

The last decade has seen significant growth in the renewable energy sector. It is widely argued that the three pillars of sustainability need to work together, namely the environment, social equity, and economics. The challenge for the transition to low-carbon energy systems is to find transition mechanisms that are both economically viable and socially acceptable. This article presents how to achieve this transition sustainably by overcoming the challenges that arise during the process of transition to low carbon energy systems.

Keywords

Renewable energy; Environment; Social equity economics; Low-carbon energy systems

1. Introduction

Sustainability refers to the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs. It is a concept that encompasses environmental, social, and economic factors, and it is often referred to as the "three pillars of sustainability". The economic pillar focuses on making sure that the transition to low carbon energy systems is economically viable. This means that the energy systems must be cost-effective and should not create an economic burden for citizens and

businesses. To achieve this, governments must invest in renewable energy sources such as solar, wind, and hydropower, as well as energy efficiency measures such as building insulation and lighting upgrades. This is important because renewable energy sources are often cheaper in the long run compared to fossil fuels and can help to reduce greenhouse gas emissions. The social pillar focuses on making sure that the transition to low carbon energy systems is equitable and beneficial to all. This means that the transition should benefit all people, regardless of their social and economic backgrounds. To achieve this, governments must ensure that everyone has access to affordable and reliable energy and that the transition does not lead to job losses or social inequalities. Additionally, governments should invest in education and training to ensure that people have the skills necessary to take advantage of the new energy systems. Finally, the environmental pillar focuses on making sure that the transition to low carbon energy systems is environmentally sustainable. This means that the energy systems should be designed in a way that minimizes their impact on the environment. To achieve this, governments must invest in renewable energy sources and energy efficiency measures that reduce greenhouse gas emissions. Additionally, governments should invest in research and development to ensure that new energy technologies are developed in a way that is harmonious with nature.

Sustainability is an important concept because it helps us to understand the interdependence of the three pillars and how they are all connected. It also helps us to recognize the importance of finding ways to meet our needs in a way that is both environmentally and socially responsible, and that ensures a stable and prosperous future for all. Transitioning to low carbon energy systems is one of the most important steps that can be taken to address the global climate crisis. To achieve this transition, it is necessary to follow the three pillars of sustainability.

2. Low carbon energy systems

Low carbon energy systems refer to methods of generating and using energy that have a lower impact on the environment, particularly in terms of carbon emissions. These systems are typically focused on renewable energy sources, such as solar, wind, and hydro

power, which do not produce greenhouse gases when they are used. Other low carbon energy systems may include advanced nuclear power technologies, which have the potential to generate electricity with low emissions, as well as energy storage systems, such as batteries, that can help to balance the intermittent nature of many renewable energy sources. Low carbon energy systems are important for addressing climate change, as the burning of fossil fuels is a major contributor to greenhouse gas emissions and global warming [1]. By transitioning to low carbon energy systems, we can reduce our reliance on fossil fuels and mitigate the impacts of climate change. In addition to their environmental benefits, low carbon energy systems can also have economic and social benefits, such as creating new jobs, improving public health, and reducing our dependence on foreign energy sources.

3. Methods to achieve low carbon emission

There are several ways to transition to low carbon emission systems:

3.1. Renewable energy

One of the most effective ways to reduce carbon emissions is to use renewable energy sources such as solar, wind, and hydroelectric power. These sources do not emit greenhouse gases when generating electricity, so they can help reduce the overall carbon footprint of a community or country [2].

3.2. Energy efficiency

Another way to reduce carbon emissions is to increase the energy efficiency of buildings, vehicles, and industrial processes. This can be achieved through measures such as insulation, LED lighting, and energy-efficient appliances.

3.3. Electric vehicles

Transportation is a major source of carbon emissions, and hence switching to electric vehicles can significantly reduce the carbon footprint of a community or country.

Electric vehicles do not emit any tailpipe emissions and can be powered by renewable energy sources, making them a cleaner alternative to traditional gasoline-powered vehicles [3].

3.4. Carbon pricing

One way to incentivize the transition to low carbon emission systems is to put a price on carbon, either through a carbon tax or a cap-and-trade system. This can encourage businesses and individuals to reduce their carbon emissions in order to avoid paying the price [4].

3.5. Public transportation

Encouraging the use of public transportation, such as buses, trains, and subways, can also help reduce carbon emissions. These modes of transportation are often more efficient and emit fewer greenhouse gases per passenger mile than individual vehicles.

Conclusions

Transitioning to low carbon energy systems is essential to address the global climate crisis. To achieve this, it is necessary to follow the three pillars of sustainability – economic, social and environmental. By doing so, governments can ensure that the transition is economically viable, equitable and beneficial to all, and environmentally sustainable.

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Moringa Oleifera - Water Purification and its Antibacterial Efficacy

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Abstract

Clean water and hygienic life are the need of every living being. This article focuses on the water purifying effect of Moringa Oleifera seeds by analyzing pH, TDS, hardness etc. and how it prevents life style diseases like diabetes, cholesterol and proving these scientifically. By understanding the properties of such plants, we can reduce the dependency on modern medicines to a large extent and thus, can ensure a sustainable future.

Keywords

Moringa Oleifera; Water purification; Antibacterial efficacy.

1. Introduction

It is a known fact that 71% of Earth is covered with water, but only 0.5% of it is termed as pure water and drinkable. Our world is in a situation that within 50 years, an alternate way for drinking water has to be realized. Many countries are trying to protect the pure water bodies and hence purifying water in a cost-efficient way is an important requirement today. Lifestyle diseases are common nowadays, and dependency on medicines for minor diseases has also increased a lot. Moringa Oleifera seeds can be used as a cost-effective solution for both [1]. It has the potential to purify water effectively [2, 3] and reduce the impacts of cholesterol, blood pressure and diabetes [4-6].

2. Experimental section

2.1. Preparation of moringa oleifera seed powder

The seeds are collected and the wings of the seeds are removed, well dried seeds are powdered using mortar.

2.2. Anti-bacterial test

Moringa Oleifera seed powder samples were sent to Unibios Laboratories, Kochi, Kerala to determine the antibacterial properties using well diffusion method. Stock solution (10mg/ml of sample) was prepared. Stock solutions in different volumes (25 ml, 50ml, and 100ml) were used against bacteria filled agar plates. Chloramphenicol was used as a comparison parameter. Results were noted down after separate time intervals.

2.3. Study on lifestyle diseases

A study was undertaken on people living in the experimenter's neighbourhood. The study population was directed to include moringa in their food cycle, either by using moringa leaves or seeds in curries or by adding moringa powder (maximum of a quarter teaspoon) to the dishes. Blood pressure and sugar levels of the study population were tested before and after this experiment.

3. Results

Water purification studies of Moringa Oleifera seeds are discussed in the following sub sections and the results are given in **Table 1**.

3.1.pH

The pH of the water collected from the well had shown some alkaline nature before treatment with moringa. This may be due to the reaction with atmospheric CO₂. After treating with moringa for 1 hour pH changed to 7, which is a good condition for drinking.

3.2. Conductivity

Conductivity of water collected from the well was 138.2 mho and it changed to

162.6, 183.3 and 209.2 mho after 1, 6, and 12 hours respectively. It is observed that conductivity is proportional to the time for which the experiment is conducted. This may be due to the cationic protein present in Moringa Oleifera seeds called Moringa Oleifera Cationic Protein (MOCP), which binds the minerals and helps in settling and thereby increasing the conductivity of water.

3.3.Total dissolved solids (TDS)

Before treatment with Moringa Oleifera, the TDS was indicated at 420 mg/l. After treatment for 1, 6 and 12 hours respectively, its value changed to 265, 170 and 112 respectively. These values come under the designed value kept by World Health Organization (WHO). This may be due to the fluctuant property of moringa seed powder.

3.4. Dissolved oxygen (DO)

Before treatment, the DO level was 4.7 mg/l and after treatment for 12 hours, the level changed to 8.1 mg/l. This may be due the bio active substances present in the moringa seeds.

3.5. Hardness

Before treatment, the hardness of water was 460 mg/l. After treatment with Moringa Oleifera seed powder for 1,6 and 12 hours respectively, hardness changed to 380, 320 and 270 mg/l. Hardness decreases as time proceeds and after 12 hours, its value came under WHO standards. The reduction in adsorption capacity may be the reason for decrease in hardness.

3.6. Fluoride

Before treatment, the level of fluoride in water was 2 mg/l, and it changed to 0 mg/l when treated with moringa for 12 hours.

3.7.Effect of Moringa Oleifera seed powder in reducing growth of bacteria

The results from the lab showed that when moringa seed powder was given in 25 μ l, 50 μ l quantity, it did not resist the growth of bacteria. When 100 μ l quantity was given,

it resisted the growth of bacteria (**Table 2**). When compared with the chosen control – Chloramphenicol, moringa showed an equally good performance against bacterial growth and this proved the fact that moringa can be used as an antibiotic in future.

Table 1: Water purification studies of Moringa Oleifera seeds

Parameters	Sample 1 (Water)	Sample 2 (After 6 hours)	Sample 2 (After 6 \hours)	Sample 2 (After 12 hours)	Standard value (WHO-2005)
Temperature (°C)	25.4	26.2	27.2	28.2	27.3
pH	6.5	7	6.7	6.6	7.4
Conductivity (mho)	138.2	162.6	183.3	209.2	300
TDS (mg/l)	420	265	170	112	500
Dissolved oxygen (mg/l)	4.7	5.8	7.1	8.1	5.6-9.5
Hardness (mg/l)	460	380	320	270	300
Chloride (mg/l)	180	120	90	70	250
Fluoride (mg/l)	2.0	1.5	1	00	4

Sample 1-Before adding Moringa Oleifera seed powder & Sample 2- After adding Moringa Oleifera seed powder

Table 2:Antibiotic property of Moringa Oleifera seed powder

Bacteria Type	Quantity added (µL)			
	Moringa Oleifera seed powder			Chosen Control- Chlorom Phenicol
	25	50	100	100
	Antibiotic property			
E. Coli	NO	NO	5	6

3.8.Study on lifestyle diseases

Test results showed that most of the study population's sugar, blood pressure and

cholesterol levels had decreased in small quantities on including moringa seeds to their diet.

3.9. Anti-oxidant and anti-microbial property of moringa seeds

Since moringa has antibacterial properties, a question arises whether moringa has anti-oxidant or anti-microbial effects. Based on other research papers, if a plant has an antibacterial effect most of the time it has an antimicrobial effect too. Antimicrobial activity was tested by using moringa against Streptococcus mutants and E Coli. Antioxidant activity was tested using nitrous oxide. Radical scavenging activity and the microbial activity are summarized in **Table 3**, **Table 4** and **Table 5**.

Table 3: Nitrous oxide radical scavenging activity

Sample concentration: 100mg/ml

Sample Name	Moringa Seed Extract			
Sample Concentration	0.5ml	1ml	1.5ml	2ml
Control OD	0.380	0.380	0.380	0.380
Test OD	0.302	0.292	0.284	0.261
Radical Scavenging Activity	20.52	23.15	25.26	31.31

Table 4: Antimicrobial property of moringa seed extract against Streptococcus mutants

Sample concentration : 100 mg/ml

Bacteria	Concentration(μ l)	50	100	150	200	250
<i>Streptococcus mutants</i>	Control OD	0.921	0.921	0.921	0.921	0.921
	Test OD	1.537	1.629	1.934	2.003	2.156
	OD of extract	0.853	1.044	1.469	1.638	1.844
	Final Test OD	0.684	0.585	0.465	0.365	0.312
	%of inhibition	25.73	36.48	49.51	60.36	66.12

Table 5: Antimicrobial property of moringa seed extract against E Coli mutants

Bacteria	Concentration(μ l)	50	100	150	200	250
<i>E.coli</i>	Control OD	0.785	0.785	0.785	0.785	0.785
	Test OD	1.425	1.541	1.864	1.881	2.014
	OD of extract	0.853	1.044	1.469	1.639	1.844
	Final Test OD	0.572	0.497	0.395	0.243	0.17
	%of inhibition	27.13	36.68	49.68	69.04	78.34

Conclusions

Pure water is the basic need of every human being. In the present situation purifying water is getting more and more costly. This project has shown that water can be purified in a cost-effective way. It was also understood that moringa can resist bacterial growth and hence in the future moringa can be used as an alternative to antibiotic medicines, which comes with a lot of side effects. Moringa has less or no side effects making it a better solution in the future. Moringa Oleifera seed has the potential to purify water efficiently. It increases the dissolved oxygen, conductivity, pH, temperature and reduces fluoride, chloride, TDS, and hardness. Moringa Oleifera has the capacity to prevent lifestyle diseases. Its seeds have the potential to resist the growth of bacteria i.e., antibiotic effect.

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Quantum Entanglement: Understanding and Harnessing

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Abstract

Quantum entanglement is a bizarre and anti-intuitive phenomenon of Physics that links two particles together in such a way that any change happening to one of them will make a correlated change in the other, even if the particles are far away from each other. Entanglement is one of the aspects of quantum mechanics, a broad and vital branch of physics. This article deals with understanding and harnessing the phenomenon of quantum entanglement, the method of production of entangled particles and their applications in various fields.

Keywords

Quantum entanglement; Superposition of states; Quantum computing

1. Introduction

Quantum entanglement is a phenomenon that comes up in modern science fiction movies. Marvel superhero fans must be very familiar with this idea because this is closely associated with teleportation and also the backbone of the concept of character destinies becoming intertwined. However, quantum entanglement is not just a science fiction buzzword but a natural and useful phenomenon [1]. This is one aspect of quantum mechanics that describes the mechanics of atomic and subatomic particles.

A deeper understanding of quantum entanglement is required to make it suitable for various applications. Two particles are said to be connected when they remain connected even after being separated by a vast distance. Their quantum states or state of being will be strongly correlated and unified. These particles are then not considered individual particles, but an inseparable whole. i.e., In a pair of entangled particles, one of the particles cannot be described without considering the other. Entangled particles are strongly connected even if they are physically far away from each other [2].

2. Quantum superposition of particle states

Quantum entanglement relies completely on the superposition of quantum states. Quantum superposition is a kind of particle state, where they can take multiple states at the same time. For example, consider the case of a coin: it will be in its head-up position and tail-up position simultaneously if it is in its quantum superposition state. Now assume that the coin is flipped in the air: when it is in the air, swirling, the coin is taking a quantum superposition state of being in both head-up and tail-up. But it takes a single state of either head or tail when it strikes the ground. i.e., Until measurement, particles are in a quantum superposition state, and once measured, the superposition state is disturbed. If this coin is correlated to an electron, it could be in a superposition state of spin up position and spin down position until measurement, and once measured, the superposition state collapses, giving rise to either spin up state or spin down state [3].

In quantum entangled particles, both particles are in a quantum superposition state until they are measured, and once the measurement is made both give a correlated result. i.e., If one of the particles shows spin up, the other particle shows spin down, and vice versa. As an example of entanglement, a subatomic particle decays into an entangled pair of other particles. The decay event has to obey various conservation laws and as a result, the measurement of the outcomes of one daughter particle must be highly correlated with the measurement outcomes of the second daughter particle so that the total momenta, angular momenta, energy, and other parameters remain constant before and after the decay.

For instance, a spin-zero particle could decay into a pair of spin $\frac{1}{2}$ particles, since the total spin before and after the decay must be zero according to the conservation of angular momentum. Whenever the first particle is measured to be in a spin-up state on some axis, the other when measured on the same axis is always found to be in the spin-down state. This implies that both particles will be in a quantum superposition state of being both spin-up and spin-down until measured, and this superposition state collapses once measured.

In principle, one could place two entangled particles on opposite ends of the galaxy and still have this instantaneous knowledge. This communication between the particles happens at a speed greater than that of light. This is contradictory to Einstein's theory of relativity as this phenomenon violates the limit of the speed of light. Hence Einstein along with his friends Boris Podolsky and Nathan Rose put forward EPR Paradox [4]. Einstein used this paradox as a piece of evidence that the quantum theory itself is incomplete. He brought up the idea of hidden variables i.e., particles are not connected across space instead the particles themselves are pre-determined about their position at the moment they are entangled. According to Einstein, particles might have been either spin-up or spin-down since the moment they get entangled, but this information is hidden from us until the measurement is done. He ruled out quantum superposition and instead called this arrangement between the particles a "hidden variable" since this is unknown to us. This hidden variable theory of Einstein argued against entanglement. It stated that quantum theories are not mentioning anything about the hidden variable in their theories and hence the theories of quantum mechanics are incomplete [5].

The discussions on quantum entanglement and EPR paradox paved the way for a number of experiments and later, John Stewart Bell proved that we could rule out hidden variable theory. He proposed this idea with his mathematical expression named Bell's inequality [6]. His experiment suggests two possible results: one considers the rules of quantum mechanics which is quantum superposition and their connections, and the Second, considers hidden variable theory. After a series of experiments called the Bell test experiments, Bell provided partial confirmation for entanglement but the hidden variable

theory could still explain the probabilistic nature of quantum measurement due to loopholes in Bell's experiments. It was for proving that quantum theory is correct through his groundbreaking experiments using entangled photons and showing entanglement can be supported by quantum theory, John Clauser was awarded Nobel Prize in Physics in 2022. Alain Aspect and Anton Zeilinger were also awarded the Nobel Prize in Physics in 2022 for closing the loopholes in Bell test experiments and demonstrating teleportation [7].

3. Production of entangled particles

Production of entangled particles is not seen at the macroscopic level. If it were, we would be able to experience quantum mechanics in our everyday life and entanglement will not be a surprising phenomenon. So, for now, we need to deal with it at the microscopic level where it is easier to look at the quantum effects. There are some ways to entangle particles: one is to cool down the particles to a very low temperature and place them close to each other so that their quantum states overlap. Another way is to entangle a pair of photons by splitting up a single photon. There is also a possibility to get entangled particles from nuclear decay since subatomic process like nuclear decay automatically produces entangled particles.

4. Application of entangled particles

Even though the real science behind quantum entanglement is yet to explore, we have started making use of entanglement for different technologies. Perhaps, the most widely used application of quantum entanglement is in quantum cryptography. **Figure 1** demonstrates the quantum cryptography model. In quantum cryptography, a sender and a receiver build a secure communication link that includes a pair of entangled particles. The black dots above the receiver and sender are represented as entangled particles in **Figure 1**. The sender and the receiver then generate private keys using the entangled particles, which are known solely to them. They use these keys to encode and decode data. If someone interrupts the signal and attempts to eavesdrop on information, the entanglement breaks. Since measuring an entangled particle changes its state, the receiver will not be able

to decode the data or in other words, the data is lost. Now, the sender and receiver have to do the process all over again to transfer the data [8].

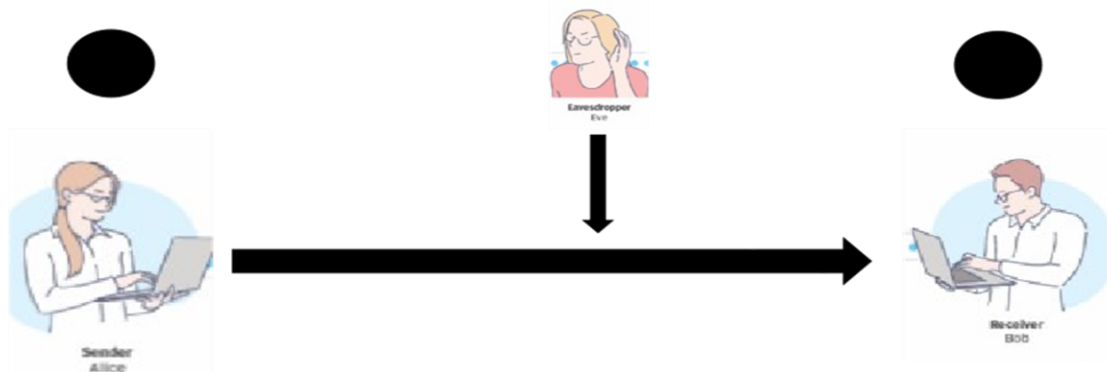


Figure 1: Quantum cryptography model.

Another application of entanglement is quantum computing in which a large number of particles are entangled, thereby allowing them to work together to solve some large complex problems [9]. Still, research is going on based on quantum computing. Ultra-precise clocks represent another application of quantum entanglement. Today, the most precise clocks in the world are atomic clocks that use the principles of quantum theory to measure time. The preciseness of atomic clocks depends partially on the number of atoms used. If we could occupy 100 times more atoms into an atomic clock, 100 times more will be the accuracy. However, there is a limit on the number of atoms that can be accommodated in it.

5. Scope and research developments

Recently, researchers have successfully used entanglement to enhance the precision of atomic clocks that could be used to accurately study dark matter and gravity. In 2014, a team of researchers at Japan's Hokkaido University developed the world's first can be

entanglement-enhanced microscope [10]. They use entangled photons to measure the pattern/image. Since the measurement of one entangled photon provides information regarding its partner, the amount of information gathered by the microscope can be enhanced greatly with the use of entangled photons.

Conclusions

Quantum entanglement is one of the bizarre phenomena seen once things are within the quantum realm. When two or more particles link up in a certain way, no matter how far apart they are in space, their states stay linked. That means they share a common, unified quantum state. So, observations of one of the particles can automatically provide information about the other entangled particles, regardless of the distance between them and any action done on any one of these particles will invariably impact the others in the entangled system. Understanding and harnessing entanglement is vital to create many cutting-edge technologies like quantum computers, which can solve issues quicker than standard computers and quantum communication devices that might permit us to communicate with one another without the slightest risk of eavesdropping.

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Space Technology- Ensuring a Sustainable Planet for Future Generation

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Abstract

Space Technology has become a vital pillar in today's world. Sustainable space technology means achieving sustainable development goals namely, food security, telecommunication, monitoring natural resources, and reducing the risk of natural calamity through the applications of space technology such as earth observation and geolocation. Recent developments include artificial intelligence and machine learning, crowdsourcing, and developments regarding satellite positioning technologies and aerial platforms. There has been much advancement in the field of reusable launchpads and satellite parts, like reusable cryogenic foam insulation, reusable hybrid propellant modules, etc. This article reviews the recent development of more usable space tools and technologies to sustain the earth in different aspects.

Keywords

Geolocation; Earth observation; Satellite positioning technologies; Reusable satellites parts

1. Introduction

From the beginning of the space age in the last century, we have developed technologies that allow us to explore outer space, live permanently on board the International Space Station, and even safely land humans on the Moon. The technological developments of humankind have been staggering yet, we are reaching the limits of many of Earth's planetary boundaries, depriving the options available to future generations and limiting their possibilities to live on our planet with the same resources available as we did.

It is therefore, time to change the way we live. One possibility is to create a link between new space exploration ventures and sustainable economic, social and environmental development.

2. Sustainability pillars

Sustainability assumes that resources are finite and should be used conservatively with a view to long-term priorities and future consequences. The foundation of this concept is made up of three pillars: economy, society, and environment [1]. In the applications of sustainable space technology, we can utilize the data as the two most critical emanating from space: earth observation and geolocation. Further details can be deduced from these two primary applications, including urban planning, and monitoring forestry and desertification impact. The key elements were categorized within those goals, in which space plays a crucial role by helping fight poverty, monitoring crop cultivation, desertification, and other elements that affect poorer areas around the world, as well as monitoring habitats and life on land [1].

3. Space technologies for sustainability

The potential opportunities of space-enabled technologies for delivering on sustainable development goals and proposing science, technology, and innovation policy options for harnessing space technology comprise the following sections:

3.1. Agriculture

Space-based technology is of great value to farmers, agronomists, national agricultural ministries and departments, and international organizations, who wish to enhance food production and its profit. Rainfall assessments from satellites help farmers plan the timing and amount of irrigation needed for crops. Remote-sensing satellites provide key data for monitoring the soil, drought, crop development, etc. It can also be critical in anticipating and mitigating the effects of food shortages and famines [2].

3.2. Information technology

Space-based connectivity helps to make smart societies a reality (including intelligent transport systems, electronic government, e-health, smart energy, and smart agriculture), in both developed and developing countries. These technologies are also facilitating advances in sustainability, banking, and diverse government services. Access to terrestrial networks is limited or non-existent in many parts of the world, particularly in sparsely populated rural or remote areas. Satellite technologies are well-placed for the delivery of broadband services in those areas, either on their own or in combination with other technologies. Expanding access to rural areas is challenging, as population is less dense, further from main networks, and has less purchasing power [3].

3.3. Health and its applications

In the public and global health domains, space technology and its applications (including Earth observation and remote sensing; telecommunications, positioning and tracking; and space-based research) play a crucial role in supporting decision-making, improved care, education, and early warning measures [3]. In the context of the COVID-19 pandemic, using geographic information system data, various institutions have been able to publish information on confirmed infections and deaths, which has been useful in epidemiological studies of the virus.

3.4. Disaster management

Space-enabled technology applications have become an important element of local, national, and regional disaster risk reduction strategies. Volcano hazards, for example, can be observed through land deformation due to tectonic forces. Drought hazards can be monitored by observing soil moisture, precipitation, and vegetation indices. Earth observation can also be used to map urban and rural areas that have been impacted by natural, technological, and biological disasters, as well as to assess damages and losses. Flooding and tsunami impacts can be directly measured based on the size of the flooded areas visible in satellite images [4].

3.5.Environmental management

Earth observation is highly relevant for both monitoring and achieving sustainable development goals. It provides information to support agriculture, fisheries, freshwater, and forestry management. It can also help to monitor activities that are harmful to the environment, such as illegal logging, mining, poaching, etc. Earth observation data from satellites are also used to overcome various challenges such as water management, air pollution, and forest preservation. One example is the observation of precipitation, which is useful for addressing water-related disasters such as floods, typhoons, and landslides [1].

4. Recent technological development in space exploration

New technological developments are driving down the costs to use, adopt and adapt space science and technology.

4.1.Artificial intelligence and cloud computing

Artificial intelligence and machine learning can enable users to analyze vast amounts of Earth observation data in a faster and more efficient manner. With appropriate in situ observations, and convolutional neural networks, a deep learning method may be used to automate image recognition and classification tasks on remote sensing imagery. As a result, Earth observation data could be analyzed in real-time, minimizing the time and effort needed by human analysts [5]. The cloud computing model is becoming the prevailing mode of work for most medium-scale and large-scale global data sets, including Earth observation applications. This is due to the ability of cloud services to archive large satellite-generated datasets and provide computing facilities to process them. One of the main disadvantages of using cloud services is their lack of interoperability [6].

4.2.Emerging satellite and aerial platforms

Firstly, data from continuous recording reference stations for global positioning systems can be used to extract information on atmospheric and tropospheric water content

that can be fed into operational weather forecasts to improve the forecasts in many areas. Secondly, experiments are underway in the United States to use data from continuously recording stations for global positioning systems, to monitor the passage of tsunamis across ocean basins, due to the impact on the ionosphere. If a tsunami is detected, its source, likely passage across ocean basins, and potential impact can be predicted 24 hours in advance. Furthermore, satellite Earth observation platforms are developing capabilities to monitor the global wireless spectrum, with applications for monitoring digital divides, wireless penetration drones can serve as an alternative relatively cheap source of Earth observation data compared with satellites and are increasingly being used in crop prediction and food security applications. However, their use tends to be regulated by law in many countries. Thus, despite the relatively higher cost of satellite data, it will likely continue to be used in place of lower-cost drones as a source of Earth observation data [7].

4.3.Crowdsourcing

Crowdsourcing is enabled through digital, mobile, and social networking tools that can support efforts to effectively harness space technologies for sustainable development. Crowdsourcing platforms like Ushahidi may help to contextualize information gathered from space technologies using data provided by civil society on the ground. Similarly, crowdsourced image labeling is used by several aid-related non-governmental organizations to manually identify patterns of areas affected by a natural disaster that can be automated with machine learning. Data Collaboratives for Local Impact, a partnership between the United States President's Emergency Plan for AIDS Relief and the Millennium Challenge Corporation, is working in Africa to build an enabling environment for data-driven decision-making to end the AIDS epidemic, improve health outcomes, reduce gender inequality and support economic opportunities for youth [8].

5. Barriers to space technology

Despite the decreasing costs of some space technologies and the increasing availability of open-source data, some bottlenecks hinder their application in certain fields and their use in some regions of the world.

5.1.Lack of financial resources

The lack of domestic and international financial resources is an obstacle to investing in space programmes in developing countries. In developing regions, it is particularly difficult to develop the private sector in the space industry or to attract private funding. In much of Asia and the Pacific, compared with Australia, Canada, the United States of America, and Europe, there are a few opportunities to commercialize geospatial research and development activities and technologies from space applications [9].

5.2.Technology and skill gaps

In many developing countries, lack of capability and expertise to produce satellite information with local resources and provide user support can be a barrier to expanding the use of satellite technologies. There is also an absence of a critical number of personnel with the capacity to generate downstream applications of space technologies. In developing countries, losing even a single expert within an organization can jeopardize efforts within government agencies. This absence of critical mass applies not only to institutions developing space applications but also to government agencies and private sector firms that could be potential users of the technology [9].

5.3.Geographical constraints

Some countries face geographical constraints in developing space launch facilities and conducting astronomical research. These constraints can be bridged through international partnerships and cooperation. For example, the Lao People's Democratic Republic, in 2015, launched the Laosat 1 satellite from China. Chile hosts around 50 percent of the world's installed capacity of astronomical observatories due to its unique atmospheric conditions. Many of these are operated by international partners such as Brazil, Canada, Japan, the United States, and the member states of the European Union [9].

Conclusions

Statistics from 2020 have revealed that around 1,300 satellites have been registered and such a figure is expected to continue increasing, with the likes of SpaceX planning the launch of as many as 42,000 Starlink satellites. Other mega satellite constellations are also planned, which are only set to pile up space debris. So, this is going to be a really serious problem for governments, and the private sectors. Some possible solutions to overcome this challenge include creating more sustainable space tools and technologies like reusable launchpads and reusable satellite parts. A few companies and start-ups have come up in the last few years that are specialized in figuring out methods of capturing space debris, trying to clean it from space, and avoiding it is becoming an accumulating problem.

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Physical Health in the Lives of Professionals and the Repercussions of a Fast-paced Lifestyle

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Abstract

As the world pushes for social sustainability as a part of overall sustainable development, personal physical well-being is a frequently overlooked component of a professional's life. In this article, some of the most common physical health issues caused as a consequence of hectic lifestyles, as well as scientifically proven methods to gradually incorporate a healthier lifestyle into a professional's everyday life without hindering their performance at work are discussed.

Keywords

Health; Fitness; Lifestyle diseases; Fitness myths

1. Introduction

One of the most important parts of a person's life is health. Ironically, that's also one of the components of many people's lives, particularly corporate workers', that's neglected the most. Highly intensive work, particularly in the information technology and computer science sectors, can demand more time and energy from an office worker than they can likely expend. Erratic eating habits and tumultuous sleep, sometimes accompanied by stress-induced alcohol consumption, worsen the situation. These are only a few of the many things that cause lifestyle diseases and the overall deterioration of one's health in the long run.

Achieving sustainability is a goal that can only be accomplished by the collective effort of all sectors of the socio-economic pyramid. Physical health is one of the metrics by which the Social Sustainability Index (SSI) is calculated by the Worldwide Governance Indicators (WGI). The health and well-being of office workers in the corporate sector, on top of propelling productivity, also seeps into other aspects of their lives and brings about a collective rise in the SSI.

This article discusses a few of the most common health issues spawned by fast paced lifestyles, their causes, and solutions that do not retard productivity in the workplace. The methods discussed are all part of a treatment called preventive healthcare. This kind of treatment revolves around detecting the signs of chronic illness before they have matured into something more grievous, finding the appropriate course of action to reverse or "prevent" them, and making alterations in the patient's lifestyle accordingly.

2. Some health problems, causes and viable solutions

2.1. Eating disorders

Eating disorders such as binge eating, anorexia, and purging among young adults are all found to be linked to workplace stress and/or a negative body image. Binging and purging is the act of consuming large quantities of food in a short period of time until the person is completely full and forcing themselves to vomit the food out by means of gagging, excessive exercise, or chemicals. Anorexia is a disorder that induces a fear of getting overweight in the patient, even if they're dangerously underweight, thus forcing them to resort to self-starvation or extreme restrictions on their eating habits. The pressure from co-workers to look fit at all times is one of the primary causes for the formation of a negative body image in the patient. The patient, due to a lack of free time to maintain a "good" physique, resorts to drastic measures. If left untreated, extreme cases can even lead to death as a worst-case scenario. Eating disorders are an example of a situation where a mental illness poses a threat to one's physical health.

Research has proven that there is a direct correlation between mental illness and eating disorders as well. Anxiety, stress, depression, etc. caused due to difficulties in the workplace or excessive work can play a key role in the formation of said illnesses. The American National Institute of Mental Health identifies patients with pre-existing anxiety and/or mood disorders as the most common victims of anorexia and bulimia (as represented in [Error! Reference source not found.](#)).

Table 1: Lifetime co-morbidity of eating disorders with other core disorders among U.S. adults (Source: Reference 2)

Lifetime Co-morbidity of Eating Disorders with Other Core Disorders Among U.S. Adults Data from National Comorbidity Survey Replication (NCS-R)			
	Anorexia Nervosa (%)	Bulimia Nervosa (%)	Binge-Eating Disorder (%)
Any Anxiety Disorder	47.9	80.6	65.1
Any Mood Disorder	42.1	70.7	46.4
Any Impulse Control Disorder	30.8	63.8	43.3
Any Substance Use Disorder	27.0	36.8	23.3
Any Disorder	56.2	94.5	78.9

Solutions:

- Since there is a direct correlation between mental health and eating disorders, seeking professional care like cognitive behavioral therapy can prove beneficial in some cases.
- Nutritional counselling - Putting oneself on a strict diet and nutrition plan can ensure that they receive necessary nourishment and also prevents binge eating. This can be achieved by setting aside a certain percentage (commonly 75-80%) of the daily caloric requirement for food in the plan and the rest for what the person wishes to eat.
- Inculcating a positive work environment, where body positivity is encouraged among employees.
- Eating food with a high satiety index to feel full and prevent binge eating.

- e) Taking the appropriate medication to counter/hinder the causes or aftereffects of the disorders (as prescribed by a doctor)

2.2. Poor nutrition

Although often mistaken as an eating disorder, a diet that fails to incorporate all vital nutrients is a different problem entirely. The fast-paced lifestyle of a professional almost inevitably entails erratic eating habits. Unlike eating disorders, bad eating habits may not always be caused by mental illness. Many people are not aware of their own bad eating habits unlike victims of eating disorders. Intensive therapy, restrictions, or medication is also probably not required. Studies conducted by Cookpad have shown that only 66% of working professionals in India cook their own meals and eat them. Unsurprisingly, the percentage of people that suffer from lifestyle diseases is also found to overlap with those that don't cook their own meals. A person's likelihood of eating home cooked meals has a direct correlation to factors like their age, sex, ethnicity and B.M.I. among others (**Table 2**).

Table 2: Percentage consumption of meals at home (Source: Reference 5)

		Percentage Consumption of Meals at Home					p Value
		<25	25-49	50-69	70-89	>90	
<i>n</i>		88	477	1047	1587	1537	
Age (years) (mean)		37.9	37.2	41.0	49.4	56.5	
Sex (%)	Male	65.3	55.0	56.2	43.6	44.8	(ref)
	Female	34.7	45.0	43.8	56.4	55.2	0.01
Ethnicity (%)	White	94.8	91.7	90.1	89.4	87.8	(ref)
	Non-white	5.2	8.3	9.9	10.6	12.2	0.57
Income (quintile) (%)	≤£12,300	6.6	6.2	9.3	16.8	23.6	(ref)
	>£12,300 ≤ £19,890	6.3	13.0	16.4	19.9	28.8	0.04
	>£19,890 ≤ £28,615	22.0	17.6	19.3	18.7	16.3	0.00
	>£28,615 ≤ £42,500	18.6	30.2	23.3	22.0	17.5	0.00
	>£42,500	46.5	33.0	31.6	22.6	13.8	0.00
BMI (%)	Underweight	0.6	2.2	1.3	0.6	2.3	0.85
	Normal weight	39.7	38.8	34.2	35.4	33.8	(ref)
	Overweight	25.4	35.8	39.3	35.3	36.7	0.44
	Obese	30.5	19.5	22.9	26.0	25.0	0.66
	Morbidly obese	3.8	3.7	2.3	2.7	2.2	0.04

Table 3: National Diet and Nutrition Survey (NDNS) Rolling Programme (RP) food groups defined as core and non-core (Source: Reference 5)

Core foods	Non-core foods
Pasta, rice and other miscellaneous cereals	Biscuits
Bread (all types)	Buns, cakes, pastries and fruit pies
Breakfast cereals (all types)	Puddings
Milk (all types)	Ice cream
Cheese	Butter, spreads and oil
Yogurt and fromage frais	Dairy desserts
Eggs and egg dishes	
Beef, veal and dishes	Meat pies and pastries
Lamb and dishes	
Pork and dishes	Bacon and ham
Chicken and turkey dishes	Coated chicken and turkey
Liver products and dishes	
	Burgers and kebabs
	Sausages
	Other meat and meat products
White fish, shellfish and fish dishes	Coated or fried white fish
Oily fish	
Salad and other raw vegetables	
Vegetables (not raw) including beans and meat alternatives	
Other potatoes and potato salads	Chips, fried and roast potatoes and potato products
Nuts and seeds	
Fruit	
Smoothies	
Fruit juice (capped at maximum intake contribution to 5-a-day)	Soft drinks not diet
Tea, coffee and water	Soft drinks diet
	Alcoholic beverages
	Sugar, preserves and sweet spreads
	Sugar confectionery
	Chocolate confectionery

Various food items are classified into core or non-core, depending on whether they are “acceptable” in a healthy diet. Core food are those that are present in the principal food groups and considered important or acceptable in an ideal diet. All other food are classified as non-core food. Food were pre-classified into the two categories based on a study by Johnson L., van Jaarsveld C.H. and Wardle J. as shown in **Table 3**.

Unregulated consumption of food articles from the non-core section is a contributing factor to the development of diabetes, heart diseases, kidney diseases, strokes, etc. This has also been linked to less productivity in the workplace and turmoil in the personal lives of individuals. The lack of core food in a person’s diet can also bring about deficiency diseases that reduce the quality of life and shorten one’s lifespan.

Solutions:

- a) Cooking food at home.
- b) Only allocating a small percentage of the daily caloric requirement for non-core foods.
- c) Taking nutrition supplements (as prescribed by a medical professional).
- d) Replacing food and food ingredients with healthier alternatives, for example, Pepsi Black, low-fat cheese, baked snacks, etc.
- e) Incorporating raw, unprocessed foods into diet.

2.3. Sleep deprivation

Sleep is a biological process that is necessary for life. Consequently, it is also one of the most researched. Deep, unfragmented sleep is vital for optimal physical and mental health. The lack of sleep or poor quality of sleep is directly related to sub-optimal physical health in all aspects, as shown by countless studies performed by all sectors of the health and fitness industry.

The parameters used to assess one’s sleep pattern are duration, quality, timing, regularity, and the absence of sleep disorders or disturbances. For an adult, the ideal sleep

duration is 9 hours, with anything over 7 hours being passable. Sleep is divided into 5 phases: 4 non-retinal eye movement phases (NREM) and 1 retinal eye movement phase (REM). The third and fourth phases of NREM make up the first third of the sleep duration and are the most important and restorative parts. Hence, it is imperative that an individual be in a comfortable setting, particularly in the early stages of sleep, in order to facilitate the proper transition from one phase to another. The timing of sleep must be in tandem with one's circadian rhythm. The circadian rhythm synchronizes sleep with the external day and night cycle by receiving signals from the superchiasmatic nucleus (SCN), which receives input from the retinal nerves acting as brightness detectors. Irregular sleep patterns or repeated sleep

Table 4: Sleep deprivation and risk factors (Source: Reference 6)

Category	Risk factors
Lifestyle	<ul style="list-style-type: none"> • Consuming excessive amounts of caffeine • Drinking alcohol • Drug abuse • Shift work • Attending university • Jet lag
Environmental	<ul style="list-style-type: none"> • Excessive noise, such as industrial wind • Excessive light
Psychosocial	<ul style="list-style-type: none"> • Anxiety, worry, and rumination • Parents of young children • Caregivers to a family member with a chronic, life-threatening, or terminal illness
Sleep disorder	<ul style="list-style-type: none"> • Insomnia • Obstructive sleep apnea • Restless leg syndrome • Narcolepsy • Circadian rhythm disorders
Medical	<ul style="list-style-type: none"> • Pain • Restrictive lung disease • Chronic kidney disease • Diabetes • Neurodegenerative diseases • Psychiatric disorders • Use of certain medications

deprivation result in "sleep debt," a condition in which the effects of sleep deprivation compound over time. Fragmented sleep, caused by external disturbances, can disrupt the sleep cycle before its completion and reduce the quality of sleep.

A plethora of lifestyle, environmental, psychosocial, and medical causes, as well as sleep disorders, can precede poor sleeping habits (**Table 4**).

Solutions:

- a) Exercise during the day- Strenuous workouts 2-3 hours before sleep have been shown to exhibit the opposite of the required effect.
- b) Limiting alcohol consumption at night.
- c) Maintaining a regular "bed time".
- d) Individuals' sleep has been shown to improve when the temperature in their bedroom is kept cool.
- e) Removing objects that emit an excessive amount of light or noise.
- f) Avoiding large meals right before bedtime.
- g) Avoiding caffeine in the evening.
- h) Avoiding naps in the evening.
- i) Taking melatonin supplements or light sedatives (as prescribed by a medical professional).
- j) Seeking medical help in the case of sleep disorders or medical conditions that affect sleep.

2.5. Substance Abuse

Abuse of alcohol, tobacco, and recreational and performance-enhancing drugs is a massive bane in today's society, and millions of corporate workers also fall victim to such activities. Intake of such substances is usually induced by stress, alienation, or a lack of

motivation in the workplace. The easy availability of said substances is also a reason. According to the National Clearinghouse for Alcohol and Drug Information, companies in the United States lose up to \$100 billion annually due to substance abuse by employees. According to a survey conducted by a team of researchers among 900 office workers, over two-thirds of them admitted to bringing and using substances prohibited by the company in areas of the building, break rooms, and sometimes at their own workstations. This indicates a clear lack of supervision or appropriate action by corporations regarding such delinquencies.

Solutions:

- a) Depending on the nature and severity of the situation, enrolling in the appropriate rehabilitation institutions such as Alcoholics Anonymous or behavioral therapy can prove to be therapeutic.
- b) Discouraging substance abuse in the workplace.
- c) Prioritizing mental health because it is the source of the problem.
- d) Taking measures to prevent relapse after becoming sober.
- e) Finding alternative ways to deal with anxiety and stress.
- f) Remove anything that might bring about an urge to use drugs, alcohol, or tobacco.
- g) Medication as prescribed by a medical professional.
- h) Workplace drug testing and taking the appropriate action for employees, who do not abide by the company rules.

Conclusions

By strategically incorporating the aforementioned methods into one's life, they can gradually improve their quality of life without inhibiting productivity in the workplace. On the contrary, the methods have been proven to improve productivity. Physical health of office workers, being one of the parameters by which sustainability is measured, must be given more

priority by corporates as well as the workers themselves. By giving more attention to one's diet, sleep and health, a collective rise in social sustainability indices can be brought about.

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