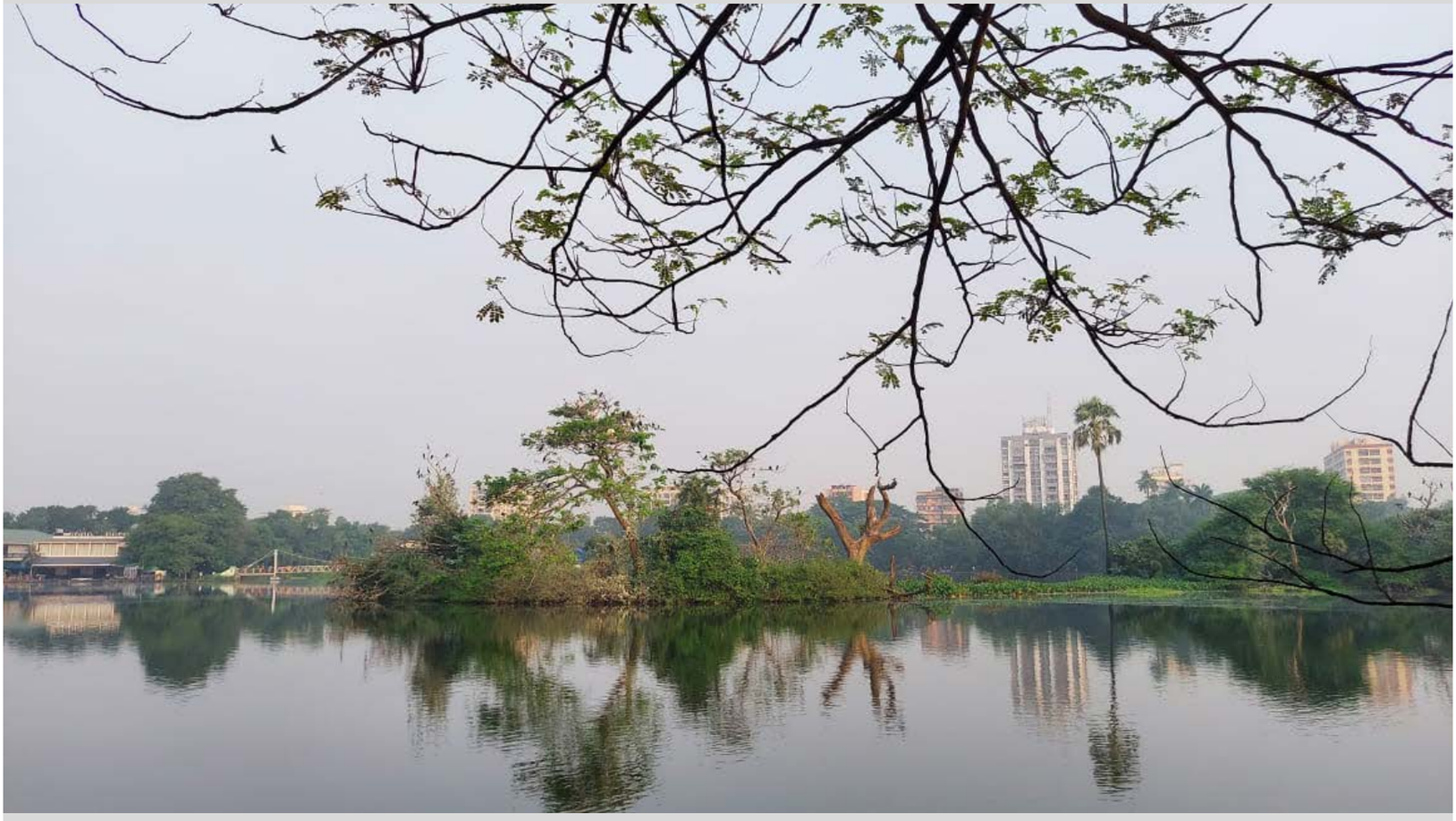
Sustainable Development: A Way Forward



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Editorial

Sustainability is the crux that balances the environmental, sociological, and economical concerns for improving the standard of living. Broadly speaking, sustainable development can be defined as an advancement that meets the current needs without endangering future generations ability to meet their own requirement. This book delves into the developmental advancements that meet the current requirement without compromising the ability of future generations.

Soil forms the outermost layer on Earth and comprises of a diverse range of organic and inorganic components in different stages of development and organization. It also serves as an excellent habitat for a wide variety of microorganisms which differ greatly in their physical and physiological requirements. Study of the nature of microorganisms living in soil, their functions, and their role in influencing soil properties are covered in soil microbiology.

Medicinal plants have an important role in preventing and curing human ailments due to the presence of a plethora of bioactive secondary metabolites. These therapeutic plants play a vital role in improving the healthcare system of a large number of countries including India, China, Indonesia, Myanmar and others. The medicinally important plants are being depleted at an alarming rate due to overexploitation and uncontrolled harvesting. It is indispensable to conserve the medicinal plants, which are traditionally used in herbal medicines as well as the pioneer of many new drugs and allied products, for the treatment of the ailing people.

Pteridophytes are very fascinating group of non-flowering plants. Pteridophytes like ferns and their allies have been known to mankind for about 2000 years. They grow exuberantly in humid and temperate tropical forests in different ecological and geographical regions of the world. Although limited number of reports is available regarding the pharmacological activities of this group of plants compared to medicinally important angiosperms, recent research suggests large number of pteridophytes to be suitable for use in alternative medicine complying with its familiarity in traditional therapies.

Cross pollination is said to be the foundation of pollination ecology. Explosive pollination is one of the most interesting events observed among different types of pollination noted in plants. This type of pollination is noted in different plants belonging to families Lamiaceae, Papilionaceae, Loranthaceae, Rhizophoraceae and Onagraceae. *Hyptis* is a large genus belonging to the family Lamiaceae under the order Lamiales, with about 300 species and occurs as an herb or shrub growing in the warmer tropical regions. Many species of *Hyptis*, belonging to the family Lamiaceae, exhibits the floral morphology of having stamens concealed in an articulate corolla lip in a compressed state of tension. The violent movement of anthers or stamens and style alone or together with restraining petals is the key to the success of explosive or parallel mechanism of pollination in flowering plants. Explosive mechanism is variously designed by different plant species and triggered by different species of insects, birds, and wind.

One of the critical problems in modern decade is the problem of energy source. Reserves of the conventional energy sources including fuel is decreasing alarmingly. The most common methods for synthesis of biofuels, their applications in different aspects and the future scope of biofuels are discussed comprehensively. The fossil fuels are non-renewable that causes environmental hazards and are mainly responsible for the increasing greenhouse effect. On the other hand biofuels are renewable, extracted from plants and animal wastes, clean fuel that are environmentally sustainable.

Graphene oxide (GO) an important descendant of graphene, is a popular topic for a wide range of researchers globally. Several innovative properties of GO have been invented today which includes higher tensile strength and hardness. Moreover, GO can also become electrical and thermal conductor after reduction.

The covalent organic frameworks (COFs) are an emerging class of crystalline porous organic material which provided the regular arrangements of organic monomers into wholesale structures with periodic skeletons. These are with highly tenable pore environments which are well-organized and are crucial characteristic for catalysis.

Use of pesticides has gradually become one of the most imminent parts of modern-day agriculture. However, higher dosage of these chemicals has also inevitably led to many environmental and health hazards. Against this backdrop, modern nanotechnology has led to development of nano pesticides, where the chemicals contain the carrier molecule, so called active ingredients in nano size. Nano pesticides address an appealing mechanical headway from the point of view of expanded viability and assurance of the climate and human wellbeing.

Olive Ridley sea turtle (*Lepidochelys olivacea*) was reported in India since1974 at gahirmatha rookery for arribadas (mass nesting), which is close to the Brahmani-Baitarani (Dhamra) River. A greater number of dwellers were laid in the middle of Markundi and Bahuda River mouth than Gopalpur to Markundi. Several efforts are underway across the world to save the inhabitants of the olive Ridley Sea Turtle.

India is rich in its biodiversity among one of the 17 mega-diverse countries. However, due to lack of awareness regarding profits of its preservation, biodiversity is in steady decline. Economic activities like fisheries, agricultural, forestry, health, nutrition, energy, water supply, trade, industry, transport, and tourism depend on biodiversity and comprise the main concern of the country.

A wetland is a particular biological system that is flooded by water, either forever or occasionally. It is recognized by its interesting hydric soil and presence of trademark vegetation around it. Wetlands are regions where water coverts to the soil. Wetlands offer numerous types of assistance, including water system, home grown water supply, freshwater fisheries and water for amusement.

The global climate change is the change in long-term weather that mark the world's regions. Human activity, especially the combustion of fossil fuels that pump carbon dioxide (CO_2), methane, and other greenhouse gases into the atmosphere, is responsible for the progressive warming of the Earth's surface, oceans, and atmosphere. As a result of global warming noticeable impact is observed on Earth.

In a broader scientific sense, sustainability is synonymous with continuity, or the ability to continue on a path without stopping. As a result, sustainability is compatible with the existence of the universe, and it is defined as the ability to preserve a predictable and steady outcome.

The Editors would like to thank all the Authors for their contribution in such varied topics that will help to create awareness in various aspect of life. They are also thankful to the Principal, Surendranath College, Kolkata, India, and the Management of Lincoln University College, Malaysia along with Lincoln Research Publishing Limited, Australia for giving us the necessary permission to publish this book. We are also thankful to Department of Biotechnology, Government of India for providing the financial assistance. This book provides a valuable window on information assurance and covers the necessary areas that humanity is facing in the present situation. As is evident from the articles, the information present is both forthright and motivating. Therefore, this book would be useful to those working on successful implementation of sustainable development practices and will also help countries to protect the ecosystem and preserve natural resources for future generations.

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FOREWORD

It is my great pleasure to introduce this book titled as "Sustainable Development: A Way Forward," a collection of review articles written by the undergraduate students of the four DBT STAR departments of Surendranath College, Kolkata, covering a wide range of contemporary themes on current advances in various areas of sustainable development, under able mentorship of their faculty members as mentors.

The volume consists of fourteen chapters and pursues specific objectives while complementing the existing literature on different areas of sustainable development. It explores the scope of future developement in various related emerging fields and analyses the challenges in doing so. I extend special thanks and underline my deepest appreciation to the publisher for publishing this issue, Department of Biotechnology, Government of India for providing the financial assistance and all the editors of this book for their real hard work and sincere effort in bringing out this wonderful volume.

While I hope this collection will have particular appeal to all the new young readers in this field, I am confident that the volume will raise interest among our regular readership of scholars and practitioners elsewhere as well, thanks to the relevance and diversity of contributions compiled here in this volume.

Happy reading to all!

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Economic Importance of Soil Microorganisms

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ABSTRACT

Soil forms the outermost layer of the earth comprising of a diverse range of organic and inorganic components which are in different stages of development and organization. It serves as an excellent habitat for a wide variety of microorganisms which differ greatly in their physical and physiological requirements. They do so by establishing microenvironments tailored to their own specific preferences. Although soil bacteria have been studied for more than a century, most of the diversity of soil bacteria remains undescribed. And along with that the ecological and beneficial role of these most abundant and diverse group of organisms on Earth is still unexplored to a large extent. This review highlights some of the major beneficial microorganisms isolated from soil and their economic applications.

Keywords: Microbial Diversity; Bioremediation; Biofertilizers; Biopesticides

INTRODUCTION

Study of the nature of microorganisms living in soil, their functions and their role in influencing soil properties are all included in soil microbiology. The first microorganism to appear on earth about four billion years ago was an ancient bacterium which originated in an ocean and was capable of fixing atmospheric nitrogen. These microorganisms along with other types released oxygen into the atmosphere which brought about the evolution of other more advanced organisms. All categories of soil microorganisms (bacteria, actinomycetes, fungi, algae, protozoa) have their specific characteristics and functions. Each of them affects and influence soil in a typical way altering soil properties like structure and fertility. For example, the rhizosphere of a single plant may comprise thousands of different species of bacteria and one gram of soil may also have up to 10 billion bacterial cells. Although, the composition of bacterial communities may change according to the microenvironments established in different locations.

The exact identification of bacterial communities inhabiting a specific soil site is a very difficult task as soils are complex and dynamic biological systems. Present methods of identification and detection of microbial communities by estimation of the rates of certain important metabolic processes or enzymatic assays of those enzymes involved in important biochemical reactions do not provide sufficient information for correct determination of the bacterial species. Proper identification and characterization of soil microbial communities requires analysis of extracted DNA and RNA from soil. And these studies have to be carried out along with other sophisticated methodologies which would be able to detect most (if not all) of the microbial colonies residing in that particular soil habitat, so that the correct relationship between genetic diversity and community structure of microorganisms can be established.

Knowledge about the composition of microbial community structure of soil is important for quantification of nutrient dynamics in soil. Determination of the system of nutrient pools and estimating the fluxes linking them is the most efficient method to understand nutrient cycling carried out by the soil microorganisms. Carbon, Nitrogen, Phosphorus and Sulfur content of soils can be measured by fumigation as well as by sophisticated molecular techniques.

LITERATURE REVIEW

Economic importance of bacteria isolated from soil

1. Bioremediation of hydrocarbons, dyes, heavy metals:

a. *Hydrocarbons* – Bioremediation studies were carried out in laboratories and field experiments were

performed with soils contaminated by different types of oils (fuel and motor) (Brubaker & Exner, 1988, Hoeppel, Hinchee & Arthur, 1991). Selected strains of bacteria were applied in these experiments for bioventing (Brown,1987). Oil content and microbial cell concentration in the soil was measured and it was seen that amount of oil decreased and microbial cell activity increased considerably in the treated soil (Gruiz & Kriston, 1995) Presence of high amount of CO_2 in the evacuated gas shows the elevated level of oil degradation initially and the rate declines gradually. Significant changes in oil composition were detected by chromatographic oil analysis. Some studies have also focused on bacteria isolated from soils contaminated with oil and they have shown to be highly capable of degrading low-density polyethylene (Kavitha, Mohanan, & Bhuvaneswari, 2014).

b.*Dyes* – It has been reported that some bacteria like Bacillus sp. can aerobically decolorize azo dyes, for example, Acid red 2 and Acid orange 7. These strains have been found in soils contaminated with textile dyes. Bacillus sp. decolorized 90% of Acid red 2 (100mg/L) at pH 6 at 370°C within 72 hours and 99% Acid range 7 (100mg/L and pH 6-8) at 300°C within 48 hours under shaking condition (Jaiswal, Gomashe & Agrawal, 2014). These strains of Bacillus sp. can be of significant importance in removal of dyes from wastewater.

c.*Heavy metals* – Microorganisms such as Flavobacterium, Pseudomonas, Bacillus, Arthrobacter, Corynebacterium, Methosinus,Rhodococcus, Mycobacterium, Stereum hirsutum,Nocardia, Methanogens, Aspergilus niger, Pleurotusostreatus, Rhizopus arrhizus, Azotobacter, Alcaligenes, Phormidium valderium, Ganoderma applantus carry out heavy metal bioremediation (Verma & Kuila,. 2019). Microorganisms and plants possess inherent biological mechanisms that enable them to survive under heavy metal stress and remove the metals from the environment. These microbes use various processes such as precipitaton, biosorption, enzymatic transformation of metals, complexation and phytoremedation techniques of which phytoextraction and phytostabilization have been very effective. The microbial strains can be easily genetically modified and thus help in remediation of several types of polycyclichydrocarbons (PAHs). Microorganisms which help in remediation of heavy metals can do so by different mechanisms and serve as an important tool for reduction as well as retrieval of heavy metals (Gruiz & Kriston, 1995). For example, lead resistant bacteria are used to biomineralize this metal and are used for Lead bioremediation effectively (Kang *et al.*, 2015). Also, some bacteria may accumulate and transform certain heavy metals making them suitable candidates for commercial utilization as agents for bioremediation of soil and effluents produced by various industrial processes (Banerjee *et al.*, 2011)

2.*Biofertilizer* – PGPRs or plant growth promoting rhizobacteria (endophytic bacteria also) may promote plant growth (Alam *et al.*, 2001) by several mechanisms like biological nitrogen fixation (Albrecht *et al.*, 1981), synthesis of phytohormones (Akiyoshi, Regier & Gordon, 1987), inhibition of plant ethylene synthesis (Abeles, Morgan & Saltveit Jr, 1992), degradation of organic-P compounds, phenazine-related mineral solubilization, and synthesis of lumichrome. These growth promoting activities of microorganisms have been studied immensely in the last few years and there are reports citing a significant enhancement in crop yield which are of great interest to the agricultural microbiologists. The increased growth in plants is actually a reflection of the sum total of the effects of different ecological associations of the plant bacteria interactions (Fuentes-Ramirez & Caballero-Mellado, 2005). While selecting PGPR species as biofertilizers, utmost care is needed for the screening process. Selection of strains and the pathogenecity of the selected strains should be considered as well as the number of bacterial cells needed for inoculation, the typical characteristics of the cultures of those species also needs to be studied (Alami *et al.*, 2000). The biofertilizers produced should be perfectly safe for usage.

3.*Biopesticide* – These are pesticides of microbial (biological) origin, these may be some biochemicals derived from microbes or genetic material of these organisms may be incorporated in the crop plants which then become protected from some specific pests. One of the most commonly used microbial pesticide is Bacillus thuringiensis, it's very effective against insects and safe to use (Roh *et al.*, 2007). Other bacteria and fungi with similar potentialities have also been effectively used against numerous pests. These microorganisms may grow competitively with the pests thus eliminating them, or they may employ other strategies also to remove the pests from the vicinity of crop plants (Sudakin, 2003).

More studies and research are being carried out to specifically assess the risks which may be concerned with human exposure to these genetically modified foods and microorganisms and also their associated gene products.

DISCUSSION

This review highlighted the importance of study of soil microbiology. Several thousands of microorganisms may be found in only a single gram of soil and they establish microhabitats and niches within soil according to their own preferences (Roh *et al.*, 2007). They are also crucial for nutrient cycling and are immensely important for maintaining ecological balance and stability in the environment. Several studies have stressed on the importance of exploring the microbial diversity of the different soils around the world (Cavicchioli *et al.,* 2019). But the estimation of microbial diversity of soil is extremely difficult and the results obtained from several studies show considerable variation, as the composition of soil microbial communities depend mostly on the chemical composition of soil of a particular area (Gattinger, Palojärvi & Schloter, 2008). Thus, it can be safely concluded that more studies need to be done in this field of microbiological research. Nevertheless, numerous studies have shown the presence of a diverse array of microorganisms in soil which may be of considerable economic importance.

CONCLUSION

This study has highlighted some economical usages of bacteria which have already been reported from soil. But a huge number of soil microorganisms, still remain unexplored in the various types of soils found throughout the world, and more importantly their economic and ecological potentialities need to be discovered and reported.

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Endangered Medicinal Plants of India: A Short Review

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ABSTRACT

Medicinal plants show an important role in preventing and curing human ailments due to the presence of some important active constituents. Medicinal plants play a vital role in improving the healthcare system of our country as well as in foreign countries. The traditional medicinal plant management is an issue of great importance now a days. Medicinal plants are potential renewable natural resources. Since the beginning of human civilization medicinal plants have been enormously used for curing human diseases. The biodiversity of India is enriched with various types of medicinal plants which are used as source of medicine. However, this biodiversity is seriously endangered by human activities such as destructive harvesting, loss of habitat, degradation in its quality and overexploitation by pharmaceutical companies. Medicinal plants are on depletion at a very serious rate. It is indispensable to conserve the medicinal plants which are the pioneer of many new drugs and allied products for the treatment of the ailing people. Thus, the traditional medicinal plant diversity should be used sustainably for the benefit of the mankind.

Key words: Endangered; Biodiversity; Traditional Medicinal Plant; India

INTRODUCTION

India is endowed with rich biodiversity and has innumerable medicinal plants. The traditional medicinal plants contain large number of secondary metabolites and essential oils which has an important therapeutic role. The crude drugs are isolated from the whole plant body and also from other parts like root, stem leaf, flowers, fruits, inflorescence and barks. Almost all tribes in India has some species of medicinal plants which are essential for their wellbeing. Medicinal plants synthesize some secondary metabolites like alkaloids, sterols, cyanogenics, tannins, resins and volatile oils, etc. which have both therapeutic and prophylactic use. Traditional medicine has been popularly utilized by the tribals and rural people. Plants and their valuable products are exploited by drug companies for the development of new herbal drugs. They play a drastic role in the development of primary health care in India, China, Argentina and other countries of the world. Our country India on this planet is blessed with various types of medicinal plants from Himalayas in the north to Kanyakumari in the south. But unfortunately, these important life forms have become endangered due to man's multifarious activities and different climatic changes. The forests account for 90% of India's total medicinal plants diversity and rest of the known medicinal plants are restricted to non-forest habitats. There is reliable data for the number of medicinal plants on Earth, and numbers for species used medicinally include: 35,000 - 70,000 or 53,000 worldwide; China includes 10,000 -11,250; India includes 7500; Mexico includes 2237 and North American Indians traditionally includes 2572. According to World Health Organization (2006), 80% of the population in developing countries depend on traditional medicines. (Mukherjee, 2009; Sharma & Thokchom, 2014 and Jose, Sivaraman & Singh, 2001)

LITERATURE REVIEW

Some medicinal plants of India and their status

In terms of biodiversity India occupies a good position in the world as it has 12 agroclimatic zones. India has rich number of flora and fauna including our life saving medicinal plants. The medicinal plants are used since times immemorial for human survival and this tradition is even found today in our country. Traditional medicine has been widely used and forms an integral part of primary health care not only in India but also in foreign countries. Plants and plant products are being extensively used by traditional medical practitioners and various pharmaceutical companies for the preparation of herbal medicine. But gradually these medicinal plants are disappearing due to the impact of climatic changes, global

warming, prolonged mining, industrial and urban developments. The progress of traditional medicine has resulted in an increased demand on medicinal plant products. Thus, the ethnomedicinal plants are under stress as their production has decreased due to various environmental factors, excessive collection and exploitation (Saha, 2008). These resources are depleting very fast and they have high chances of becoming extinct and endangered. Some of the important endangered medicinal plants noted in this review work are as follows-

1. *Aegle marmelos*

Aegle marmelos (L) Corr., (Family – Rutaceae) is a popular plant mostly found in tropical regions of India. All parts of the plant body are used to cure diarrhea, malaria, jaundice and skin diseases.

2. *Tribulus rajasthanensis*

It is another plant placed under the category of critically endangered. It is distributed in Rajasthan and Gujarat in India. The entire plant body is useful in curing fever, sterility and skin ailments.

3. *Commiphora wightii*

This plant is known as Guggulu in Hindi, Oleogum in English. It is restricted to dry regions of Western India. The plant is medicinally used to decrease cholesterol synthesis in the liver.

4. *Valeriana lesehenanultia*

It is endemic in Southern-Western Ghats. According to IUCN Red list only two localities have been recorded for the species. Valeriana is well conversant in India traditional system of medicine and useful in treating the diseases of eye, blood, liver and hysteria, etc.

5. *Saussurea costus*

This known as kuth in Hindi, is endemic in North India. The species is cultivated for roots which are used for preparing medicine.

6. *Gymnocladus assamieus*

This species is a medium-sized deciduous tree and also locally known as Mewangmanba-shi or Minkling. This species in endemic to North-East India where it is found in Arunachal Pradesh, Meghalaya, and Nagaland. The plants parts are used in ethno-medicine for its anthelminthic properties. The species is also listed for national recovery program in India.

7. *Saussurea lappa*

This a tall, robust perennial herb. The species is endemic to the northern Kashmir. Roots is used as tonic, stomach disorders, breathing problems and skin diseases.

8. *Acorus calamas*

This plant is popularly known as 'sweet flag' or 'Bach'. The rhizomes have anti-spasmodic, carminative and anthelmintic properties.

9. *Celastrus paniculatus*

It is another endangered plant also aknown as Malkangini, Jyotishmati and Bittersweet. This plant is used to cure nervous disorders, abdominal disorders and cancerous tumors.

10. *Peganum harmala*

It is a perennial herb found in NorthWest India It is important for digestive, diuretic, hypnotic, antipyretic, antispasmodic properties and also used in asthma, colic, hysteria, neuralgia, malaria etc. (Pattanaik, Reddy & Reddy, 2009).

Apart from the above-mentioned plants, in Himalayas *Berberis aristata, Podophyllum hexandrum* and *Gentiana kurroo* are endangered. *Withania coagulans, Leptadenia reticulata and Mitragyna parvifolia* are the endangered medicinal plants in Rajasthan. *Cycas beddomei,* the *Pterocarpus santalinus* tree and *Decalepis hamiltonii* are some endangered plants in Eastern Ghats. The status of some important endangered medicinal plants of India are mentioned in Table 1.

Table 1: ***List of Some Medicinal Plants in India and their Status***

SL. NO	PLANTS SPECIES	FAMILY NAME	STATUS
1	*Aegles marmelos*	Rutaceae	Endangered
2	*Tribulus rajasthanensis*	Zygophyllaceae	Critically Endangered
3	*Commiphora wightii*	Burseraceae	Endangered
4	*Valeriana leschenanultia*	Caprifoliaceae	Endangered
5	*Saussurea lappa*	Asteraceae	Endangered
6	*Acorus calamus*	Araceae	Endangered
7	*Celastrus paniculatus*	Celastraceae	Rare and endangered
8	*Peganum harmala*	Nitrariaceae	Endangered
9	*Saussurea costus*	Asteraceae	Threatened
10	*Gymnocladus assamicus*	Leguminoseae	Vulnerable
11	*Prosopis cineraria*	Fabaceae	Endangered
12	*Simmondsia chinensis*	Simmondsiaceae	Endangered
13	*Aconitum chasmanthum*	Ranunculaceae	Critically Endangered
14	*Chlorophytum borivilianum*	Asparagaceae	Major threatened
15	*Gentiana kurroo*	Gentianaceae	Threatened
16	*Lilium polyphyllum*	Liliaceae	Critically Endangered
17	*Swertia chirata*	Gentianceae	Endangered
18	*Tylophora indica*	Apocyanaceae	Endangered
19	*Ginkgo biloba*	Ginkgoaceae	Endangered
20	*Rauwolfia serpentina*	Apocyanaceae	Likely to be threatened
21	*Aconitum deinorrhizum*	Ranunculaceae	Almost extinct
22	*Aconitum heterophyllum*	Ranunculaceae	Greatly threatened
23	*Angelica glauca*	Apiaceae	Threatened
24	*Bacopa monneiri*	Scrophulariaceae	Greatlythreatened
25	*Mucuna pruriens*	Fabaceae	Endangered
26	*Persea glaucescens*	Lauraceae	Critically endangered
27	*Berberis aristata*	Berberidaceae	Vulnerable
28	*Gynocardia odorata*	Achariaceae	Endangered
29	*Desmodium motorium*	Fabaceae	Vulnerable
30	*Podophyllum hexandrum*	Berberidaceae	Critically endangered

Source:www.biologicaldiversity.org ; www.htttps://wbenvironment.nic.in/html/bio_div/nbpsap/M-TEXT%2007.doc ; www.jjbps.net ; https://www.researchgate.net/figure; HYPERLINK "http://www.plantsjournal.com/

DISCUSSION

India is endowed with a rich population of medicinal plants among various other natural resources. But these medicinal plants are endangered due to anthropogenic activities and various environmental changes which also affects its productivity. Medicinal plants may get exhausted when overused and if used with care then it is reliable. Majority of the collection of medicinal plants is from wild. The method of harvesting medicinal plants should be sustainable but there is depletion of these valuable resources in different parts of the country (Bose *et al.,* 2020). The responsibility of pharmaceutical companies for unorganized marketing of medicinal plants is vital. Many species are overharvested for food and shelter. Due to excessive commercial demand from rapidly increasing pharmaceutical industries for which there is no collection regulation exist affects the medicinal plants of various taxa. Nearly 150 plant species have been considered as endangered (World Health Organization, 2006).India is an important place for wild collected plant medicine industry in Asia but the number of key species of medicinal plants have decreased due to over exploitation and opportunistic marketing of medicinal plants. TRAFFIC and IUCN researchers examined the trade in several medicinal plant species and found India as an important destination (Roberson, 2008). In India, the status of medicinal plants is critical. Excess harvesting has brought about depletion and scarcity of medicinal plants. The herbal potential of our country has facilitated the rapid growth of phyto-pharmaceuticals and perfumery. As a result, the extraction of these commodities from the wild has increased tremendously. About 100 species of medicinal plants in the Western Ghats are threatened due to excessive harvesting on the basis of Rare Endangered Threatened analysis of that region. There is an urgent requirement to spread awareness among the masses about endangered species of medicinal plants so that it is not overexploited (Choudhury, Singh & Pillai, 2008). Many societies in this world have learnt the benefits of medicinal plants to cure several diseases. These readily available medicinal plants have led to a culturally important traditional health care system which can be easily afforded by the common man. It has become an alternative means of livelihood for tribal and rural people. Many rural people and tribal medicinal practitioners use herbal medicine to cure variety of diseases and disorders. They rampantly collect medicinal plants without knowing that some are endangered and rare. They are not acquainted about the valubility of such medicinal plants and there is need to make them aware about the conservation of these indispensable endangered plant species. Some important features noted in this review work are

- Cost of harvesting of ethnomedicinal plants is less than artificial drug synthesis. Eg. Reserpine.
- Due to heavy demand of the medicinal plants, some species has been threatened and at the level of extinction.
- There are no regular developmental programs in the forestry and agriculture sector to promote regeneration and revival of endangered species

Major causes of medicinal plants depletion

- Non-sustainable, destructive, high density harvesting by plant collectors.
- Declination in traditional knowledge of local communities regarding use of medicinal plants.
- Over harvesting of the material due to low income of collectors and low prices paid to them.
- Increased international demand for medicinal plants.
- Commercialization of medicinal plants and increased accessibility of traders to remote forest areas.
- Over deforestation

- Global climate change
- Pollution of soil, water and atmosphere
- Unsustainable population growth
- Greenhouse effect
- Increased natural resource consumption
- Unplanned development
- Prolonged mining
- Industrial and urban developments
- Habitat destruction and fragmentation for expanding agriculture.
- Overexploitation of natural resources
- Lack of awareness
- Biological invasion
- Overgrazing by domestic animals
- Export of some important species of medicinal plant
- Pressure to export to ameliorate debt
- Impact of introduced species of flora and fauna (accidental or deliberate)
- Economic systems and policies that fail to value the environment and its resources.
- Natural phenomenon (Landslides, Forest fire, Global warming, Drought)

(Chatterjee & Prakashi 1991; Saha 2008 and Subbaiyan *et al.,* 2014.)

Suggested Measures

- Awareness of new species varieties.
- Educate the drug collectors
- Substitution of plant or with other parts of plants.
- Program to promote herbal gardens in and around public places like schools, roadsides, worship places of all religion.
- Facilitate link between farmers and manufacturers.
- Conservation of Entire Biome
- Preservation Plots
- Sacred groves
- Seed Banks
- Medicinal Plant gardens
- Pollen storage
- Botanical gardens
- Tissue culture
- Genetic Resource Centers
- Genetic Engineering
- Micropropagation

- Reintroduction through Seeds & Seedlings
- Cryopreservation
- Increasing industries using medicinal plant's products to obtain raw material at market price and help them to raise much in advance to meet their needs.
- Habitat Restoration
- Domestication & Cultivation of Wild Plants
- Domestic Legislation & International conventions
- Creating a new cadre of forest managers and foresters committed to the conservation of medicinal plants.
- Involvement of rural/tribal people in these programs
- Mass awareness campaign to explain the effects of environmental changes on the productivity of crops especially medicinal plants to the common people.
- Conserve the existing forest.
- Reduce dependence on wild for collection of drugs.
- The development of tissue culture protocol
- Biodiversity areas must be identified and conserved (Gepts 2006; Paulsamy 2011).
- Micropropagation
- Reintroduction through Seeds & Seedlings
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- Reduce dependence on wild for collection of drugs.
- The development of tissue culture protocol
- Biodiversity areas must be identified and conserved (Gepts, 2006 & Paulsamy, 2011).

CONCLUSION

The traditional medicinal plants in India are mostly endangered. Over exploitation, habit destruction and various other climatic factors are the most destructive threats to medicinal plants. Only in-situ conservation cannot be successful in conservation of medicinal plants, ex-situ conservation is also be needed. In India, some of the medicinal plants have also become rare, vulnerable and also threatened. So, there is need for urgent protection and conservation of these important life forms. Not only in India

but also in other countries of the world, medicinal plants are used for curing various ailments. These medicinal plants are endangered due to anthropogenic activities like urbanization, overexploitation, prolonged mining, industrial and urban developments and various environmental changes. The booming of traditional medicine has resulted in an increased demand on medicinal plant products. The medicinal plant resources are depleting at a rate which is seriously alarming, and they will soon be extinct and endangered if proper action is not taken by the authorities. It is very important that medicinal plants should be conserved as exploitation of medicinal plants can affect the balance of our ecosystem. The knowledge in this field would enable introduction of timely cultivation and maintain the balance between utilization and overexploitation of these endangered plants. Compared to other crops, medicinal crop cultivation requires less attention and expenditure and can be successfully adopted by the cultivators. Many institutes and other various agencies play a crucial role in preserving rare and endangered medicinal species and also in the development of agroforestry by providing machinery for efficient production. They can play a key role in developing market linkages to farmers in order to extend the area and generate income source to them. The conservation and cultivation of rare and endangered medicinal crops can be treated as an alternative income source for the tribal and rural people without affecting their ongoing income source. By doing the cultivation of medicinal species, we will not only be able to conserve the precious wealth of medicinal plants but also, we will also achieve the goals of conserving the medicinal plants which are threatened and at the level of extinction.

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Emergent Pollutants (EPS): Water and Waste Water Pollutants: A Short Review

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ABSTRACT

Nowadays the term emergent pollutant is used for new environmental pollutants. Agriculture, industries and our population are using water as well as releasing many compounds in wastewaters. This particular substance that is released into the environment can cause harmful effects on human health and also direct effects on our society. Different diseases like human development, growth, reproductive and psychological problems can occur for this new contaminant. This contaminant can affect aquatic as well as terrestrial environments. Newly introduced pollutants can be detected and eradicated through proper advanced analytical tools. Proper studies, analysis, and strategies can help to remove drinking and wastewater pollutants.

Keywords: Emergent Pollutant; Water; Wastewater

INTRODUCTION

Wastewater characteristic has been changed to words the environment view. Some of this newly changed wastewater compound is of anthropogenic origin. This compound not only impacts aquatic or terrestrial ecosystems or life forms but also human health. This is the actual main issue of concern among the general public, scientists, engineers and health workers. This harmful compound is known as “emerging pollutants”. Richardson, 2009 introduced emerging micropollutants or non-regulated organic trace pollutants with the help of advanced analytical technologies. The term “emerging” denotes contaminants that newly originated and also an alternate route to humans or some newly created technique. According to DoD, 2011; US EPA, 2012 categorized emerging pollutants by different factors like actual risk of human health and environment. Emerging pollutants may be different in origins like industrial, municipal as domestic waste, agriculture, and hospital waste. It may be categorized into 3 broad categories like

a) Pharmaceuticals (PhACs)

b) Endocrine Disrupting Compounds (EDCs) and

c) Personal Care Products (PCPs)

In our society, main water pollutants are viruses, bacteria, fertilizers, plastics, inorganic compounds like phosphate, nitrate, many pharmaceutical products, etc. Nitrates, sulfur, mercury, lead, phosphates, different acids are common industrial pollutan

LITERATURE REVIEW AND DISCUSSION

Environmental/health issues and regulations related to emerging pollutants

Due to the lack of some inadequate relevant data related to emerging pollutants (Gogoi *et al.,* 2018), it is very challenged to measure emerging pollutants levels in our environment for any government. Still not as such no laws present to properly regulate restrict upper limits of concentrations of emerging pollutants in the form of wastewater in our environment. In the United States observing technique of Endocrine Disrupting Compounds (EDCs) was established (European Commission, 2011) but this was no such set upper limit of permission for use EDCs in wastewater, drinking water. In India, no such regulation is present now.

Main things of water and waste water pollutants

Fertilizers like nitrate and phosphate are dangerous to the environment (Deblonde, Cossu-Leguille & Hartemann, 2011) because they are used so extensively. They are not so toxic but can affect our environmental ecosystem broadly. They cause algal blooms and as a result cause water oxygen level decline. Many pathogenic microorganisms can grow with the help of these micropollutants. This pathogenic microorganism causes different diseases like cholera, typhoid fever, diarrhea, and many other diseases. Even Municipal wastewater treatment plants (WWTPs) doesn't purify modestly biodegradable nitrogenous, carbon substance, or microbes (Verlicchi, Al Aukidy & Zambello, 2012). The main cause for this use of human pharmaceuticals which enter the aquatic ecosystem through WWTPs and Personal Care Products (PCPs) through domestic waste.

Waste water management

In terms of the traditional wastewater treatment system, there are three parts 1. Primary treatment, 2. Secondary treatment and 3. The tertiary treatment is used by precipitation and filtration (Batt, Kim & Aga, 2007). Biological and physiochemical substances are used for wastewater treatment systems. This method is used in our Urban wastewater treatment plant (UWTP). But till now wastewater management techniques used is not ensured the complete removal of emerging contaminants (Celiz *et al.,* 2009). Wastewater can be clean and protected waters treatments by proper scientific wastewater management (Bwapwa & Jaiyeola, 2021). Wastewater management procedure:

1. Screening wastewater and Pumping
2. Fine material Removal
3. Primary sludge removal
4. Biological degradation
5. Wastewater separates from microorganism.
6. Filtration.
7. Disinfection.
8. Oxygen Uptake: Bring the dissolved oxygen up

Removal of Emerging Contaminants by Adsorption

Removal of emerging contaminants is now most challenging for us because it is now a high risk for the environment especially when industrialization occurs in the whole world (Berridge & Gorsky, 2012). This contaminant of drinking water and wastewater is at high risk for nature and the environment and affects human health (Sanghi & Singh, 2012). So, for environmental sustainability contaminants should be removed and for this adopt wastewater management for our environmental betterment.

Adsorption as Green Technology

The adsorption technique is one of the important processes for the removal of emerging contaminants from water (Simeonov & Sargsyan, 2008). It is a physical procedure and can use as an “integrated treatment”. Activated carbon is used as absorbents (Xu, Wu & He, 2013). But this is not actually fully remove the pollutants of water and is also cost-effective. Now, many scientists try to find low cost and more effective adsorbents for wastewater treatment.

CONCLUSION

Water especially drinking water and wastewater contaminated and this is threatened to our nature. Because this contaminant not only a huge impact on our ecosystems like development, reproductive organs, growth, and mental health. So, the first technology should be adopted for determining the

source of contaminants. Using industrial, agricultural, domestic wastewater should go through the proper wastewater management for purification. Aware people about harmful effects of emerging pollutants in our ecosystem or nature.

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Antifungal Properties of Pteridophytes – An Overview

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ABSTRACT

Pteridophytes are very fascinating group of non-flowering plants. They grow exuberantly in humid and temperate tropical forests in different ecological and geographical regions of the world. Due to its pharmacological activity, it is used as an alternative medicine and herbal medicine for treatment of human diseases. However, their medicinal values have not been explored much. Mostly their ethnobotanical uses have been reported in literature, but the precise characterization of bio-active phytoconstituents and how they chemically and pathologically react to other substances and their organic structure have largely been ignored. This study shows over the years how researchers have looked into pteridophytes from various perspectives through phytochemical analysis and found significant antifungal properties in pteridophytes. This signifies that pteridophytes have prospective pharmacological effects as regulators of fungal biology not limiting to ethnobotanical usage only. However, their optimal antifungal activity assay and strategies of implementation still need to be determined.

Keywords: Pteridophytes; Antifungal; Ethnobotany; Phytoconstituents

INTRODUCTION

Pteridophytes, the plants that make up ferns and their allies, have been known to mankind for about 2000 years, and are referenced in ancient texts. (Kirtikar & Basu, 1918; Nayar & Kaur, 1961). It has been noticed for long time that pteridophytes are immune to many microbial infections such as fungus and bacteria, which might perhaps be one of the key causes in their evolutionary success and the fact that they have persisted for over 350 million years. According to WHO, around 80% of the world's population still relies on traditional medicine to treat variety of diseases. In one of his books, the great founder of modern botany Theophrastus (ca. 372-287 B.C.) emphasised the medicinal use of ferns. In his significant documentary book De Materia Medica, Greek physician and pharmacologist Pedanius Dioscorides, (ca. 50 A.D.), also alluded to numerous ferns, notably *Pteridium aquilinum* (L.) Kuhn. and Dryopteris f*ilix-mas* (L.) Schott., as having medicinal potential. Charaka (ca. 100 A.D.) and Sushruta (ca. 100 A.D.) both suggested the medicinal use of ferns in their Samhitas in ancient Indian medicine history. Volume one to 11 of The Raw Materials series (1948-1977) of the Wealth of India also has some mention-worthy references to ferns for their antibacterial value.

Ferns and fern-associates are one of the Pteridophyta's oldest main divisions, with over 12,000 species scattered across 250 genera (Chang, Gupta & Tsay, 2011). The medicinal use of pteridophytes was encouraged by the ayurvedic medical systems. Ferns are furthermore recommended in the Unani medical treatment (Uddin, Mirza & Pasha, 1998). Around 300 different types of ferns were employed as traditional Chinese medicinal herbs. The ferns had antibacterial, antiviral, anti-inflammatory, antitussive, anticancer, and anti-Human Immunodeficiency Virus bioactivities in addition to their antioxidant activity (Chang, Gupta & Tsay, 2011). Several ferns are suggested by native Chinese doctors in the traditional Chinese medical system (Kimura & Noro, 1965). Several researchers have conducted ethnobotanical and advanced pharmacological studies on ferns and their companions in recent years (Dhiman, 1998; Vasudeva, 1999; Reddy *et al.,* 2001; Singh *et al.*, 2001; Gogoi & Das, 2002; Singh *et al.,* 2008a; Singh *et al.,* 2008b; Chen *et al.,* 2005a; Chen *et al.*, 2005b). Plant extracts have been shown to exhibit antifungal efficacy against pathogens of numerous cultivated plants and commercially important crops by several authors. The pteridophyte, especially ferns are considered to be one of the significant plant group having antifungal as well as antimicrobial activity (Ody, 1993). This unique phyto-biochemical nature of the fern has been explored for the agricultural and preliminary therapeutic purpose (Zakaria *et al.,* 2010). For considerable

reduction in use of chemical fungicides and maintenance of the food security the antimicrobial activity of fern has been addressed in several investigations in crop science (Sahayaraj *et al.,* 2009; Freitas *et al.,* 2017). Some information regarding the fungicidal effects of pteridophytes was presented (Manikam *et al.,* 1992; Parihar & Bohra 2002; Singh *et al.,* 2003).

Antibiotic use is frequently linked to side effects in the user, such as hypersensitivity, depletion of beneficial gut and mucosal microorganisms, immunological suppression, and allergic reactions. Furthermore, the indiscriminate use of antimicrobial medications has resulted in significant clinical issues in the treatment of infectious diseases (World Health Organization, 2001), as bacteria acquire resistance to commonly used antibiotics. The accumulation of several antibiotic resistance mechanisms within the same strain leads to the formation of multidrug-resistant (MDR) microorganisms (Ishaq *et al.*, 2014; World Health Organization, 2012). This necessitates the creation of alternative antimicrobial medications from medicinal herbs, which are a rich source of innovative antibacterial and antifungal chemotherapeutics, for the treatment of infectious disorders (World Health Organization, 2012).

The antibacterial potential of India's medicinal ferns has been thoroughly tested all over the world (Singh *et al.*, 2008a; Maridass, 2009; Parihar, Parihar & Bohra, 2006; Dalli, Saha & Chakraborty, 2007; Duraiswamy *et al*., 2010). Pteridophytes are primarily found in high-altitude mountainous areas such as the Himalayas, Western Ghats, and Eastern Ghats. The Western Ghats in South India are home to over 300 species of ferns and fern relatives (Manickam & Irudayaraj, 1992). Ferns have a wide range of economic uses, including food and fodder indicators, biofertilizers, insect repellents, medication, and traditional medicines (Ghosh, 2004). For several years, the medicinal efficacy of pteridophytes has been known. Ferns have extraordinary antimicrobial characteristics when compared to higher plants, which may be due to the presence of a significant number of defensive natural biochemical substances such as alkaloids, flavonoids, tannins, and phenolics (Rani, Khare & Dantu, 2010; Bir, 1987). Many illnesses can be treated with plant parts such as the rhizome, stem, fronds, pinnae, and spores. Based on these findings, screening phytochemicals from ferns is likely to be advantageous to society. Their therapeutic plant cultivation potential, on the other hand, has gotten little attention.

Many studies have been conducted on the economic value of higher plants, however pteridophytes have been overlooked (Mannan, Maridass & Victor, 2008; Kumar & Kanwar, 2020). Plant phenolics have long been known to have antifungal and antibacterial properties (Taiz & Zeiger, 1998; Grayer & Harborne, 1994). Many pteridophytes have characteristics that could be utilised to treat a variety of human ailments in alternative medicine. For the manufacture of anti-disease drugs, biotechnology methods can be used to maintain and even augment their bioactive components. Despite the fact that ferns have been used medicinally in various research, the bioactive components of several pteridophytes have yet to be found. In addition, their ideal dosage amount and treatment strategies must still be discovered (Baskaran *et al*., 2018).

Ethnobotanical antifungal uses of pteridophytes

Since the dawn of civilization, several groups of plants with medicinal properties have been documented for the treatment of a variety of illnesses, and people from all continents have used botanical remedies for millennia. Since ancient times, India has had a rich tribal population with a traditional knowledge system that deals with several vital features and health issues of them. These tribal people are partially or solely dependent on different forest products for different resources for their survival. During the course of resource collection from forest and surrounding they have assimilated some unique cum indigenous knowledge about the surrounding plant wealth which can be utilized in traditional therapeutics and modern-day systems of medicine for the treatment of various diseases. The tribal inhabitants used to receive treatment from local practitioners using their own herbal concoctions in an ethnic manner. Ferns play a significant role in folklore. These plant families have been utilised successfully in Ayurvedic, Unani, Homeopathic, and other medical systems, as well as throughout human history. Some of the botanists from southern part of India described the

ethnobotany and economic uses of some ferns and their allies of Satpura Hills (Vasudeva, 1994, 1999; Singh, Dixit & Sahu, 2003, 2005, 2007). Singh and Rajkumar (2017) reported the ethnobotanical antifungal use of *Selaginella tamarisciana and Salvinia natans***.** Minarchenko *et al.,* (2017) significantly reported the ethnobotanical antifungal activities of *Adiantum capillusveneris, Botrychium lunaria* on human from Ukraine. Antifungal, antibacterial and antiviral activities of *Equisetum ramosissimum* have been reported by Benjamin and Manickam (2007). *Ygodium venustum*, a medicinal plant used by indigenous tribes in Mesoamerica, is said to have antiseptic, fungicidal, and trichomonacidal properties and is used to treat dermatoses, mycoses, and infections (Duke, 2008).All medicinally important ferns should be maintained, and steps required to prevent extinction should be taken. Their medical benefits should also be discussed and disseminated worldwide for the benefit of humans.

Objectives

The goal of this review is to compile ethnobotanical and phytochemical characterisation of antifungal characteristics of pteridophytes in order to provide an updated evaluation of this topic, including latest results on antifungal bioactive phytochemicals and pteridophyte pharmacology.

LITERATURE REVIEW AND DISCUSSION

Fungi are amazing, all-around organisms that play a crucial part in complicated ecosystems. These eukaryotes range in size from massive organisms to microscopic moulds and yeasts. This group of organisms is considered to have potent pathogenicity against plants and animals. However, fungi are also responsible for causing detrimental human infections which can even be lethal. Due to ill hygine, the frequency of community-acquired and nosocomial fungal infections has risen dramatically in recent decades. Antibiotic resistance is on the rise, as are the number of disorders linked to immunodeficiency and/or immunosuppression, as well as the limited therapeutic choices available are triggering the search for novel alternatives (Fernández *et al.,* 2020). Pathogen-induced proteins or constitutively expressed proteins could be the source of antifungal phytochemicals from pteridophytes. Numerous studies demonstrate that antimicrobial peptides have straight antimicrobial activity in vivo, particularly the improved resistance to microbial infections provided to transgenic plants when compared to plants expressing thionins, defensin, or LTP (Breen *et al.*, 2015). Antifungal proteins, unlike phytoalexins, do not appear to be phytotoxic and reach high levels in tubers, seeds and other plant tissues, where they are thought to act as protectants.

The antifungal activity of water extracts and extracted phenols from gametophytes and different parts of sporophytes of the two ferns, *Adiantum capillus-veneris* L. and *Adiantum lunulatum Burm***.** f., used as folkloric medicines in India, China, Tibet, America, the Philippines, and Italy, was investigated further by Guha, Mukhopadhyay and Gupta, (2005). Both crude extracts and extracted phenols from gametophytes and various sections of sporophytes from both plant species were shown to be bioactive against fungal strains. *Adiantum capillus-veneris* was found a better antifungal agent than *Adiantum lunulatum***.**

Ethanol and aqueous extracts of *Dryopteris filix-mas* (L.) Schott obtained from sub-Himalayan West Bengal (India) were evaluated against the pathogens *Pestalotiopsis theae* (Saw.) Stey., Colletotrichum camelliae Mess., *Curvularia eragrostidis* (P. Hennings) Meyer, and *Botryodiplodia theobromae* Patouiilard to develop ecofriendly antifungal compounds for controlling most important foliar fungal diseases of tea. The antifungal capabilities were assessed using the spore germination method. Ethanol and aqueous extracts of *Dryopteris filix-mas* (L.) Schott were shown to inhibit 100% of spore germination. The antifungal component of these plants might be utilised to produce new tea-garden fungicides (Saha, Dasgupta & Saha , 2005).

By using the mycelial dry weight method, the antimycotic activity of three fern extracts from *Hemionitis arifolia* (Burm.f.) Moore., *Pteridium aquilinum* (Linn.) Kuhn., and *Christella parasitica* (Linn.) H. Lev.

was assessed against the groundnut early leaf spot and rust disease causative agents *Puccinia arachidis Speg*. and *Phaeoisariopsis personata*. All three fern extracts tested were sensitive to both fungi. In comparison to *P. arachidis, P. personata* was found to be more responsive to the plant extracts tested. The chloroform extract of *H. arifolia* was shown to have the highest antifungal activity against both fungi of the extracts tested. Therefore, it was established that chloroform extract from *H. arifolia* can be used to treat rust and leaf spots on groundnuts (Sahayaraj, Borgio & Raju, 2009).

The antifungal properties of *Selaginella tamariscina* (Beauv.) spring were reported by Jung *et al*., (2006). Amentoflavone is a plant biflavonoid that has been studied by 1D and 2D NMR spectroscopy, including DEPT, HMQC, and HMBC. An ethyl acetate extract was used to isolate it from the complete plant of the aforementioned pteridophyte. Amentoflavone displayed significant antifungal action against a variety of pathogenic fungal strains, although it had a negligible hemolytic effect on human erythrocytes. As a stress reaction to the medication, amentoflavone caused a build-up of intracellular trehalose on *Candida albicans*, disrupting the dimorphic transition that generates pseudo-hyphae during pathogenesis. Finally, amentoflavone offers a lot of potential as a lead chemical for antifungal drug development.

Dalli, Saha and Chakraborti (2007) prepared Methanol extract from the fronds of *Pteris biaurita* and partially purified the extract via solvent partitioning with diethyl ether and ethyl acetate, then hydrolysis and further ethyl acetate partitioning. They used spore germination, radial growth, and agar cup procedures to test the three fractions against five test fungi: *Curvularia lunata, Fomes lamaoensis, Poria hypobrumea,* and *Fuasrium oxysporum.* The results demonstrated that the active principle was found in the ethyl acetate fraction (III). The active fraction's TLC plate bioassay revealed an inhibitory zone with a Rf of 0.5-0.65, and a Silica gel from this region was scraped, eluted in methanol, and submitted to UV-spectrophotometric measurement. The absorption maximum was found to be 278 nm. TLC eluate HPLC examination revealed a single peak with a retention duration of 8.1 minutes. In the retention time range of 7.2-10.9 minutes, GC-MS analysis revealed six main peaks. The extract may contain a combination of eicosanes and heptadecanes, according to a comparison with GC-MS libraries. Therefore, this plant can be used as a potential medicinal antifungal plant.

Using various column chromatographies, Onaga and Taira (2008) isolated and purified Chitinase-A (PrChi-A) from the leaves of a fern (Pteris ryukyuensis) in 2008. Rapid amplification of cDNA ends, and polymerase chain reaction were used to clone a cDNA encoding PrChi-A, which had 1459 nucleotides and encoded a 423-amino-acid-residue open-reading frame. The amino acid sequence deduced revealed that PrChi-A is made up of two LysM domains at the N-terminus and a catalytic domain at the C-terminus, and that it belongs to the plant class IIIb chitinases, which are related by proline, serine, and threonine-rich areas. These findings imply that the LysM domains play an important role in PrChi-antifungal A's action by binding to chitin in the cell wall of fungi. The PrChi-A gene's nucleotide sequence has been deposited in the GenBank database with the accession number AB247328. This protein's amino acid sequence can be found in the NCBI protein database under the accession number BAE98134.

Methanolic extract of root, stem and leaf of winged bean *Stenochlaena palustris* was reported to show antifungal activity against yeasts and four molds viz. *Penizillium chrysogenum, Rhizopus stolonifer, Aspergillus niger* and *Fusaruim* sp. Leaf extract is the most effective extract than root and stem extract against microbial pathogens. The minimum inhibitory concentrations (MICs) of the leaf extracts range from 50 to 12.5 mg/ ml. was determined by the broth dilution method (Zuraini *et al.,* 2010; Sumathy *et al*., 2010).

Zakaria *et al.,* 2010 conducted further extensive studies and reported that three pathogenic fungal strains, *Aspergillus niger, Rhizopus stolonifer* and *Candida albicans,* can be stopped by the

methanolic extract of leaves, stems and roots of the local ferns *Stenochlaena palustris, Diplazium esculentum, Nephrolepis biserrata* and *Acrostichum aureum* by using disc diffusion method. These fern extracts are highly sought after and recommended for their antipathogenic effects, as well as their antifungal capabilities, which could have uses in public health. The antifungal activity of *D. esculentum* stem and leaf extracts is greater. This research will aid in the future creation of a reliable antifungal property.

Panda *et al.,* (2014) found that three pteridophytes plants, *Salvinia minima* Baker, *Thelypteris interrupta* (Wild.) K. Iwats, and *Marsilea minuta* L., had antifungal activity against four fungal diseases, *Candida albicans, Aspergillus niger, Aspergillus flavus* and *Rhizopus* sp. In comparison to chloroform, methanolic extracts demonstrated the presence of significant phytoconstituents such as alkaloids, tannins, anthroquinone, steroids, and terpenoids, and the methanol extract of *S. minima* had the highest antifungal activity (22mm) against *A. flavus*.

Guha, Mukhopadhyay and Gupta, (2005) investigated the antifungal activity of water extracts and extracted phenols from gametophytes and various portions of sporophytes of two species of Adiantum, *A. capillus-veneris* L. and *A. lunulatum Burm*. f., which are used as folkloric medicines in India, China, Tibet, America, the Philippines, and Italy respectively. The fungal strains were found to be resistant to crude extracts and extracted phenols of gametophytes and different sections of sporophytes from both the species. *Adiantum capillus-veneris* was discovered to be a more effective antifungal than *Adiantum lunulatum* (Table 1).

The antifungal effectiveness as well as the modifying effects of ethanol extracts of these plants in conjunction with fluconazole were evaluated using the micro-dilution method, according to Freitas *et al*., (2017). *Candida* strains' micromorphology alterations are a virulence factor linked to the pathogenicity of these microorganisms. Both extracts suppress morphological alterations in *Candida* species, indicating that they may have potential pharmacological efficacy as fungal biology modulators. *P. calomelanos* potentiates the activity of fluconazole, and both extracts inhibit morphological changes in *Candida* species. Hence, new research is needed to see how these extracts effect on *Candida* species' virulence and pathogenicity, as well as the potential of fern species to cure fungal diseases.

A study aimed at investigating (GC-MS method) the phytoconstituents and antimicrobial potency of the raw methanolic extract and the active chromatographic fractions of *Gleichenia pectinata* was performed by Femi-Adepoju *et al.* (2018). They reported that the raw methanolic extract of *G. pectinata* contains important phytochemicals such as phenolics, terpenoids, anthraquinone, tannin, alkaloid, saponin, reducing sugar, protein and flavonoids. At 25mg/ml concentration, some *G. pectinata* chromatographic fractions exhibited significant antibacterial and antifungal activities. This study was a preliminary validation of the antimicrobial potential of *G. pectinata* and a call for the proper conservation of this important but unpopular plant (Femi-Adepoju *et al.*, 2018) (Table-1).

Future directions

Because of its cost-effectiveness, pteridophytes play a significant role in primary indigenous health care. The effectiveness of active antifungal phytochemicals compounds of pteridophytes could be increased by researching them in in vitro culture and decoding their biosynthesis processes, modes of action, and downstream genetic expression using biochemical knowledge and biotechnological technologies. Multidrug therapy should be developed from this group of early tracheophyta, in addition to research of their biological activity, pharmacokinetics, and toxicological profiles. Their secondary metabolite synthesis can also be followed and analysed in order to better understand their mechanism of action as antifungal agent.

Table 1: ***Tabular documentation of Antofungal properties of Pteridophytes***

Pteridophytes With Antifungal Properties	Controlled Pathogen	Used Plant Extract Type	Mode 0f Inhibition	Bioactive Antifungal Compounds (If Idenified)	Source (S)	Reported by and Country of Research
Adiantum capillus-veneris and *A. lunulatum*	*Aspergillus niger* and *Rhizopus stolonifer*	Water and phenols extracts	Inhibits spore germination and hyphal growth	-	Plant parts	Guha, . Mukhopadhyay & Gupta (2005), India
Dryopteris filix-mas	*Pestalotiopsis theae, Colletotrichum camelliae, Curvularia eragrostidis (P. Hennings)* and *Botryodiplodia theobromae*	Ethanol and aqueous extracts	Inhibits 100% of spore germination	-	Plant parts	Saha, Dasgupta & Saha (2005), India
Hemionitis arifolia, Pteridium aquilinum and *Christella parasitica*	*Puccinia arachidis and Phaeoisariopsis personata*	Chloroform extract	-	-	Plant parts	(Sahayaraj *et al*., 2009), India
Selaginella tamariscina	*Candida albicans*	Ethyl acetate extract	-	Amento-flavone	Plant parts	Jung *et al.* (2006)
Pteris biaurita	*Curvularia lunata, Fomes lamaoensis, Poria hypobrumea* and *Fuasrium oxysporum*	Methanol extract	-	Eicosenes and heptadecanes	Fronds	Dalli and Chakraborti, 2007 India
Stenochlaena palustris	*chrysogenum, Rhizopus stolonifer, Aspergillus niger* and *Fusaruim sp*	Methanolic extract	-	-	Root, stem and leaf	Zuraini *et al*., 2010; Sumathy *et al*., 2010 Malaysia
Stenochlaena palustris, Diplazium esculentum, Nephrolepis biserrata and *Acrostichum aureum*	*Aspergillus niger, Rhizopus stolonifer* and *Candida albicans,*	methanolic extract	-	-	Leaves, stems and roots	Zakaria *et al*, 2010 Malaysia
Salvinia minima, Thelypteris interrupta and *Marsilea minuta*	*Candida albicans, Aspergillus niger, A. flavus* and *Rhizopus sp.*	methanol extract	-	Alkaloids, tannins, anthroquinone, steroids and terpenoids	Plant parts	Panda *et al.* (2014) India
P. Calomelanos	*Candida Sp.*	Micro-dilution method and ethanol extracts	Inhibits the morphologica l changes	-	Plant parts	Freitas *et al*., (2017) Brazil
Gleichenia pectinata	-	Methanolic extract	-	Phenolics, terpenoids, anthraquinone, tannin, alkaloid, saponin, reducing sugar, protein and flavonoids	Plant parts	Adepoju *et al.* (2018) Nigeria

CONCLUSION

The bioactive elements of this tracheophyta plant group have achieved pioneer status for their contribution to traditional and herbal medicine. This review has sought to expand tribal peoples' local knowledge of the use of pteridophytes in various medical systems. The research also discusses the ethnobotanical usage of pteridophytes as antifungal agents in the treatment of a variety of human and plant ailments. This research is an attempt to document the rich ethnobotanical knowledge of the locals, which is otherwise passed down verbally from generation to generation. It was shown that people in both rural and urban areas rely heavily on medicinal Pteridophytes as a source of antifungal treatment for a variety of maladies, and that they have extensive ethnobotanical knowledge of medicinal pteridophytes. The article goes on to discuss the phytochemical assay of various antifungal activities identified in pteridophytes, indicating that they could have pharmacological efficacy as fungal biology modulators. As a result, more research is needed to determine how these extracts affect the virulence and pathogenicity of fungal diseases, as well as the potential of fern species to cure fungal infections.

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Explosive Pollination Mechanism in Flowers of Hyptis (Lamiaceae)

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ABSTRACT

The floral mechanism that ensures successful pollination upon tripping by pollinating agents is the explosive pollination mechanism. The violent movement of anthers or stamens and style alone or together with restraining petals is the key to the success of explosive or parallel mechanism of pollination in flowering plants. Explosive mechanism is variously designed by in different plant species and triggered by different species of insects, birds and wind. In this review, an attempt has been done to put together the scattered reports in the literature focussing the explosive mechanisms of pollination in the species of *Hyptis*. The nature and the function of the mechanisms in relation to pollination effected by tripping agents have been documented.

Key words: Hyptis; Explosive Pollination; Floral Morphology

INTRODUCTION

Hyptis is a large genus belonging to the family Lamiaceae under the order Lamiales, with about 300 species and occurs as an herb or shrub growingin the warmer tropical regions (Harley, 1988). Many members of this genus gain importance for the medicinal uses by virtue of possessing antifertility, anti-inflammatory and antiplasmodial properties. Pharmacological studies of plant extracts of some species like *Hyptis suaveolens* and *H. verticillata* suggest that they possess antimitotic, antioxidant, anti-HIV, antisecretory, hepatoprotective properties among others (Mishra, Sohrab & Mishra, 2021; Picking *et al.*, 2013). The characteristic floral morphological structure and its functioning as observed in the genus has been found toperfectly align with the explosive pollination syndrome.

LITERATURE REVIEW AND DISCUSSION

Floral morphology of *Hyptis*

Inflorescences of *Hyptis* are in arranged in heads, spikes and capitates, with the flowers having five-toothed calyx and bilabiate corolla. The genus is characterised in flowers having flag-shaped blossoms with the primary sexual organs always extending ventrally from the corolla tube, proximating towards or along the lower lip of the bilabiate corolla, unlike the upper flower lip as is the case in other genera of Lamiaceae.Stamens are didynamous and all the four stamens bear long hairs. They are inserted on the distal part of the corolla tube. The short filament of the upper pair of stamens is inserted laterally, whereas the filaments of the lower pair are continuous with the ridges inside the corolla (Brantjes & De Vos, 1981). The didynamous stamens are held in the lower lip of the corolla in an immensely compressed position, giving the characteristics of asternotribic flower (Harley, 1974). The anthers are firmly attached to the end of the filament; the pollens are loose and powdery. The syncarpous ovary is bicarpellary with each carpel being unilocular. In the initial stages of development of ovary, a constriction appears in the anterioposterior line on each carpel. The long style is gynobasic originating from the base of the ovary between the carpels and terminating in a short bifid stigma. This style is inserted below the upper pair between the didynamous stamens (Aluri, 1990). Floral morphology of *Hyptis* is absolutely adapted for the explosive pollination mechanism, where self or cross pollination is ensured by tripping of an appropriate forager at the slightest touch.

Pollination mechanism by tripping agents

In *Hyptis suaveolans*, the stamens and stigma are concealed by the middle lobe of the lower corolla lip and therefore they do not open up following the natural anthesis or opening of the floral bud. After anthesis, the carinal lobe remains tensed and is released later by the wind or the pollinators like bees of

various species. Due to this, the stamens spring out and eject a cloud of pollens a few centimetres in the upward direction above the anthers. Simultaneously, the lower corolla lip flips back and remains in that position. The pollinators trip the explosive floral mechanism efficiently in a single attempt, thereby releasing the pollen from the stamens and aiding their deposition on the stigma and the forager in sternotribic manner.

However, pollination is nototribic in *H.capitata*, in which the principle pollinators are wasps and they collect the nectar from the flowers in a way that leads to the pollen deposition specifically on its dorsal side (Keller& Armbruster, 1989). This ensures that the pollens would be successfully utilized in the flowers where the wasps would visit next. In *H. capitata*, the explosive pollination mechanism initiates with the prerequisite that the saccate petal lobe is already in a "trippable state" and is ready to flip downwards whenever disturbed by the tripping agents. The filaments of the stamens are held in a position of tension in the lobe. As soon as a disturbance causes the lobes to flip back, the stamens are set loose. The narrow elliptical anthers are longitudinally dehisced due to the impact of the tripping agents. Subsequent insect visitors coming in contact with the anthers often pick up the yellow pollen. After the discharge of the pollens from the theca openings of the anthers, the stamens remain in an upright position. The stamens then gradually bend down into the lobes, thereby exposing the stigma for contact with the visitors. During this entire period of the trippable state to next consequent corolla drop, a flower is exposed to be visited by insects for approximately about fifty times.

In case of *H. pauliana*, the style remains hidden between the two upper stamens during the process of anthesis. With the tripping by a hummingbird, the filaments of the stamens swing up releasing the pollens upwards above the anthers in an explosive manner. Following this, the style protrudes beyond the anthers and the stamens move downwards away from the stigma head. However, it seemed to be essential for the nectar flow to continue so that the repeated visits of hummingbirds are ensured, since the flower has to be revisited again for its pollination (Brantjes & De Vos, 1981).

The explosive pollination has been observed in many species of *Hyptis* like *H. alata, H. brevipes, H. dictyodea, H. emoryi, H. fasciculata, H. hamatidens, H. paradisi, H. mutabilis, H. nitidula, H. pectinata, H. peduncularis, H. rhomboides, H. siphonantha, H. spicigera, H. verticillata,* etc. (Brantjes & De Vos, 1981; Harley, 1974).

The tripping agents have been various for different species (Aluri & Reddi, 1996). The flowers of the species like *H. pauliana* and *H. subrosea* are tripped by hummingbirds; *H. emoryi* is tripped by both hummingbirds and bees, whereas bees trip *H. siphonantha* in a sternotribic manner. The bees as visitors playing key role in the pollination mechanism in *Hyptis* are reported to be from the genera *Megachile, Bombus, Centrile and Hypanthidium* (Harley, 1974) and the wasp reported is *Mischocyttarus labiatus* (Richards, 1978).

CONCLUSION

Many species of *Hyptis*, belonging to the family Lamiaceae, exhibits the floral morphology of having stamens concealed in an articulate corolla lip in a compressed state of tension. This morphological characteristic proves to be an excellent adaptive feature favouring the explosive pollination mechanism observed in many species of the genus. These mechanisms are parallelly aided by the various tripping agents like hummimg birds, bees and wasps and also wind in some species.Thus the explosive pollination mechanism in the flowers of *Hyptis* is a function of legitimate foragers collecting floral resources from the plant, along with periodical occurrences of appropriate wind.

ACKNOWLEDGEMENT

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Biofuels: Synthesis, Mechanism, Utility, Problems, Future scope

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ABSTRACT

One of the most emerging problems in modern decade is the problem of energy source. The storage of the conventional energy sources is decreasing alarmingly. In this aspect, this article tries to enlighten about biofuels as a potential alternative energy source. The most common methods for synthesis of biofuels, their applications in different aspects and the future scope of biofuels are discussed in a comprehensive way. Some serious drawbacks of biofuels and their possible remedies are also included. Also, the global scenario regarding biofuels are described.

Keywords: Biofuels; Transesterfication; Biogas; Global Warming; Renewable; Clean Fuel

INTRODUCTION

Fuel is the indirect cause to lift human generation into the next level. Fuel is defined as the species which undergoes chemical changes to produce energy. The efficiency of a fuel can be defined as their calorific value. Calorific value is defined as the amount of heat energy produced by complete combustion of a fixed mass of fuel at constant pressure and in normal condition. Its SI unit is- KJ/Kg.

Fuels are the source of energy. The energy sources can be classified as- renewable and non-renewable energy sources. The fossil fuels are too much important to the mankind. Now a days, people can't take a step forward without the help of fossil fuels. In general fossil fuels like crude oil, coal, natural gas has a lot of uses. But the bitter truth is the fossil fuel will be going to extinct because it is not renewable. It is the buried combustible geologic deposits of organic materials, formed from decayed plants and animals that have been converted. So, in future extinction of fossil fuel will be a must face problem. Scientists have already discovered an alternative known as biofuel. In case in common it's considered as an alternative of fossil fuel.

LITERATURE REVIEW

Synthesis and Mechanism

A natural oil is methyl ester of an unsaturated fatty acid. It is a kind of natural compound having the main functional group of R-COOR' . Biodiesel is produced by the trans-esterification or alcoholysis of normal fatty oils contained in vegetable oils, creature fats, unused waste fats and lubes, unused cooking oils or side stream products of different refined consumable oil materials with short – chain alcohols. Since glycerol has 3-OH groups, 3 long chain natural 'unsaturated fats' get connected to make the massive 'triglyceride 'ester.

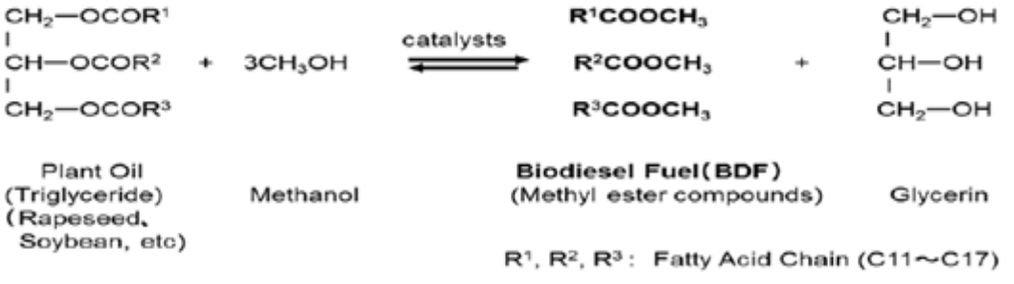

Figure 1: *3 Long Chain Natural 'Unsaturated Fats' Get Connected to Make the Massive 'Triglyceride 'Ester (Fraunhofer, n.d.-a)*

It can be noted that, this is a reversible reaction. As esters can be produced using alcohols and acids , they can again switch alcohols or acids by hydrolysis . So the key innovation is the utilization of catalyst.

Right now , most biodiesel is manufactured by utilizing soluble catalysts , for example, sodium and potassium methoxide or hydroxides . From a chemical point of view, the active intermediate of these two kinds of catalysts are methoxide particles , while in industrial manufacturing NaOH and KOH are preferentially used because of their wide accessibility and minimal expense .

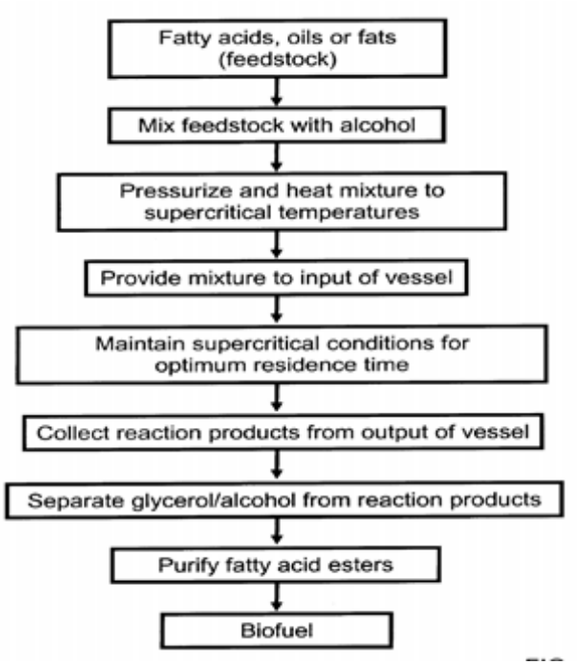

Figure 2: *Diagram of The Procedure to Making Biofuel (*Fraunhofer, n.d.-b*)*

After catalyst based transesterification, glycerol is generated as a by product with biodiesel. That's why we have to carry out the separation of glycerol from biodisel. The traditional method of removing glycerol is performed mainly by gravity separation.The non-polar methyl ester particles making up the biodiesel don't blend in with the polar glycerol molecules and the combination of products will form two separate layers where the less thick biodiesel floats on top of the more thick glycerol layer.

Figure-3: *The Traditional Method of Removing Glycerol(*Fraunhofer, n.d.-a*)*

Utility of Biofuels

Every one of the non-renewable energy sources are exhaustible , reason for extensive environmental pollution and add to the green house impact , on the opposite the biofuels are sustainable , separated from plants and creature waste products , clean fuel and good for our environment (SGB biofuels, n.d.).

1. Eco-friendly : Fossil fuel producess bunches of carbon with CO_2 which brings about critical degrees of air contamination . This CO_2 joins with other ozone harming substances and wind up bringing Global

warming on our lovely nature. In contrast, biofuels don't delivery such tremendous measure of carbon, CO_2, sulfur dioxide etc . Biodiesels contains oxygen in their molecules , it ignites better and producess less carbon. Subsequently, biofuels diminish risk of an ecological disaster, they are climate agreeable too.

2. Transportation : The most broadly utilized fluid biofuels for transport are ethanol and biodiesel. Biodiesels are made through mixing of fats and oils obtained from creatures and plants individually. Liquor is another ingradient that prompts the assembling of biodiesel. A few synthetic cycle are required like trans-esterification , which includes esters and alcohols, for example, methanol and ethanol in the creation of biodiesel. Ethanol made through the course of farmentation of high carbon content biomass, essentially sugars and cellulose. Sugarcane is among the plants liked for this purpose. In Brazil , an major sugarcane provided country, its utilization has been effective with vehicles being controlled by 100% ethanol (de Oliveira Bordonal *et al.*, 2018).

3. Biogas : Biogas is the gaseous variety of biofuels. It is essentially made out of methane and CO_2 gas delivered from the course of anaerobic breakdown of biomass by a Consortium bacteria. The fuel is separated from a combination of the two-animals and plants in light of the fact that each contributes a particular elemant (C and N) . Presently biogas is utilized in horticultural firms, bundled in gas chamber for family use, generation of electricity or mechanical force and others.

4. Cleaning of oil spills and grease : Biofuel is known to be harmless to the ecosystem, it can likewise assist with tidying up oil slicks and oil. Biofuel has ben tried to fill in as a potential cleaning specialist for regions where unrefined petroleum contaminated the waters.Biofuels can likewise be utilized as a industrial solvent for cleaning metal, which is additionally advantageous because of its absence of poisonous effect.

5. Low costs : Most biofuels are not difficult to create and are less expensive than petroleum products. Investigators say that supplanting imported oil with biofuel will assist with settling the economy when oil is unavailable. Their utilization can accordingly , make life simple for the normal residents.

6.Prosperity of Agriculture: As the majority of the biofuel traverses various kinds of harvests, grains, so with an increment popular for biofuel would be resultant to more cultivating of the reasonable crops.So having those catchable advantages the interest of biofuels is expanding step by step and may in future it will be our solitary expectation. Alongside these, any nation can start the creation of biofuels without meddling with different nations. When a nation becomes ready to create its own biofuel, they can set its own valuation on items without such a lot of local limitation.

As indicated by the RFA February 2019 Ethanol Industry Outlook report " Ethanol stays the most elevated octane, least expense engine fuel in the world."

Disadvantages of biofuel

No matter what happened, biofuel is the inevitable future. Though it has several drawbacks.

1.Monoculture : Monoculture refers to the growth of a single plant species year after year rather than producing various crops. But there are many problems with large tracts monoculture. The major problem with monoculture is that the plants lack genetic diversity. When a particular species of plant is susceptible to a certain pest or is subjected to environmental changes with which it cannot cope.

2.Problems with water : Biofuels indirectly causes water pollution. Biofuels are produced from crops and these crops need fertilizers to grow better. Fertilizers contain nitrogen and phopsphorus and when they washed away from soil to nearby ponds, lakes or rivers, water will be polluted. In order to produce corn-based biofuels to fit local demand ,large quantities of water are used that could put unsustainable pressure on local water resources.

3.Biodiversity : Production of biofuel will affect wild and agriculture biodiversity in some positive ways. To go on side by side with demand and economical purpose people convert natural ecosystem into plantations. This convertion of forest or grassland for crop production has a significant effect on wild biodiversity ,because of the loss of habitat. Those existings arable lands biodiversity also will be lost through monoculture.

4.Global-Warming: Burning of the biofuel, produces CO_2, which adds to an world-wide temperature boost. The main constituents of biogas are methane and CO_2 (Mathews, 2008). Those are basically green house gases(GHG) too. Though it is actually the case that biofuels produce less GHG discharges than non-renewable energy sources, yet that can just prompt sluggish global warming and not halting or turning around it. The emisson of green house gas will prompt relocate environment changes. Researchers who have measured the health costs related with various sorts of fuel says that, "Biofuels are harmful to people. Some biofuels cause more medical issues than petroleum and diesel.

DISCUSSION

Future of Biofuel

It has been mentioned earlier that fossil fuels are exhaustible whereas, biofuels are produced from renewable feedstocks. As biofuel primarily considered as potentially cheap, eco-friendly, low-carbon energy source. It is represent a key target for the future energy market that can play an important role in maintaining energy security. Replacing fossil fuels with biofuels will generate a number of benefits. So global transport market already started to invest on biofuel production.

1.Global Perspective: In future the creating or extending biofuel creation depend upon its natural advantages. Worldwide road transport has developed quickly in the course of recent years and is projected to keep on expanding. Worldwide biofuel creation has significantly increased from 4.8 billion gallons in 2000 to about 16.0 billion in 2007, yet represents under 3% of the worldwide transportation fuel supply. Around 90% of creation is gathered in the United States, Brazil, and the European Union(EU).

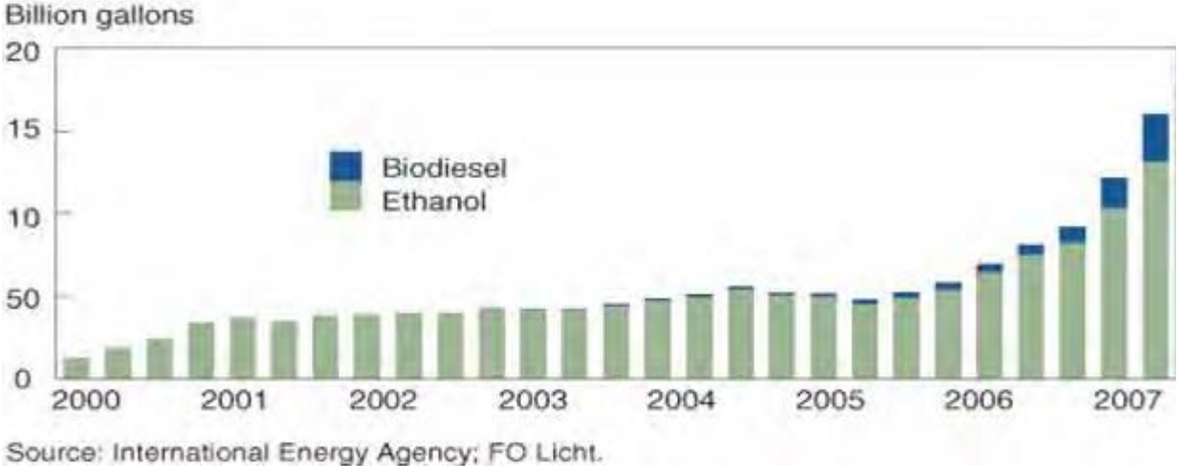

Figure 3: *Global Biofuel Production Tripled Between 2000 and 2007 (*Coyle, 2007*)*

The ascent in oil costs is the main factor boosting the seriousness of elective fills, including biofuels. Numerous vulnerabilities stay for the eventual fate of biofuels. Next generation biofuels are produced from cellulose by enzymatic transformation and method of fermentation. Cellulosic ethanol could raise per section of corn- ethanol respects in excess of 1000 gallons, altogether decreasing area necessities. U.S. cellulosic fuel creation are currently assessed at more than $2.50 per gallon and $1.65 per gallon for corn ethanol. Funding and government appropriations are supporting organizations keen on making cellulosic ethanol monetarily reasonable, basically in the United States , yet in addition in a few different nations, including Canad, Brazil,China,Japan, and Spain.

The future job of biofuel relies on productivity and new innovations. Biofuel creation will probably be generally productive and naturally harmless in tropical regions where crop-growing seasons are longer, per section of land biofuel yields are higher, and fuel and other info costs are lower. For instance, Brazil utilizes bagasse, which is a result from sugar creation, to control ethanol refineries, though the United States utilizes petroleum gas or coal. U.S. set a proposition to increase inexhaustible fuel expectation to 36 billion gallons by 2022.

With quick extension in biofuel creation, there will be an analysis on the worldwide food framework cost. As per the worldwide Monetary Fund, world food costs rose 10% in 2006 due to increment in corn, wheat, and soybean costs, principally from interest side components, including rising biofuel request.

2. Indian Perspective: Being the second most populated country India is one of the biggest producer of green house gases(GHG). Indian vehicle area records to 13 percent energy related CO_2 emissions (Banerjee, 2017). It tends to be more eco-accommodating by embracing a supportable methodology, for example, higher creation of biofuel. Yet, India is lacking in palatable oils, non-eatable oil is the fundamental decision for delivering biodiesel. Jatropha, imported palm oil are fundamental biodiesel feedstocks in India and Molasses, sugarcranes for ethanol.

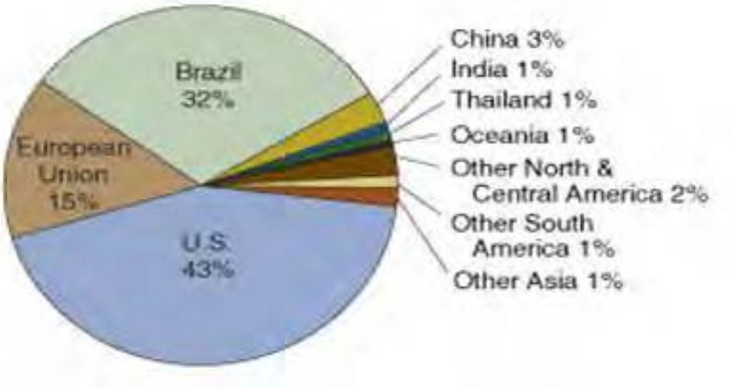

Figure 4: *Around 90% of creation is gathered in the United States, Brazil, and the European Union(EU) (*Coyle, 2007*)*

As indicated by Indian government strategy and Indian innovation impacts, some devolopment works have been completed with respect to the creation of transesterified non palatable oil and its utilization in biodiesel by units like Indian Institute of Science, Bangalore, Tamilnadu Agriculture University Coimbatore and Kumarguru College of Technology. The current arrangement situations represents that in the following twenty years India's essential energy request will twofold, from 750 Mtoe in 2011 to 1469 Mtoe in 2030. In this point of view, biofuels are arising as the most encouraging elective choices to regular fills, as they can be created locally, and can substitute diesel to meet the transportaton area's energy prerequisites.

CONCLUSION

The fossil fuels are non- renewable , causes hazardous envirnmental pollution and are mainly reponsible for the increasing green house effect , on the other hand the biofuels are renewable,extracted from plants and animal wastes , clean fuel and environmentally sustainable . The production of such fuels is cost-effective too. Although, some problems of concern are associated with the biofuels, extensive scientific developments and reasearchs are going on to overcome them.

This present review also tries to highlight the current status and potential of biofuel in India. It is seen that India is rapidly moving towards becoming one of the largest green energy producing countries in the world. India has recently invited different foreign investors mentioning that there are huge renewable energy deployment plans for the next decade.Thus it can be considered as a ray of hope towards the clean earth, green earth for the future generation.

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Properties and Application of Graphene Oxide

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ABSTRACT

Graphene oxide (GO), an important descendant of graphene, has entranced a wide range of researchers around the world. Several innovative properties of graphene oxide have been invented today. In this review mechanical, electrical, thermal, optical and some other properties are discussed. Along with this, few applications of GO have been mentioned.

Keywords: Graphene Oxide; Conductor; PET; LEDS

INTRODUCTION

"GO" is formally known as Graphene compound, it's most made by the oxidisation of carbon compound. It's a compound of carbon(C), oxygen (O) and hydrogen (H) in variable ratios, obtained by treating carbon with robust oxidizers. GO may be a two-Dimensional material and it may be viewed as one monomolecular layer. It's altered sort of graphene with O-functional cluster decorating the sp^2 carbon atoms in a very Honeycomb structure Figure 1 (Zhao, Liu & Li., 2015; Paulchamy, Arthi & Lignesh, 2015) because of the presence of Oxygen-functional cluster, GO is additionally hydrophilic and it permits the head to endure unbearable irradiation, once it may be distributed in water resolution. The dimensions of the GO Flakes may be wide-ranging from 'nm' to 'mm' (1nm =0.000001mm).

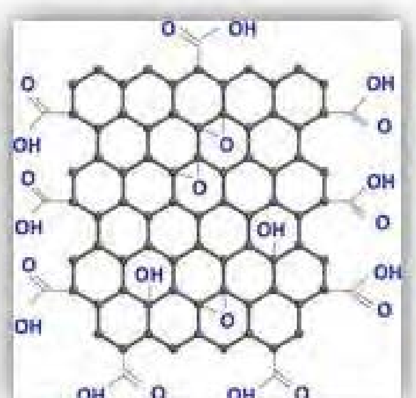

Figure 1: *Structure of GO (Marcano et al., 2010)*

LITERATURE REVIEW AND DISCUSSION

Different properties of Graphene Oxide

Mechanical properties:

Low cost and excellent performance carbon-based materials is the GO composite. Its tensile strength and Young's modulus are very high. In another, (Jiang *et al.*, 2019) reproduce a unique arrangement of polyurethane (PU) with each GO and GO-reinforced carbon fibres (CF-GO). By merging only 0.1 wt. it can form nanosheets into polyurethane before melding in associate in nursing extremely vulcanizing press, the strength of PU elastomer was increased from 42.4 to 49.3 MPa, a 16.4% development. Moreover, by combining 0.1 wt. to go similarly as 1% CF-GO, the durability improved to 62.1 MPa (46.4% higher) (Jiang *et al.,* 2019). The carbon fibres had GO imbedded onto their surfaces by cataphoretic deposition at 3 V of applied voltage to spice up the surface adhesion of GO and PU. Surprisingly, the extension at break additionally enhanced for the CF-GO/PU Figure 2 nanocomposites because of to the developed stress transfer from the matrix to the pitches.

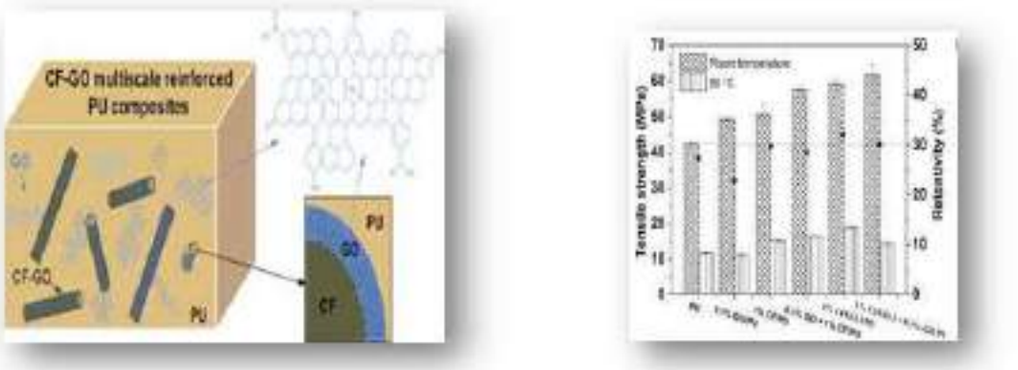

Figure 2: *Schematic Presentation of the CF-GO Multiscale and Tensile strength of PU-based Materials (Jiang et al., 2019)*

GO has excellent potential, because of its wonderful mechanical properties. Throughout this study, the influence of GO on epoxy matrix composite plant was examined. Combining 1.5volume of to go to the epoxy matrix raised the tensile strength, Young's modulus and hardness of the composite compared to the pure epoxy matrix. Next similarity between structural models of each ordered and amorphous graphene oxides are thought of. For the well-ordered graphene oxides, the Young's modulus is found to vary from 380 to 470GPa; however, Young's modulus of the amorphous graphene oxides is smaller at 290-430GPa (Suk *et al.,* 2010). Similarly, the well-ordered grapheme oxides additionally possess higher intrinsic strength compared with the amorphous ones. As coverage increase, both the Young's modulus and intrinsic strength decrease monotonically because of the breaking of sp^2 carbon link and reducing of the energetic constancy for the well-ordered and amorphous GO (Gómez-Navarro, Burghard & Kern, 2008). The Mechanical properties is recognised not solely to the strength of GO filler however the strength of the filler interfaces the –OH groups of PVA and O-functionalities of GO led to extraordinary grade of hydrogen bonding.

Electrical properties :

GO is kind of material due to the shortage of adequate pi conjugation and when the reduction it become semi conductive via restoring of pi-pi bonding or sp^2 crossbreeding due to debridement of element functionalities. However, physical phenomenon of Graphene compound depends on several factors like degree of black lead exfoliation, range of layers, surface element practical teams and significantly, impurity level. physical phenomenon of GO depends on the extent of oxidisation. whereas oxidisation, we have a tendency to square measure endlessly removing the sp^2 carbons and replacement it by sp^3 carbons having element functionalities. In essence, you are making a band gap by actuation the bands apart. thence once totally modify, the bands square measure way apart associated GO behaves as a material. In between this totally modify GO and pure printed symbol, it behaves as a semiconductor Figure 3.

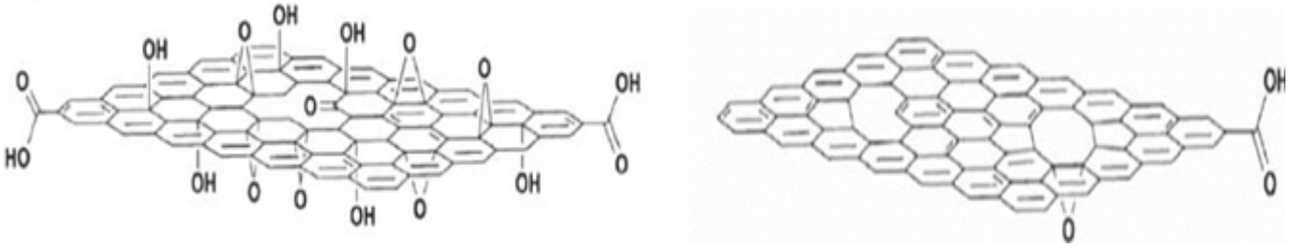

Figure 3: *Structure of GO and rGO (Flyunt et al., 2014)*

Wan *et al.,* (2015) evolved a semi conductive synthetic shell with the aid of using blend partner with chitosan (CS) terribly} very three-step method. First, a GO solution changed into combined with Cs to coat the escort Cs. In step 2, the authors used vacuum separation to gather a nanocomposite film. The very last phrase step changed into to cut returned the pass on the aspect of acid to create partner rGO/CS nanocomposite with absolutely the fine electric bodily phenomenon of one.553x10^4 Sm^{-1} at 90.5 wt. %rGO, that changed into below the natural rGO, however that noticed upgrades to every

enduringness and toughness. As well to the polymers cited on pinnacle of, rGO has conjointly been more to various opportunity polymers to boost their electric homes collectively with polythene terephthalate (PET) (Zhang *et al.,* 2010), polydimethylsiloxane (PDMS) (Song, Zhai & Zhang, 2016), polyvinyl acetate (Li *et al.*, 2015), and plutonium (Wang *et al.*, 2017) PET - it's far a fashionable cause thermo plastic polyester. it's far an extraordinarily versatile, semi-crystalline and colourless material. Pet is likewise a semiarometic compound synthesized kind type glycol and terephthalic acid. There square measure several strategies to alter opt for electrical physical phenomenon. The thermal and chemical techniques of GO amendment square measure extensive well-known to restore electric physical phenomenon. At durations the thermal reduction method GO is uncovered to temperature charge from 2000 °C/min as much as concerning 1050 °C in effect ripping input character sheets via greenhouse fueloline evolution. The chemical method of GO amendment is drawn with the aid of using its reduction with reductant and its derivates. in the course of this technique we will be inclined to feature the liquid reagents to liquid dispersion of GO and dry it. The reagents boom the belongings of GO, that outcomes in electrically semi conductive graphene- based totally nanosheets.

Thermal properties:

GO incorporates a lower thermal conductivity than graphite, growing it not a super preference for numerous programs requiring smart thermal homes. This reduction of thermal conductivity is because of the one-of-a-kind oxygen useful corporations on the surface of GO destroy the lattice symmetry and cause native form. As an end result, reduction of GO is essential for inclusion of rGO into polymers to spice up their thermal conductivity**.** Renteria *et al.,* (2015) confirmed that production rGO films through tempering GO at warmth (1000^{o}C) can notably enhance the in-plane thermal conductivity, showing associate improvement from ~3 to 61 $Wm^{-1}K^{-1}$**.** The films confirmed a stimulating anisotropy in terms of thermal conductivity because of the cross-plane thermal conductivity remittent to ~0.09 $Wm^{-1}k^{-1}$ and indicated a quantitative relation of the two (in-plane/pass-plane thermal conductivity) of 675 (Wicklein *et al.,* 2015). The thermal conductivity of GO will growth with model length. A linear relationship of the inverse period and inverse thermal conductivity was determined. The thermal conductivity of remittent monotonically with a boom inside the degree of oxidation response. As soon as the degree of oxidation changed into 10% the thermal conductivity of GO remittent by way of~ 90% and this became truly freelance of chiral route.

Optical properties :

An optical image of some scattered single-layer GO-flakes at 300 nm SiO_2/Si (1 0 0) has been said with the aid of popular optical microscopy (OM) Figure 4(De Marco *et al.*, 2010). Wrinkle's presence is apparent proof of GO's conceptual flexibility**.** Due to this character, GO is often seen locally folding in double or a couple of layers. Given the ability of GO to emit fluorescence, fluorescent microscopy (FM) Figure 5 lets in fluorescent molecules to similarly enhance the contrast of the image through the usefulness of the substrate. In this example the lateral decision may be advanced, and the isolation restrict can be decreased. An image of individual GO-flakes in fluorescence inhibition of the T4-activated SiO_2 substrate has been mentioned (Treossi *et al.,* 2009).

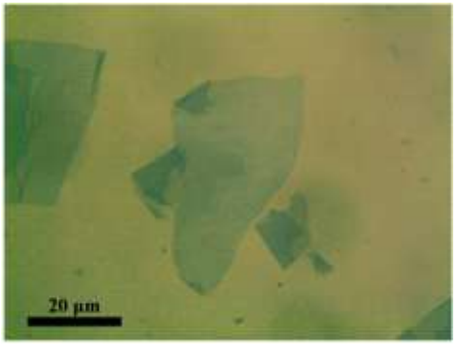

Figure 4: *OM Image of GO (De Marco et al., 2010)*

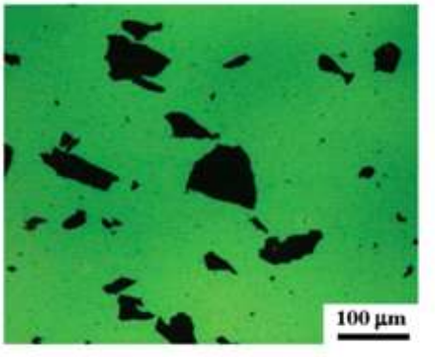

Figure 5: *FM Image of GO Flakes (Treossi et al.,2009)*

Measured the thickness of the AFM, A single layer of GO-flake is typically 1.0 nm and within1.4 nm (Stankovich *et al*., 2007 & Jung *et al.*, 2008), typically above the depth values determined for graphene (0.7 nm (Gupta *et al.*, 2006). Due to this Existence, inside the case of GO, extends to O functional organizations from the base plane. Uncertainty between 1.0 nm and above there are 1.4 nm elements for technical reasons, specially whilst the AFM dimension is executed in tipping mode. it's been proven that the cost of thickness adjustments with its Parameters of AFM settings (Nemes-Incze *et al.,* 2008).

GO flakes are normally irregularly formed. Early graphites have lateral sizes starting from some nanometers to a few millimeters, depending at the area size,the time of oxidation, and the type of oxidation method **.** Single layer GO-flakes of a few microns or more in lateral length can be easily observed by way of fashionable optical or fluorescence microscopy (Pan & Aksay, 2011; Li *et al.*, 2013).

Some other properties of Graphene Oxide :

Due to existence of Oxygen functionalities, graphene oxide can easily disperse in natural solvents, water and distinct matrixes. This will be a sizeable benefit whilst combining the fabric with polymer or ceramic matrixes to boost their mechanical and electric properties.

The properties of Graphene are regularly changed by the functionalization of graphene oxide. The chemically altered graphene received by means of this approach may want to probably be used in various application, looking at the meant utility, the graphene oxide is often functionalized in numerous methods.

Applications of Graphene Oxide :

One of the foremost areas where GO/rGO can be predicted for use is in the manufacturing of transparent conductive films after accumulation at any extent. This type of coating will be used flexibly electronics, solar cells, liquid crystal, chemical sensors and touch screen tool. Where (Becerril *et al.,* 2008) used GO as a transparent electronic mild emitting diodes (LEDs) and photovoltaic cellular devices. transparent electrodes are used as hollow transport layers in go polymer sun cells and LEDs discern 2.3 shows the diverse electronic devices Figure 6.

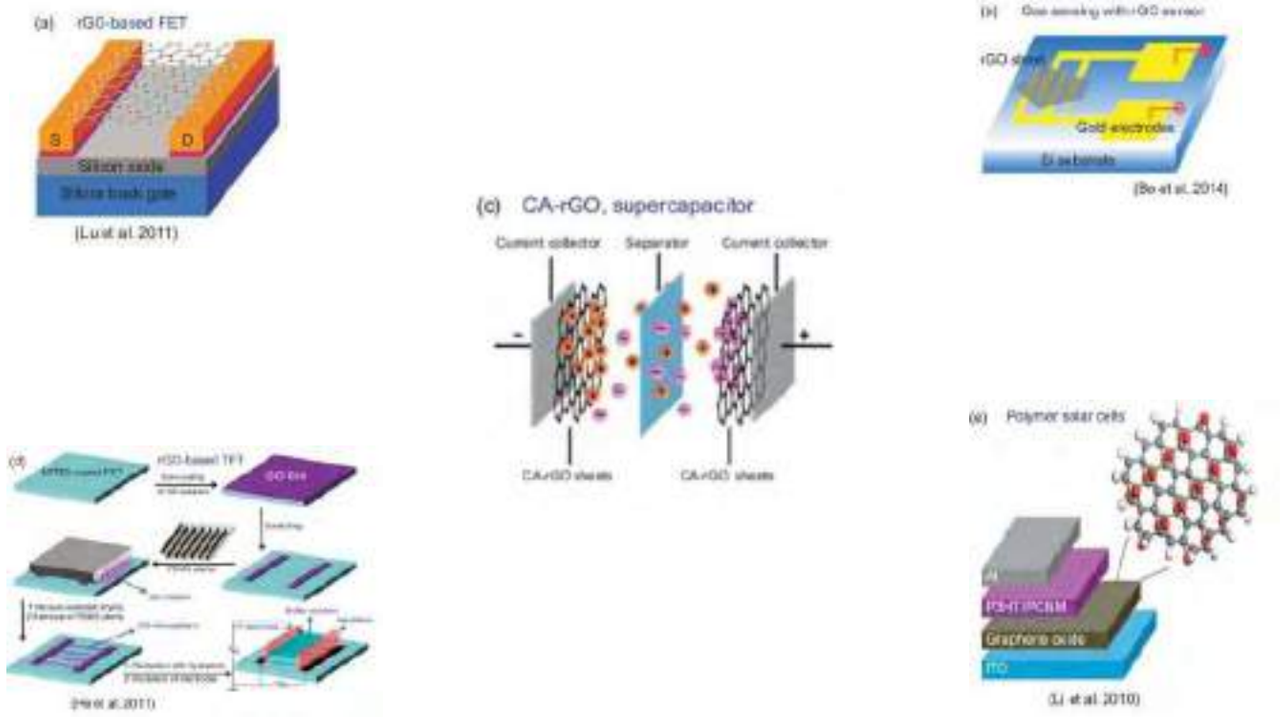

Figure 6: *(a) Represent rGO-based FET, (b and c) Represent Gas Sensing with rGO and CA-rGO-based Super-capacitor, (d)Represent rGO-based TFT, and (e) Represent Polymer Solar Cells.*

GO is employed in biomedical fields particularly in drug deliver structures. GO is maybe over many other antidepressant drugs because its objectives healthful cells, not just tumors, and has less toxicity. Activated nano-geo (nGO) anticancer drugs are hired in diverse research on target delivery. In some other observe, magnetite changed into synthesized inside the move loaded with the anticancer drug doxorubicin hydrochloride to deliver the drug to unique websites the use of magnets.

Multilayer geo-films are optically obvious and impervious in dry situations. Discovered near water (or water vapor) they allow molecules smaller than a specific size to exertions below. The films include scores of randomly stacked flakes with nano-sized capillaries in them.

CONCLUSION

In this review, different properties and application of Graphene Oxide were studied. In summary, GO has higher tensile strength and hardness. Young's modulus of the amorphous graphene oxides less than than ordered one. GO can become electrical and thermal conductor after reduction. Here also discussed about the optical image of GO. GO can be used in varieties of field, some of them also mentioned here. Graphene oxide is a huge field; further research can be done in future.

ACKNOWLEDGEMENT

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Recent Progress on Covalent Organic Framework Material for Catalysis in Sustainable Remediation

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ABSTRACT

The covalent organic frameworks (COFs) are an emerging class of crystalline porous organic material which provided the regular arrangements of organic monomers into wholesale structures with periodic skeletons with highly tunable pore environments well-organized which are crucial characteristic for catalysis. On based of the dimensionality of the linking unit they can be formed step growth or chain growth co-polymerization as 2D- or 3D- framework through the well-designed and specific connecting with the monomer linkers, thereby resulting a distinctive properties and functions in various catalytic fields. This review demonstrates the recent advancements with regard to the design and synthesis of covalent organic frameworks materials (COFs) for their sustainable applications achieved via environmentally benign pathways.

Keywords: Covalent Organic Framework; COF Synthesis; CO2; Sustainable; COF Application

INTRODUCTION

For various chemical reactions more energy is often required to overcome the activation energy barriers. However, after applied the sustainable catalyst it is noted that these energy barriers can be dramatically reduced, as a result, chemical reactions can be taken placed. In the past decades, incessant innovation of catalysts has notably promoted the chemical industrial development with enlarged energy and material efficiency and reduced production rate (Zhi *et al.*, 2020). It is surprised that with increasing global demands for energy and atmosphere change, the utilization of carbon dioxide (CO_2), as a green C1 source for the production of fine chemicals has been more concerned in modern research field worldwide in the past few decades, due to economic and environmental facts arising from the utilization of reusable sources and the increasing concern of the greenhouse effect. In this regards the CO_2 capture and storage (CCS) has become most promising research field to reduce atmospheric CO_2 level and make a green effect over environmental safety and co-friendly enhancement. For this reason it is very importance to take the several possible steps to reduce the levels of CO_2 in the atmosphere which include the removal of CO_2 from air and post-combustion of industrial raw substances such as flue-gas capture and conversion of these into fine valuable products. Hence, various types of materials including both homogeneous and heterogeneous catalytic paths have been utilized for highly excellent carbon dioxide capture and conversion. Although homogeneous materials have showed excellent catalytic performance in different types of chemical reactions, there are some problems such as the difficulty in reusable and recycling, secondary pollution caused by the use of noble metal catalysts, and difficulty for separation and purification of products under mild conditions. To solve these problems, hence, heterogeneous system is more efficient rather than homogeneous because of their unique feature such as recyclability, separation, porosity, etc. Although some heterogeneous catalysts are consists of bulk or non-functionized materials, many materials which are not formed directly without the grafted of an additional material, known as supported catalyst. There are owing to the various responsible factors such as thermal stability, huge amount of pore, larger surface area which stabilized metal particles. As a new kind of crystalline porous materials, due to additional responsibility features like highly controllable skeleton structures, structural diversity, specific surface area and flexibility covalent organic frameworks (COFs) are designed by high surface area materials with periodic structures of regular and inflexible organic building blocks linked via covalent bonds can offer a larger scope in grafting a reactive metallic particles at its surface (Hu *et al.*, 2020; Liu *et al*, 2020 and Ghosh *et al.*, 2020). On based of the dimensionality of the monomer unit covalent organic frameworks can be prepared like 2D or 3D

materials. 2D COFs are formed from planar building units, creating sheets which π-stack to generate porous channels. Moreover, 3D COFs are usually developed from tetrahedral building units. In this regard, researchers across the globe are conscientiously working for synthesis of new strategies over the atmospheric CO_2 fixation and convert it into value-added products (Ghosh *et al.,* 2021). Consequently, there have been several reports drastically increased recently over COFs as shown in Figure 1 (Hu, 2020).

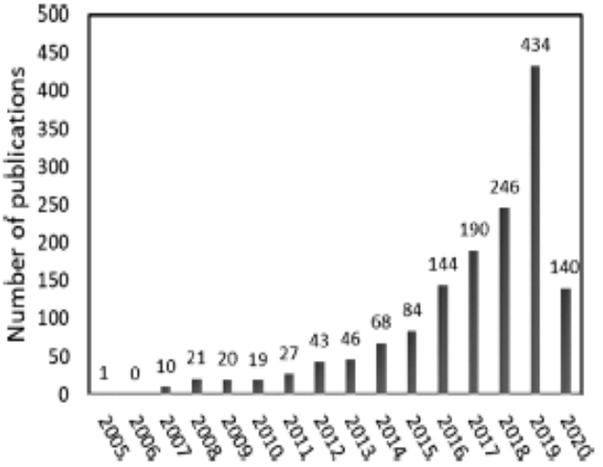

Figure 1: *Year- wise Publications Related to COFs* (Hu *et al*., 2020)

In the context covalent organic frameworks are a class of ordered crystalline porous materials that permit the periodically incorporation of natural gadgets to generate predesigned network-like morphology with high conjugated and modifiable structures and nanopores (Guo & Jiang, 2020) which have been illustrated as new promising applications for storage, catalysis, and optoelectronic programs. The variety of functional groups into the skeletons of COFs can promote catalytic platform for structural manage and useful layout. Indeed, architectures of covalent organic frameworks provide limited molecular areas over the interaction of photons, electrons, holes, ions and guest molecules, thus displaying precise homes and functions. However, COFs are synthesized by polymerization of organic monomer units and form periodically specific porous framework structures (Huang, Wang & Jiang, 2016; Diercks & Yaghi, 2017; Colson & Dichtel, 2013) (Figure 2).

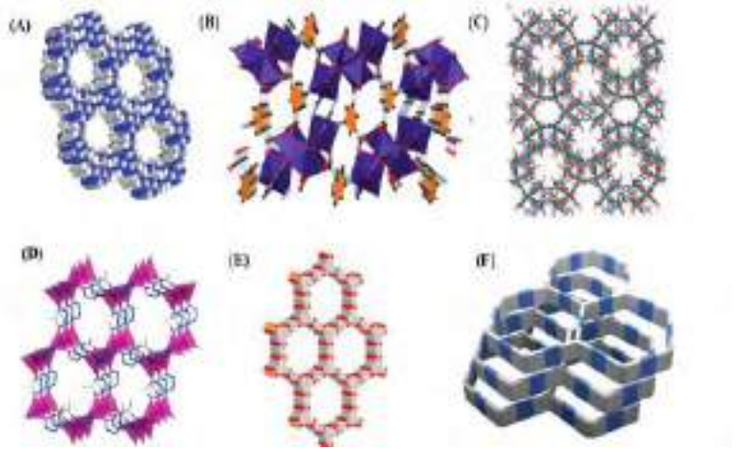

Figure 2: *Crystal Structures in Different Polymers (A) PC-POP, (B) MOF MUF-17, (C) usf-ZMOF, (D) UTSA-49, (E) COF-5 and (F) poly(benzimidazobenzophenanthroline) or BBL polymer.* (Ghosh *et al*., 2021)

Historically, in 2020 the first COF was developed by Nguyen's group, and since then a larger number of reports have been explored in various synthetic methodologies for the production of covalent organic frameworks materials. Different types of organic covalent linked monomers units have been formed for COF materials, such as boroxine (Zhan *et al.*, 2020), imine (Nguyen, Gropp & Yaghi 2020), azine (Dalapati *et al.*, 2019), imide (Lyle *et al.*, 2019), boronic ester (Qian *et al.*, 2020), hydrazone (Qian *et al.*, 2020), triazine (Wei *et al.*, 2019), phenazine (Guo *et al.*, 2013), have been published. There are highlighted some of the most common COF linkers are shown in Figure 3.

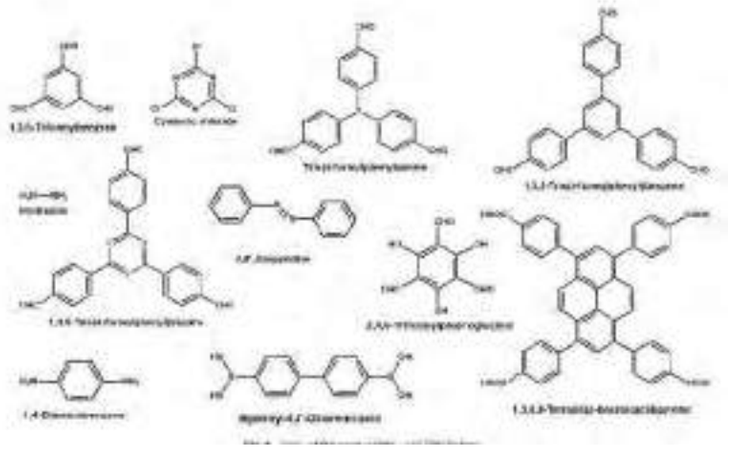

Figure 3: *Some General Used COF-linkers* (Imteaz & Jhung, 2021)

Therefore, due to their periodically, larger porous, and geometric structures, COFs can be emerged for various applications including adsorption (Guo *et al*., 2020), catalysis (Guo *et al*., 2020), filtration/separation (Wang *et al*., 2020), electrochemistry e.g., in batteries, energy storage, and redox catalysis (Li *et al*., 2020), and gas storage (Peng *et al*., 2020), so on. Furthermore, COFs have attracted and shown promising applications in recent time due to their potential in environmental remediation (Li *et al*., 2019). The most important applications of this material in environmental remediation are reflected in Figure 4 (Huang, Wang & Jiang, 2016; Wang & Zhuang, 2019; Lohse & Bein, 2018).

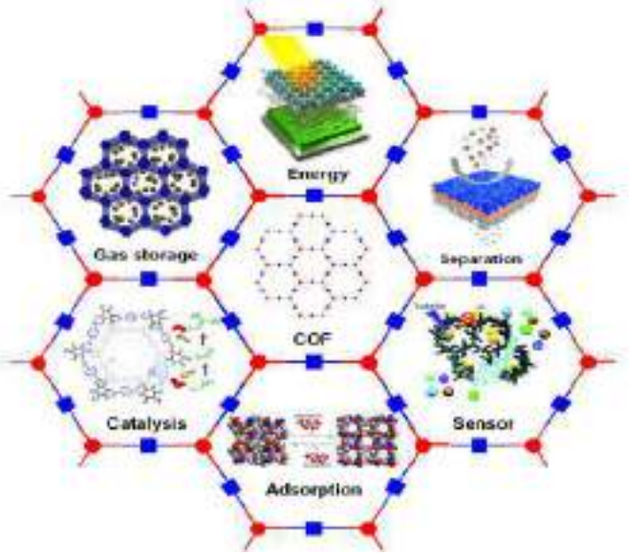

Figure 4. *Applications of COFs Catalyst as Environmental Remediation* (Imteaz & Jhung, 2021)

In this Review, we summarize the essential green-friendly development of covalent organic frameworks materials and latest achievements in growing novel layout ideas and artificial strategies. We spotlight modern useful designs and discover essential troubles that want to be addressed alongside destiny studies guidelines from chemistry, physics and substances perspectives.

REVIEW OF LITERATURE AND DISCUSSION

Preparation of COFs material

Hence, the preparation of a newly designed porous COF material with unique properties is more challenging work in different research field including organic chemistry, polymerization, material and reticular assembly. The basic syntheses of COFs are focused in Figure 5 and Figure 6 (Segura, Royuela & Ramos, 2019).

Figure 5: *Various Types of COFs for Functionalized Materials* (Imteaz & Jhung, 2021)

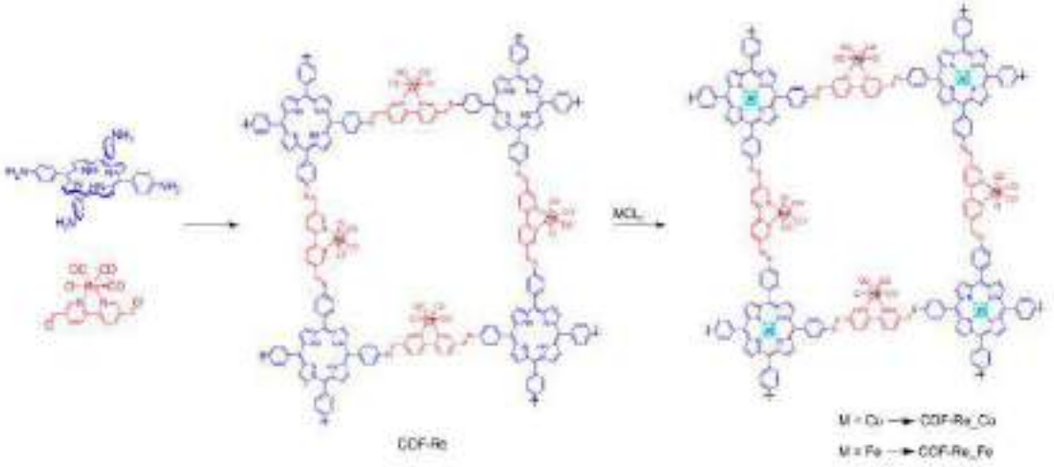

Figure 6: *Synthesis of COF via Pre-metalated Linker and the Post Metalation of Porphyrins* (Johnson, Haiges & Marinescu, 2018)

In particular, porphyrin materials are the one of the extensively valuable linker units for the preparation of grafted COF materials. They are naturally occurring complex which widely observed as biomimetic material as catalysts. Moreover, nanoparticles (NPs) have extensively application over the various types of fields such as catalysis, adsorption, separation, and so on (Imteaz & Jhung, 2021). But, due to their complexity in handling, in particular field, these porous materials have been used as support or scaffold materials to embed nanoparticles and then expand in their applicability. Further after embedded over materials it can enhance the chemical properties of the nanoparticles as well as the embedded COF material as result increased their catalytic power. Thus COFs containing NPs of Au (Pachfule *et al.*, 2014), Ag (Ghosh *et al.*, 2020), Cd (Thote *et al.*, 2014), and Pd (Chen *et al.*, 2015), imine-based COF and 3D structure of the Fe−COF (Kushwaha *et al.*, 2020) etc have also been reported.

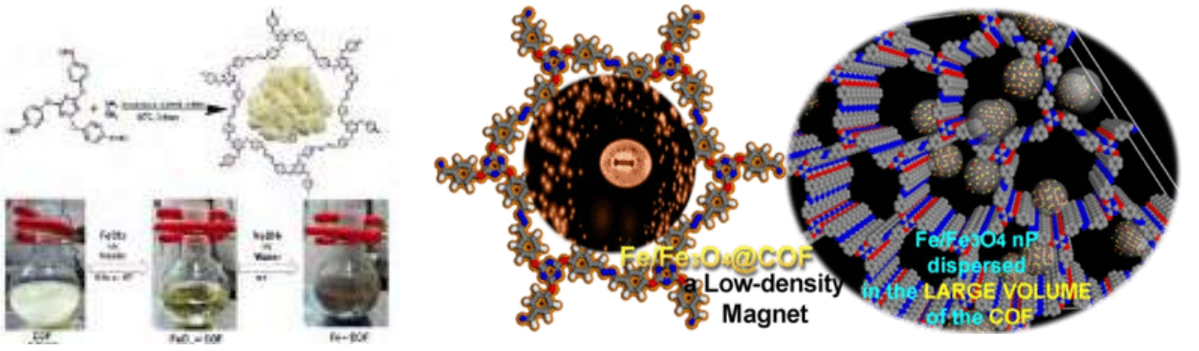

Figure 7: *Schematic Demonstration of the Preparation of the Imine-based COF and 3D Structure of the Fe−COF* (Kushwaha *et al.*, 2020)

The tubular and hollow TpPa-COF porous materials have been prepared via template-assisted replication of nano sized ZnO-nanorods. The hollow microporous TpPa shell shows some unique properties like high periodicity, chemical stability larger porosity, and capsule shaped morphology as shown from XRD, BET, TEM and SEM analyses. (Pachfule *et al.*, 2015). Recently there are explored the synthetic protocols in a various type of manners; some of the familiar methods like solvothermal, microwave, ionothermal, mechanochemical, sonochemical and light-promoted methods for the successful synthesis of COFs materials.

Application of COF material

Adsorption catalyzed by COFs

In recent years covalent organic frameworks-based adsorbents currently have attracted enormous interest. The two types of adsorption mechanisms have been held like ion-exchange and coordinative adsorption over the surface of the COF materials (Figure 8 and 9). Adsorptive removal method by COFs may be a very successful system to eliminate metal contaminants from water. A huge number of COFs have been published over the elimination of metal-containing ions from water by positive adsorption kinetics, adsorption power, and highly selectivity among various ions present in water. Furthermore, COF-grafted materials have not been broadly application for the adsorption of gases, even though the scope for their exploitation in this area may be very high. COFs grafted materials have been investigated mostly for CO_2 capture because of their abundant pore size low densities, and larger surface areas which exhibits advantageous path for CO_2 adsorption on its surface. However, Covalent Organic Framework fabricated by different active functional sites for CO_2 consumption generally contain with different, multitopic organic linked units such as imine, azo, azine and triazine (Chowdhury *et al.*, 2021). There are widely explored as efficient heterogeneous catalyst for chemical exploitation of Carbon dioxide like chemical fixation and reduction, respectively over several epoxides, alcohols and amines to getting fine chemical synthesis like cyclic carbonates oxazolidinones, carbamates, etc with remarkably yields.

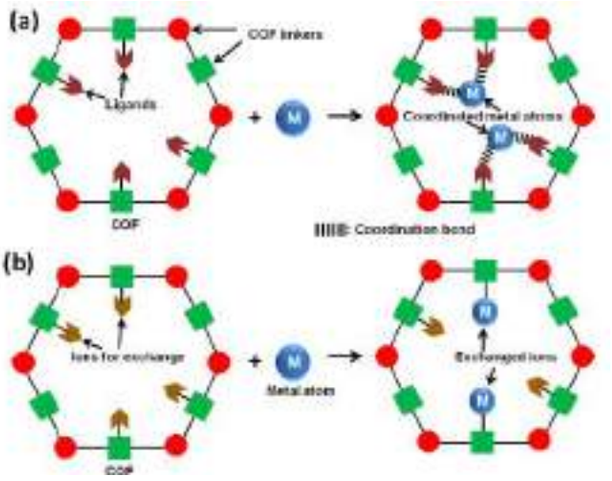

Figure 8. *Mechanism of (a) Coordination and (b) Ion Exchange over the Adsorption of Metallic Pollutants* (Imteaz & Jhung, 2021)

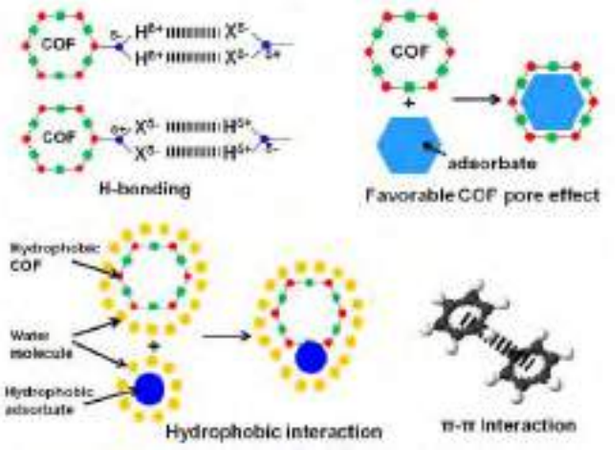

Figure 9: *The Mechanisms Hold Between Adsorbate ion and COF.* (Imteaz & Jhung, 2021)

It is highlighted the covalent organic frameworks (TpTta-1) constructing nanostructural 2D-hexagonal systems via one-pot polycondensation between Pa-1 (or Tta) and TFP. The highly stable synthesized TpTta-1 COFs have been substantiated as exclusive supporting agents for the grafting the novel metal nanoparticles, showed as excellent catalysts as the heterogeneous nature for CO_2 capture reactions.

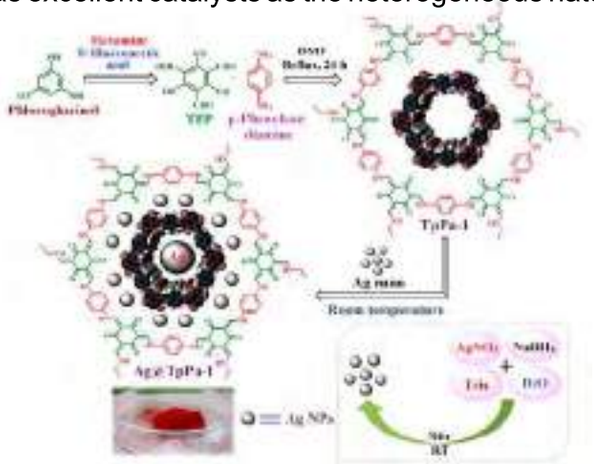

Figure 10: *Schematic Pathway for the Synthesis of Ag@TpTta-1 Nano-material* (Ghosh *et al.*, 2020)

Moreover, Conjugated Microporous Polymers (CMPs) based material followed by Covalent Organic Framework as photocatalysts which is highly potential one. Firstly, CMP materials exposed by the Jiang *et al.*, in 2007 (Chowdhury *et al.*, 2021) contains a π- conjugated backbone and a highly stable pore structure which make different them from non-porous conjugated polymers. CMPs are remarkable promising materials for diverse applications in catalysis, gas storage, sensor, biological, environmental remediation and so forth. (Figure 11)

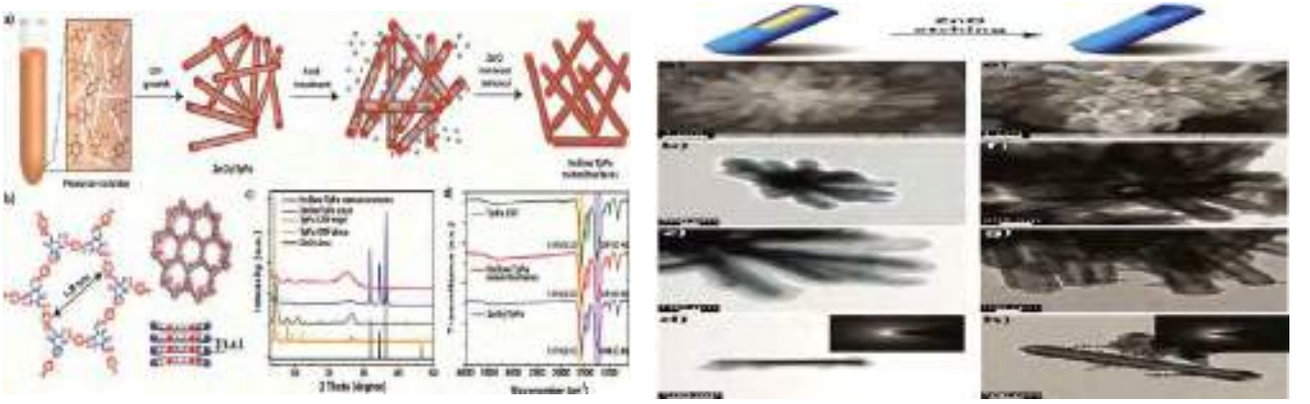

Figure 11: *Hollow and Tubular TpPa-COF Structures* (Pachfule *et al.*, 2015)

Therefore, due to low cost, larger amount of nanopores, huge porosity, high activity and stability, photoelectric features, CMPs have been explored in research as photocatalysts. CMPs can use as acceptor molecules in their three-dimensional pores, which build up the donor-acceptor compositions systems. CMPs contain permanent pores within a π-electronic framework and permit for highly efficient production of energy transduction systems with designable donor-acceptor constituents through physical confinement, without any change in the polymeric structure. Therefore, in view of the large surface areas and tunable pore flexibility for rational designing of CPPs, there are their capability to accept and transport light energy over the delocalized backbone, which provided light harvesting and energy transfer onto an adsorbed acceptor molecule to trigger physical/chemical changes towards the end product. (Figure 12)

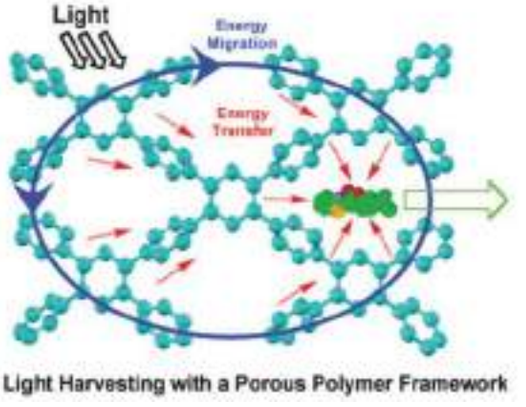

Figure 12: *A Illustrating on the Nature of Light Harvesting Catalyzed by Polyphenylene-based CMP* (Chowdhury *et al.*, 2021).

Nanoporous covalent natural framework for CO2 reduction under sunlight

Scientists have synthesized Sheet-like nanoporous COF (TFP-DM COF) nanocatalyst via solvothermal synthestic process (Chowdhury *et al.*, 2021). It has been shown the photocatalytic discount of carbon dioxide into formic acid and formaldehyde in presence of the synthesized Covalent Organic Framework (COF) because the energetic photocatalyst and water as a green solvent in

addition to sacrificial electron supply beneathneath atmospheric pressure. It provided that HCHO manufacturing rate is 36-fold better than HCOOH manufacturing rate in presence of white LED light irradiation. The catalyst confirmed true production of each the goods HCOOH and HCHO in presence of sunlight. Moreover, the COF cloth showed more reused any loss of catalytic activity power which proved as a highly efficient heterogeneous photocatalyst for CO_2 reduction under sustainable conditions.

Figure 13: *Production Procedure of TFP-DM COF Nano-sheet Catalyst* (Chowdhury *et al.*, 2020)

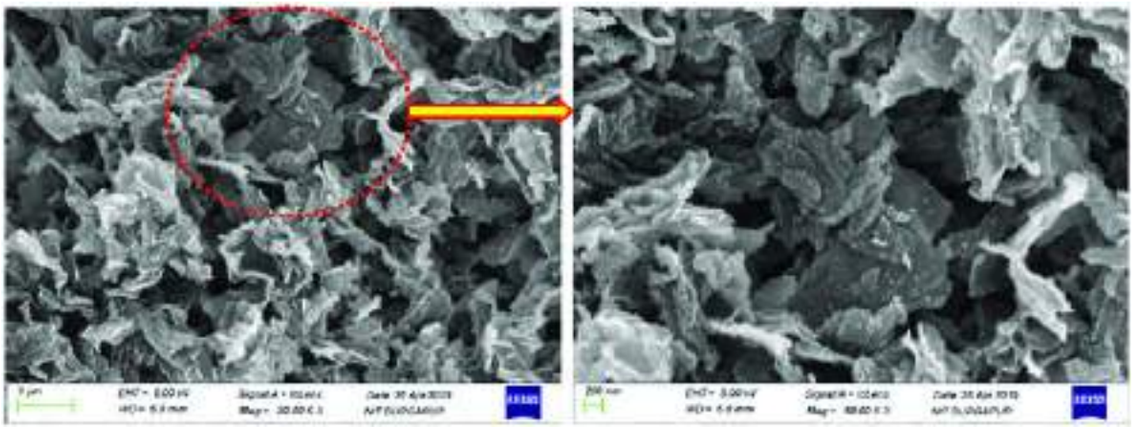

Figure 14: *FE-SEM of the TFP-DM COF Material*

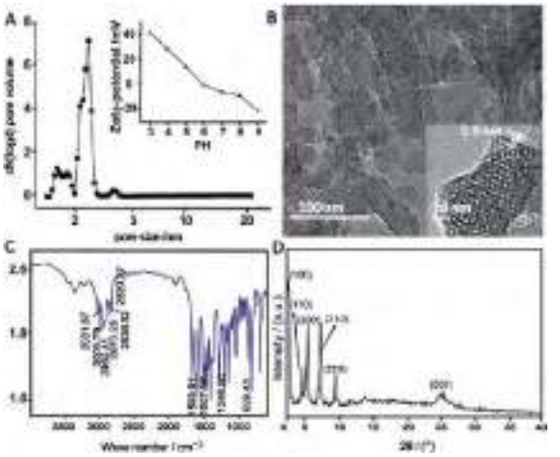

Figure 15: *Various Types of Characterization of TPB-DMTP-COF.*

The selective extraction of endogenous peptides catalyzed by covalent organic frameworks

The endogenous peptides are essential bio-elements; however, their short abundance and ample interference in biosamples obstruct their analysis. In this study, a singular nanoporous covalent natural framework become organized as well as efficaciously carried out for selective extraction of endogenous peptides from human serum. This novel porous materials exhibited robust retention and excessive adsorption capability closer to peptides, in addition to green exclusion of big proteins, ascribed to its robust hydrophobicity, uniform pore length (∼2.five nm) and big floor area (826.five m^2 g^{-1}). These capabilities facilitated the extraction of endogenous peptides from complicated biosamples, ensuing in 27 diagnosed peptides from tryptic digests of bovine serum albumin (BSA) blended with one thousand mass folds of BSA protein. Moreover, the adsorption charge of the peptides becomes three-six-fold quicker than that of proteins in this novel COF. After utility the unconventional COF to five micro litter human serum, 416 precise peptides had been definitely diagnosed. These consequences were proven the splendid homes of the unconventional COF in extraction of endogenous peptides. It is seen that COFs with adaptable natural constructing gadgets as well as precise physicochemical homes will succeed their capability programs in peptidomics studies (Zhang *et al.*, 2018)

CONCLUSION

Covalent natural frameworks are a very promising magnificence of nanoporous fabric, and 3D COFs, owning considerably better inner floor vicinity than their 2D counterparts, maintain great enchantment for packages which include separation, storage, and catalysis. But 3D COFs is afflicted by bad artificial accessibility due to kinetic factors, a deficiency in methodical expertise in their syntheses, and constrained topologies and constructing units. The article presented a short review on various types of covalent organic framework as catalysts, current trends, and their application in chemical fixation via CO_2 into value added chemicals. Improved systematic expertise of the COF synthesis response might permit for extra unique manage over the systems and pursuing in addition synthesis and characterization of unmarried crystals of a greater variety of COFs and systematic research of diverse response parameters must be a number one focus. Moreover, diversifying the constrained topologies and constructing blocks and setting up manage over community interpenetration might allow the belief of the overall ability of COFs as controllable and effortlessly tunable porous materials. Therefore, synthesis of porous heterogeneous catalysts and their applications in CO_2 capture and its chemical transformation into value added chemicals can provide enormously towards a sustainable development in the future.

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Nano Pesticides in Agriculture: Emerging Contaminants or a Road to Sustainability?

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ABSTRACT

Use of pesticides has gradually become one of the most imminent parts of modern-day agriculture. However, higher dosage of these chemicals has also inevitably led to many environmental and health hazards. Against this backdrop modern nanotechnology has led to development of nano pesticides, where the chemicals contain the carrier molecule, so called active ingredients (a. i) in nano size. Several formulations like nano emulsions, nano suspensions, controlled release formulations, solid based nano pesticides etc. have been developed recently by the research community to enhance effectivity of pesticides. The smaller size of the active ingredients of those nano pesticides helps in proper spreading of them on the pest surface thus assuring a far better action over the conventional ones. However, we all should always have a thorough understanding of the ill effects of those nano-pesticides too despite their tremendous usefulness, to traverse the road to sustainability.

Keywords: Nano Pesticide; Carrier Molecule; Controlled Release; Active Ingredient; Nano-Emulsion; Nano-Suspension

INTRODUCTION

(ENPs) the Engineered Nanoparticles are being utilized and can possibly be utilized in numerous mechanical areas including defence, energy age cum stockpiling, agribusiness, and natural remediation. Nonetheless, one area where utilization of such ENPs is getting expanding interest is the pesticide area, with the advent of an assortment of plant safety items named as "Nano Pesticides." These Nano pesticides include either minuscule particles of customary pesticides (active ingredient a.i) or other micro-scale, designed constructions with valuable pesticidal properties. During past one decade with introduction of these nano pesticides, nanotechnology has proved its potential to revolutionize agricultural practices (Konappa *et al.,* 2021). The main motto of this review is to explore the present status of those nano pesticides, their effective uses in agriculture and obviously to assess their environment friendliness as a way forward to sustainability. The main objectives of this review are to:

a) delve into likely uses of nanotechnology in nano pesticide preparation

b) enhance the solvency of poorly soluble active ingredients of nano pesticides

c) liberate active ingredients in a leisurely targeted way for viable utilization of these novel pesticides

d) save the active ingredients against untimely debasement for optimal use of these pesticides

e) identify impacts of these nano pesticides on the environment

f) analyse suitability of these nano pesticides as a future replacement of conventional pesticides

Thus, the main aim of this review is to explore 'Nano pesticides' in all aspects, their preparation, stability, effectivity and finally how much they will affect us in both good and bad sense and how much significant role it would play in future in the field of Agriculture.

What are Nano Pesticides?

The word Nano Pesticide comprises of two distinct words: Nano and Pesticides. Pesticides are items that assist us by securing the plants against different pests and the word Nano has a Greek origin which signifies 'dwarf" (Rajna & Paschapur, 2019). The size of the particles of nano pesticides goes from 5 nm to 1000 nm making them much smaller than even a strand of human hair. These novel

pesticides are so small that they can help in proper spreading on the pest surface and thus, a better action can be experienced compared to conventional pesticides. Ordinary bug sprays have significant drawbacks like float perils, functional dangers and leaving of deposits in the environment. They do influence non-target vegetation and life forms too. Recent exploration in the field of Nano pesticides can undoubtedly affirm that they can possibly revolutionize the horticulture sector. Nano pesticides have expanded viability, durability, and a decrease in the measure of (a. i) that should be utilized in each amount of nano pesticide (Kah & Hofmann, 2014).

LITERATURE REVIEW

Types of Nano Pesticide

Nano pesticide preparation consolidate a few surfactants, polymers, and metal nanoparticles within nm size range. The improvement of financially reasonable planning and adjustment strategies for such pesticides still remains the topic of intensive research. These pesticides can be best categorised by their expected outcomes influencing the environment. Afterward, subcategories were additionally done depending on the kinds of adjuvants and their anticipated inconsistencies as far as ecological destiny (Kah *et al.*, 2015). Be that as it may, as indicated by their sizes they can be further characterized in to four main categories as shown in Table1:

Table 1: Size-based Classification of Nano-pesticides

Type	Micro-Emulsion	Nano-Emulsion	Nano-Dispersion	Solid Nanoparticle
Size	(6-50 nm)	(20-200 nm)	(50-200 nm)	(1-100 nm)

a) Micro-Emulsion: They are isotropic and clear fluid combination of oil, water, surfactant, and co-surfactant to make it thermodynamically stable. Salt and different ingredients remain in the aqueous phase while subsequently oil might just be a rich combination of different hydrocarbons. As opposed to conventional emulsions, microemulsions are often shaped upon by basic blending of the segments and don't need any severe condition as utilized in forming customary emulsions. The three prime kinds of microemulsions are Direct, Reversed, and Continuous. The individual molecular size of these microemulsions is around multiple times less than the normal pesticide particles. Diverse types of scattering techniques are utilized to decide the microstructure of these emulsions. Nonetheless, the success of these techniques depends on the concentration of the dispersed phases, that need to be adequately low to keep away from any inter-particle interaction (Aswathanarayan & Vittal, 2019). Some popular microemulsions are Primo MAXX (by Syngenta), Banner MAXX, Subdue MAXX, Apron MAXX etc. These are thermodynamically stable systems allowing self-emulsification. The mean diameter of droplets is often below 0.2 mm. Such smaller size often yields exceptionally large interfacial area, enhancing proper spreading on the pest surface. However, despite all these advantages, use of an outsized concentration of surfactant and co-surfactant are also important here (Gelperina *et al.*, 2005) for stabilizing the droplets and this stability is often influenced by environmental parameters like temperature and pH too.

b) Nano Emulsion: Nano emulsions are emulsions with their sizes in the nano range, that are made for working on the smooth release of active ingredients. These have isotropic frameworks in which two immiscible fluids are blended to make a single phase by utilizing an emulsifying agent (surfactant and/or co-surfactant) to make them thermodynamically stable (Kumar *et al.*, 2019). Nano emulsions by and large have a higher kinetic stability and are frequently supposed to be metastable. However, their preparation is not much simple. Their production demands high-energy techniques that might be hard to follow for commercial producers and the onsite handlers alike requiring shear blending, high-pressure homogenizers, and super strong generators (Jaiswal, Dudhe & Sharma, 2015). Hence of late research has accordingly centred around fostering an assortment of reproducible low-energy emulsification strategies, which can be subdivided into two fundamental categories: Spontaneous method and Phase inversion temperature method. The precise mechanism by which these nano emulsions form and the way they develop their properties are still the topic of intensive research. The connection between nano

emulsion preparation and their structure and morphology are neither clear nor deliberate. Preparation of nano emulsions that remain stable throughout an adequate period of time still demands further investigation. Nano emulsions contain moderately lower fixation (~5-10%) of surfactants compared to microemulsions (~20%) and loads of preparation techniques incorporate a stage that comprises of dilution of a microemulsion to frame its nano structure. The droplet sizes reside typically within the range 20-200 nm (Prasad, Bhattacharyya & Nguyen, 2017). These nano emulsions have increased rate of absorption and enhanced bioavailability. However, the preparation procedure needs outsized concentration of surfactant and co-surfactant and finding their non-toxic variants is quite troublesome (Gelperina *et al.*, 2005). Stability variation of these nano emulsions influenced by changing environmental parameters like temperature and pH is also a major challenge.

c) Nano Dispersion: These are colloidal particulate frameworks within the submicron size range acting fundamentally as transporters of medication particles. Such dispersions are typically biphasic systems where one phase is intimately comingled with the other making the droplet size ranging within 0.1-100 µm (Jaiswal, Dudhe & Sharma, 2015). A few techniques are used for preparing such natural nanoparticles by dry or wet processing, extraction precipitation, and evaporation of solvent from emulsions. Accomplishing stability of such nano dispersions over delayed periods is truly difficult and help of surfactants or polymeric stabilizers becomes some of the time vital. Such dispersed nano crystals are broadly utilized in the food business for fuse of bioactive mixtures like carotenoids, phytosterols, and normal cell reinforcements and henceforth they are turning out to be progressively critical in the drug area as well. Despite high zeta potential (- 53 mV) value, these molecules often double their sizes within a couple of hours. Diffraction experiments affirm the amorphous nature of such nanoparticles, that make these nano dispersions readily soluble in the desired solvents and hence more active.

d) Solid Nanoparticle: In addition to the above-mentioned formulations, solid nanoparticles also can be used as nano pesticides. The inert dusts, like silica, alumina, and clays used in such pesticides often cause harm to the wax covering on the bug skin both through sorption and abrasion. This harm can result in significant loss of water finally prompting to dehydration of the insect. Among metals, silver, titanium dioxide and copper are mostly preferred as nanoparticles. The bactericidal and viricidal activities of these silver nanoparticles make them favourite to nanotechnology researchers. The low toxicity, inherent charge, larger area, and crystallographic structure increase its preference over others. The use of titanium dioxide to crops has already been proved to have effective antimicrobial and antifungal activity. Nano-copper formulations can also cause cell membrane damage of bacterial cells that has been proved effective against pomegranate bacterial blight at extremely low concentrations.

Solubility Enhancement of Nano Pesticides

The solvency of inadequately water-dissolvable active ingredients is regularly enhanced by utilizing added substances (e.g., surfactants), or by nanoparticulate development of the a.i., with a synchronous change in their rigid framework. As of now, the preeminent normal pesticide preparation for inadequately water-soluble a.i. are Emulsifiable Concentrate (EC)s and oil in water (O/W) emulsions. These ECs address about 28% of the whole number of preparations as recorded in the Pesticide Manual, 2007 (when contrasted with 43% in 1994). These ECs have organic solvent dissolved a.i. (initially xylene, though more secure choices are currently being utilized) and a blend of surfactant emulsifiers to ensure unconstrained emulsification of a.i into water inside the splash tank. The main impediments of these ECs are their poor stability after dilution, use of organic solvents increasing their cost and flammability and the dermal harmfulness of the overseers. O/W emulsions would thus be able to be proposed as substitution of these ECs, despite having their own drawbacks. They are generally thermodynamically unstable and often difficult to manufacture. Stability of O/W is much susceptible to storage condition and being bulky, often reluctant to move leading to container breakage. They are even susceptible to microbial contamination that may cause cracking. Non-achievement of uniform and correct dose is also another problem. To resolve all these issues, the preparation process often requires higher input of energy which is given by shear blenders or high value homogenizers.

Nano Pesticides vs Conventional Pesticides

Nanotechnology offers a tool for developing novel formulations of eco-friendly pesticides as majority of nano pesticide formulations are highly target specific. Targeted delivery and restricted liberation of nano pesticides can improve and optimize pesticide utilization and hence reduce residue amount and environmental pollution by Nano-microcapsule formulations (Saini *et al.*, 2015). Nano-pesticides improve adhesion of droplets on plant surface reducing drift losses and in turn improving the dispersion and bioactivity of a.i. of pesticide molecules. Thus, nano-pesticides do have higher efficacy compared to the traditional and conventional ones. Smaller size, drop flexibility, wettability, and target adsorption (when sprayed in fields), have made these nano pesticides most productive and environment friendly.

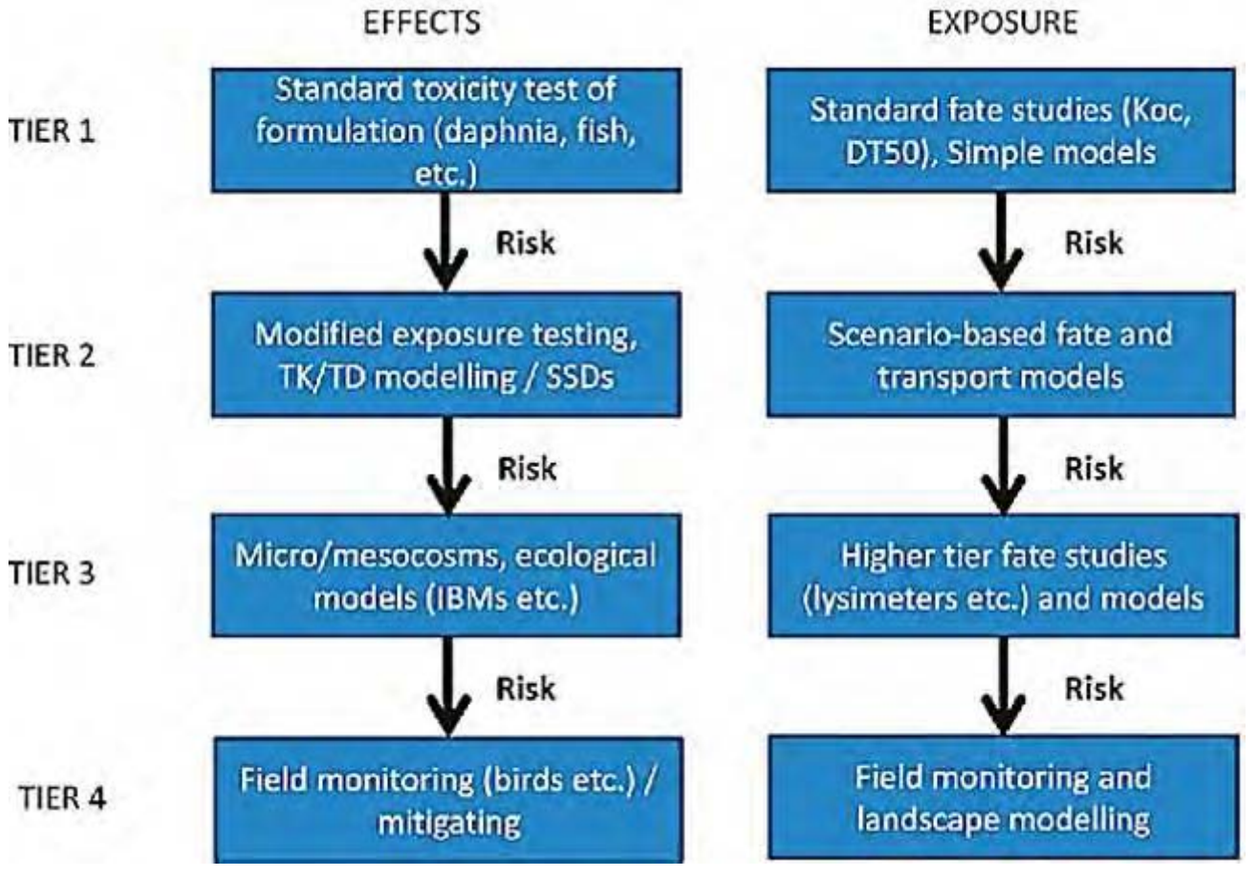

Figure 1: *Environmental Risk Assessment of Nano Pesticides by Four Tier Approach*

Environmental Risk Assessment

Natural danger evaluation of any item is generally fundamental prior to dispatching it on the lookout. To restrict the time, cost, and coordination required for these danger evaluations, a tiered methodology is normally utilized. A tier is characterized as a whole impact and exposure appraisal process prompting a fitting evaluation end point. Every tier includes assessment of a Predicted Environmental Concentration (PEC), which implies the assessed convergence of an exuberant substance in key natural compartments including surface water, groundwater, and soil. These PECs are then contrasted with that of Predicted No Effect Concentration (PNEC) (Kookana *et al.*, 2014). A diagrammatic portrayal of the general tiered danger appraisal approach presently utilized for pesticides is given in Figure 1. In future it very well might be feasible to foster exceptionally complex test techniques and demonstrating approaches that would have the option to precisely gauge the exposure and impacts of a nano pesticide in a specific circumstance in a shockingly better way than this tiered methodology. To push ahead in a common sense and implementable way, an objective system is necessitated that records for the critical contrasts between nano pesticides and the traditional ones. Albeit the expansive methodology of cutting-edge testing might be applicable for

impact evaluation dependent on the scope of at present used test living beings, however the destiny and type of a nano pesticide in an environment e.g., on a surface water body could imply that specific organic entities will have a more significant level of exposure than others. Along these lines, the tests ought to be more explicit. Even though hazard appraisal of natural blends is not normally needed for item hazard evaluation, it is conceivable that a nano pesticide will interface synergistically with different foreign substances through the Trojan-horse impact. The risk that nano-pesticides may pose to human and environmental health is thus not yet fully understood. They may create new kinds of contamination of soils and waterways since nano-pesticides are much more persistent and have higher degrees of toxicity compared to their traditional counterparts as shown in Figure 2.

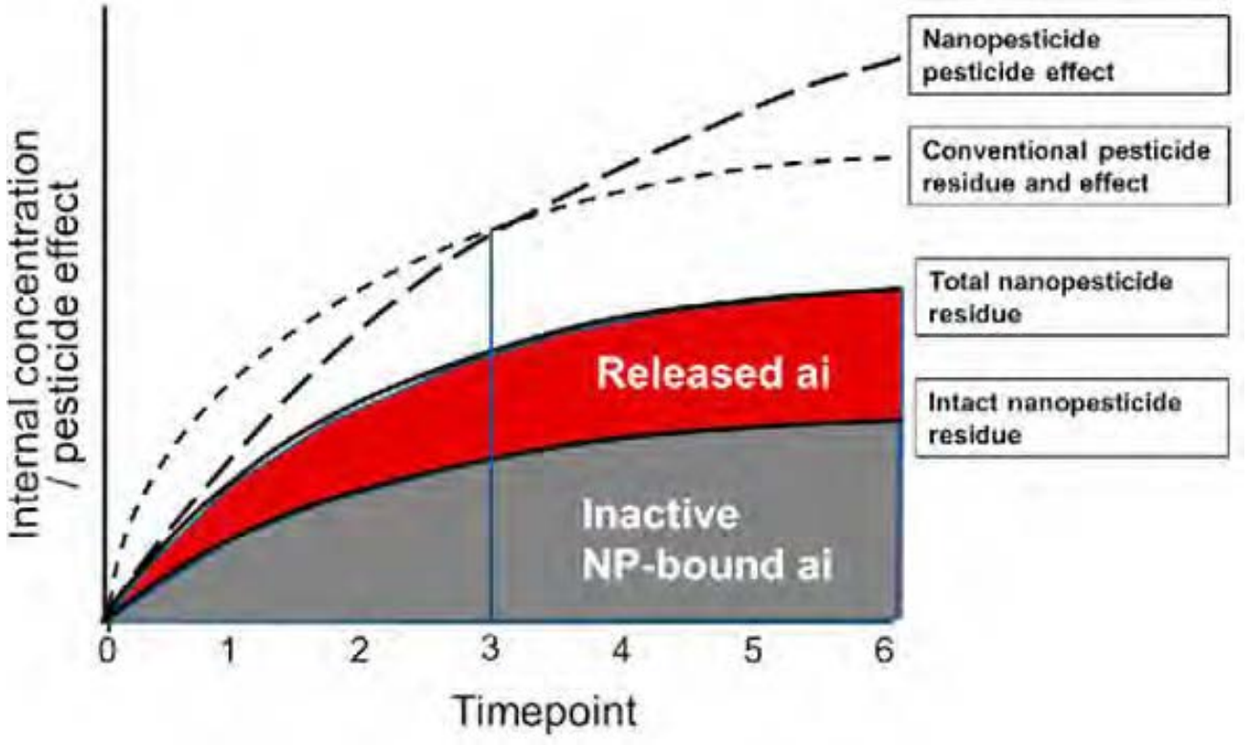

Figure 2: *Comparison of Adverse Effects of Nano Pesticides and Conventional Pesticides*

Therefore, a superior comprehension of the destiny and impact of nano-pesticides after their application is highly required. It would be good to take all the necessary safety precautions before deciding to go ahead and use these nano pesticides in large scale (Li *et al.*, 2019).

DISCUSSION

Nano pesticides address an appealing mechanical headway from the point of view of expanded viability and assurance of the climate and human wellbeing. The variables and cycles influencing the natural conduct and impacts of nano pesticides might contrast from "customary" pesticides, and subsequently new or refined danger evaluation approaches are required. In contrast to ordinary pesticides, the take-up, bioavailability, and toxicity of nano pesticides are subject to the molecule number fixation and molecule size dissemination, just as on the proportion of "free" and ENP-bound a.i. In this manner, variation of both existing and extra systems for investigation, portrayal, and impact appraisal are required. Since current information doesn't permit precise assessment of the exposure and impacts of a nano pesticide in a specific circumstance, a more sophisticated methodology combined with a hypothetical comprehension of how nano detailing may influence the toxicokinetic and toxicodynamic behaviour of the pesticide, is expected to additionally push ahead. These nano frameworks have shown extraordinary capacity of controlled delivery of a.i. making them more proficient. Moreover, nano pesticide showed further developed dissolvability and sound qualities of a.i.

for viable control of vermin. In any case, there must be work on the strategies for huge commitment in rural practices. Farmers generally utilize manufactured pesticides to oversee irritations to amplify crop yields, presenting expected dangers for laborers, customers, and the climate. However, metal connected, and agrochemical-based nano pesticides are found to be conceivably less toxic compared to those standard pesticides in plant safety, while fundamental oil and bioactive specialist based nano pesticides with control delivered detailing can possibly be utilized in natural food creation and sustainable farming. Nano-pesticides are often extraordinary means for fixing an eco-friendly and sustainable agriculture system by effectively reducing general chemical usage, decreasing toxic residues, and enhancing overall crop protection in general. However, more sophisticated, and enhanced research in this domain is desired for sustainable innovation and production of more effective, efficient, and safer nano pesticides (Li *et al.*, 2019). Development consistently brings about both downsides and advantages for human and ecological wellbeing. For example, the higher viability guaranteed for most classes of nano pesticides could assist with diminishing the amounts of a.i. applied however brought about a direct negative result of higher poisonousness for nontarget creatures (Kah & Hofmann, 2014).

CONCLUSION

Using Nano pesticides is an emerging aspect that future farmers will be using in a huge amount. But according to the researchers, nano pesticides are so small that they can affect the environment differently than the conventional pesticides. The upgraded activity of nano pesticides will unavoidably bring about both new dangers and new advantages to human and ecological wellbeing. It is indistinct whether the current administrative structure is sufficient for appropriate assessment and evaluation of these new items. The most modern nano pesticides contain novel a.i. like silver nano particles. Current ecological danger evaluation methodology is known to be insufficient for surveying such items. The new pesticide guidelines are probably going to eliminate some a.i. at present enlisted (EC 1107/2009, which came into power in June 2011). Thus, a thorough study on these nano pesticides is urgently needed to accurately assess their potential environmental risks that could finally decide whether they are only contaminants or can really help us to ride the path to sustainability.

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List of Abbreviations

- ENP- Engineered Nanoparticle
- a.i.- Active Ingredients
- E.C.- Emulsifiable Concentrates
- O/W- Oil in Water
- PEC- Predicted Environmental Concentration
- PNEC- Predicted No Effect Concentration

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A Review on Biology and Conservation Status of Olive Ridley Turtle (*Lepidochelys olivacea*) on The Coasts of Orissa, India

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ABSTRACT

Olive ridley sea turtle (Lepidochelys olivacea) was reported in India since1974 at gahirmatha rookery for arribadas (mass nesting), which is close to the Brahmani-Baitarani (Dhamra) River. Here, we abridged the detailed knowledge on turtle and geographical distribution of the population, threats and conservative measure in Orissa, using the whole information, collected from various references to reach at unity calculation and to attain trends.

Key words: Olive Ridley; Arribada; Conservation

INTRODUCTION

The Olive ridley turtles are the youngest and much plentiful of the seven species of all sea turtles and the measurement of the adults are approximately 65 cm tall (extending in a uniform direction without any bend or curve) and weight is 30-55 kg. With the anomalous of the Mexican Gulf, it is extensively spread across the tropics, with the highest populations in the north of India and Pacific Oceans which is in the east. They are renowned for their identical characteristic to build large nesting total amounts. This occurrence is called “arribada” (arrived in Spain). These Olive ridley turtles which have been classified as 'Vulnerable' in the IUCN Red List and are enlisted in Schedule I of the Indian Forest life (Defence) Rule (1972).

Turtles have been categorized as 'Vulnerable' in the IUCN Red List and fall under Schedule I of the Indian Forestlife (Defence) Rule (1972).

Olive ridley nests in mixed consistencies along the whole Indian east coast. The maximum significant nesting shores,are in Orissa, where pile nesting takes place. In the world's six, three are called main pile lodging shores that takes place. The three shelters of raven's are: Gahirmatha, Devi River mouth, and Rushikulya, are home to large percentage of the earth's olive ridley demography, which wanders to Indian seashore waters every winter along the Orissa coast.

Thousands of ridleys gather in suitable coastal waters during the breeding season, resorting to synchronized nesting involving thousands of individuals on appropriate nesting beaches.

Breeding occurs in surface coastal waters off nesting beaches (Patnaik, Kar & Kar, 2001). Generative quantity of these turtles went to the nesting shores, shortly found at Gahirmatha (Kalb, 1999). The Gahirmatha nesting was one time assumed to be the chief arribada nesting place for olive ridley turtles in the world (Bustard, 1976), although the number of nesting quantity (Shanker, 2020). The range of turtles nesting at Gahirmatha are estimated between 100k- 800k, in various years (Patnaik, Kar & Kar, 2001).

LITERATURE REVIEW

Nesting habits and Geographical distribution

India controls two main pile nesting places in Odisha –Gahirmatha and Rushikulya (Fig: 1) and the mostly invented little pile nesting place at Cuthbert Bay in the Andaman Islands.Sea turtle studies began in Orissa a tiny more than two years ago. Though, the earth's biggest known olive ridley rookery, at Gahirmatha, has remained mostly restricted. (Dash & Kar, 1990). Gahirmatha is the world's biggest known arribada rockery foe Olive Ridley turtles (Dash & Kar, 1990). With estimates ranging from 100000 -800000 individual turtles breeding there each year (Bustard,1976). Rushikulya has had the

main constant list of pile nesting over the last years.

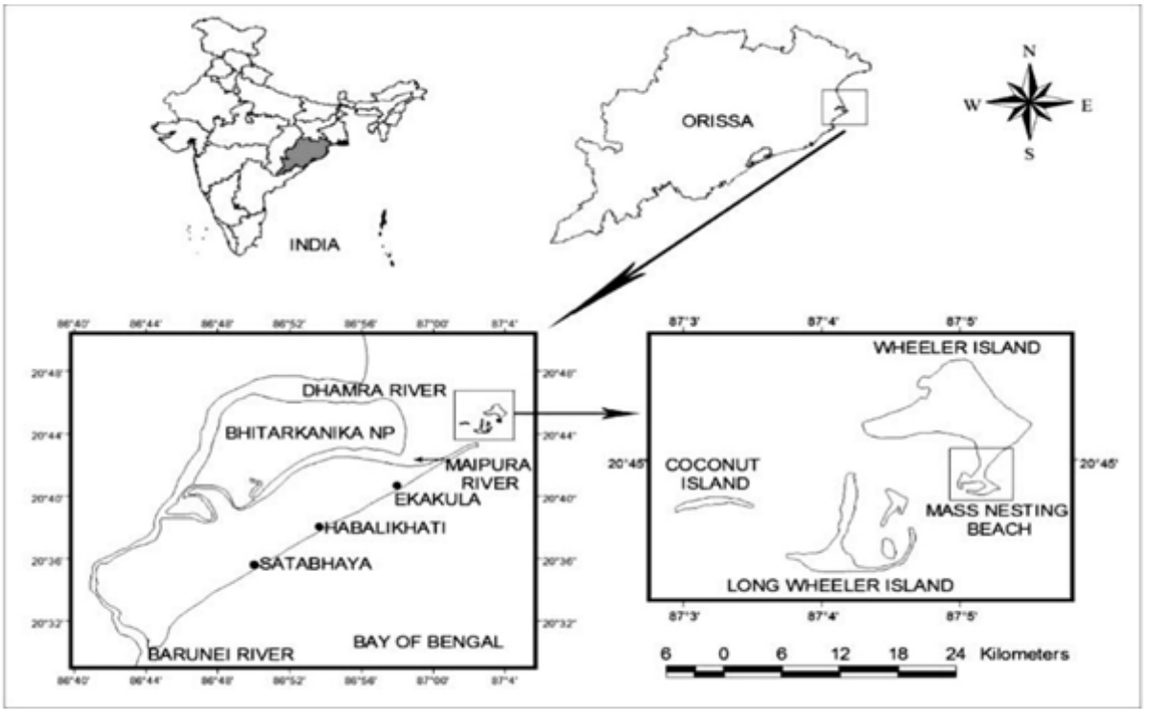

Figure 1: *Gahirmatha Marine Wildlife Sanctuary and Turtles Nesting Shores of the Orissa, India (Behera et al., 2016)*

Figure 2: *Outline Sketch of the State of Orissa, Showing Pile Nesting Places*

In 1981, a pile nesting place of olive ridley (Fig:2) was invented beside the Devi River in Orissa (Kar, 1982). The number of arribadas nesting at the Devi river that decreased to the point that they are no longer anticipated.

The Orissa Forest Department began tracking the nesting population in 1976, when the Gahirmatha rookery was discovered. Then, in 1978, in Gahirmatha, they started a tagging programme. Between 1978 and 1985 and there are 15000 raven's shelter places are found (Dash & Kar, 1990). Observing pile nesting at Rushikulya and Gahirmatha can reveal information on olive ridley turtle population

trends.
Between 1995 and 1999, the Indian forest life Institute fixed 10,000 nesting turtles and 1600 copulating couples in sea beaches. These turtles travel between pile nesting beaches, according to the findings (Pandav, 2000). Leastwise few Ridley turtles build shelter (where they can breed) to that locations, according to tagged turtles found in southern part Tamil Nadu and Sri Lanka. According to satellite imaging research, the collapse of pile shelter at Gahirmatha was expected a regular reason like decay along with a loss sheltering resident as a result of consecutive storms (Prusty, Sahoo & Mehta, 2000).

During the current observation, the shoreline in the middle of two rivers Dhamra and Bahuda measured regularly, record the amount of expired turtles cleaned the coast. Shoreline along this expansion classified in seven inquiry parts, main morphologic characteristics like some in-shore sights. (Fig:3)

Zone1 – Shore of Gahirmatha(35 km). This connects shoreline in the middles of Dhamara and Hansua and Udabali Island.

Zone 2– Shore of Paradeep (12 Km). This connects the shoreline in the middle of Port Paradeep and Jatadhara river.

Zone 3 –Shore of Kujang (40 km). This connects the shoreline in the middle of Jatadhara and Petaphutei river.

Zone 4 –Shore of Devi (30 km). This connects the shoreline in the middle of Devi and Kadua river and also Akashdia, Robert Islands.

Zone 5 –Shore of Puri (60 km). This connects the shoreline in the middle of Kadua river,
lake Chilka beside Brahmagiri.

Zone 6 –Shore of Chilka (60 km). This connects the shoreline in the middle of Lake Chilka and Rushikulya river.

Zone 7 –Shore of Ganjam (45 km). This connects the shoreline in the middle of Rushikulay river and village Dankur
outermost Andhra Pradesh.

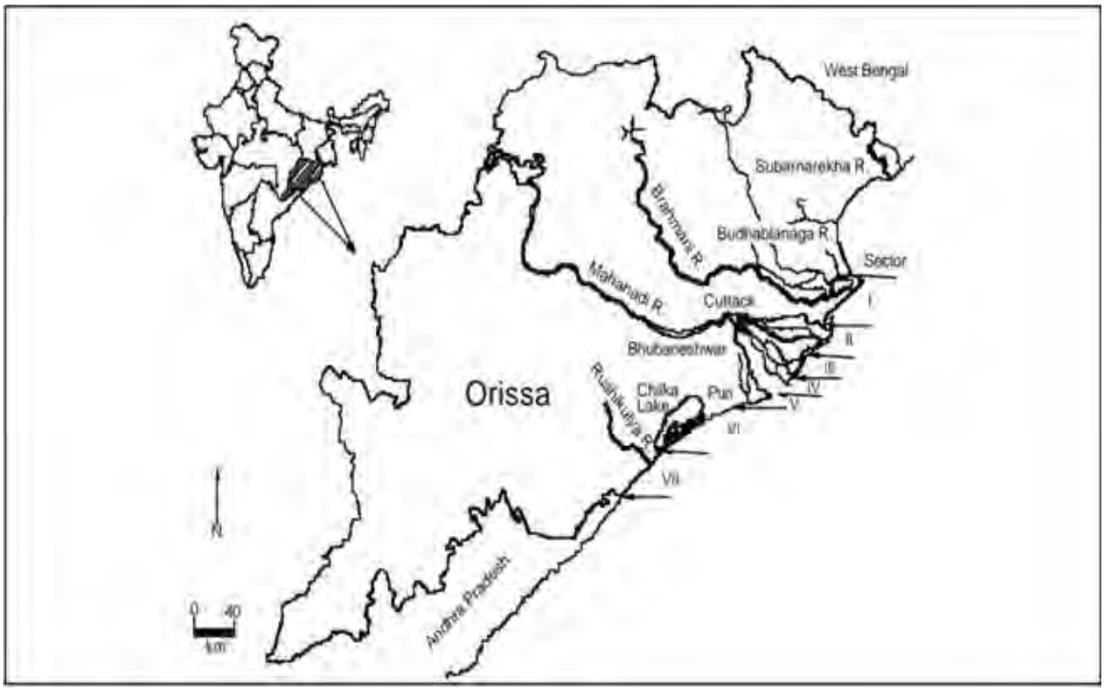

Figure 3: *For Methodical Range in Seaside, the Orissa Shore were Classified into Seven Inquiry Zones (Pandav & Choudhury, 1999)*

Threats

Throughout their lives, Ridley Sea Turtles are exposed to a variety of dangers and hazards. Absorption on breeding shores, marine and terrene resident degradation, fatality linked with coastal fishing (Behera *et al.*, 2016), and changes in the geomorphologic of the nesting shores are all examples of harmful human activities (Tripathy & Rajasekhar, 2009).The major risks to olive ridleys in Rushikulya are manmade, however activities like trawler fishing and huge gillnets are not as common along the Ganjam shore as they are on the other hand in Odisha. Uncontrolled mechanized fishing in places with high concentrations of sea turtles have produced in great-scale death of grown sea turtles in Orissa during the 1990s. (Pandav & Choudhury, 1999).

Natural hazards like as jackals, hyaenas, feral dogs, kites, and crows, in addition to anthropogenic concerns, impact intermittent nesting. It's critical to control these consequences and track how climate change is affecting population trends and the biology of this species. Sea turtles are preyed upon by a variety of animals, ranging from ants to jaguars. Hirth (1971), Stancyk (1995), and Dodd Jr (1988) provide excellent evaluations that classify predators according to the life stage of the sea turtles they feed on. Abiotic causes such as storms (Limpus & Reed, 1985) and temperature pressure frequently kill them (Meylan & Sadove, 1986; Witherington & Ehrhart,1989) Casuarina plantings along the nesting shores have resulted in a damage of nesting resident at the Devi River mouth, as well as simulated revelation from cities and expressways at the Rushikulya location (Pandav & Choudhury, 1999). By the mid-1990s, mortality had risen from a several thousand per before time 1990s to higher than 10,000 each season (Pandav, 2000). Based on evidence from recent arribada failures, a reduction in grown sizes, and significant fishery-connected fatality, an assessment of information showed that this population may be on the edge of collapse (Shanker, 2020).

DISCUSSION

Conservative measures.

1.Genus defence to the forest life (defence) Rule,1972.

Register reveal, Orissa freely supplied turtle meat and turtle eggs to local and distant markets such as Kolkata till the mid-1970s (Kar, 2001).The Forest Life Defence Rule(WLPA) started in 1972; As a result, olive ridley discovered along the shore in Orissa added to Act's Schedule I list of protected species. The WLPA announced the expense, dealings, victiming and wound of olive ridley's forbidden, its application and Rule at last guided for collapsing the dealings regarding turtles. (Kar ,2001)

2. 27th September 1997 announcement regarding the Gahirmatha Oceanic Sanctuary:

Gahirmatha was announced by the Orissa's Government, earth's greatest dwelling shores.The water of the greatest dwelling shores like the Oceanic Sanctuary in Gahirmatha takes place in WLPA's act regulations. Fishing operations in the core region are prohibited throughout the year, according to the GMS notification. However, the WLPA states that "appropriate steps should be implemented to preserve the professional attentions of tropical fishermen." The direct of transparent pathway of vessels and boats across local waters is not impacted by the advertisement, according to Section 26(2).

3.*The Laws regarding the Oceanic Fish's and the turtle related fish laws (1982)*

The Government of Orissa, issued yearly set up the Orissa Oceanic Fish's laws and rules, forbidding to catch fish from Gahirmatha dwelling seashore waters since 1994. This turtle conservation measures, and related laws are summarized in table 1 (Dash & Kar, 1990)

Table 1: *Conservation Actions and Allied legislation for Turtle protection (Dash & Kar,1990)*

Date	**Regulation**
Breed Conservation:	
1972	The Role for the Indian Forest Life Defense Act (WLPA) started. The Olive ridley turtle is now enlisted on Schedule I, which imparts utmost conservation under this Rule.
Fishingbank Governance Rule:	
1982 – 1983	Orissa Oceanic Fisheries Regulation Rule (OMFRA), 1982 and Rules established in 1983.
1983	OMFRA Rules established. It outlines various fishing areas for various fishing crafts.
Habitat Protection:	
1994	OMFRA Biannual orders preventing fishing at Gahirmatha. Reissued sequentially.
06.06.1997	The seasonal prohibition of OMFRA (January – June) on fishing by the surf caster at Devi and Rushikulya 20 km. over the sea radius. Reassigned sequentially.
27.09.1997	Announced of the Gahirmatha Oceanic Sanctuary (GMS) under the WLPA.
10.10.2003	The HPC or the High-power community confers that the federal Nation State Government repute offers for the areas like Devi and Rushkalia to be declared as Wildlife Harbour.
Twalling Rights:	
21.05.1998	The State High power community equips reductions on Twalling inside the Gahirmatha Harbour
Fishing Article Management:	
06.12.1997	OMFRA instruct compulsory utilization of Turtle Excluder Devices (TEDs) on surf casters.
17.04.2001	OMFR commands compulsory to use ‘mechanised fishing vessels’ for TEDs.
Legal Mediation:	
07.03.2003	Intermediate orders the Central Empowered Committee (CEC) of the Supreme Court of India for preservation of Turtle.
10.10.2003	The fishing has been banned by HPC for fishers and gill-netter in the mouth of the Rivers like Dharma, Rushkulya and Devi from 1st November to 3 1st May 2004.
07.04.2004	Amendation of CEC directions on fishing laws.

CONCLUSION

Lonely nesting of Olive ridley sea turtles occurred on 21km of shore between Gopalpur to Bahuda River Mouth on the Ganjam shore of Odisha, surrounding to the pile nesting shore of Rushikulya. A greater number of dwellers were laid in the middle of Markundi and Bahuda River mouth than Gopalpur to Markundi. Between the mouth of the Rushikulya River and Gopalpur, no turtle crawls were seen. 113 deceased turtles were also discovered throughout the research period, presumably as a result of encounters with fishers. The inhabitants of the olive ridley sea turtle help to save by the several efforts are underway across the world .When turtles come near to the shore for the hatch of their eggs in Nuevo Vallarta, Mexico, for example, little of them are moved to a hatchery, where they have a far greater scope of surviving. If the eggs were left on the shore, they would be vulnerable to a variety of dangers, including being swept away by the sea or being poached. The young turtles are taken to the shore and released as the eggs hatch. Another important operation in India to preserve the olive ridley sea turtle demography took place in Chennai, where the state forest life squad gathered over 10,000 eggs by the side of Marina coast, in which 8,834 conceived breeds were safely discharged within the sea in a staged way.

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Value and Conservation of Biodiversity in India

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ABSTRACT

India, a developing country has low per capita financial gain and 7.3% economic process rate. These merely implies higher utility of financial gain and lower temperament to pay for environmental benifits and amenities. Biodiversity has multiple advantages, however some economic obstacles like lack of applicable market rating, intangible nature of social profit derived by conservation of biological resources, possession issue, and traditional technique of value accounting, build some illusion to adopt market primarily based diverseness conservation approaches in developing country like India. This article reviews a brief summary of the recent Economic of Biodiversity Conservation in India. By reviewing this status of biodiversity in this Asian nation, areas which need serious attention may be enumerated.

India is rich in its biodiversity among one of the 17 mega-diverse countries. However, for lack of awareness regarding profits of its preservation, biodiversity is in steady decline. Economic activities like fisheries, agricultural, forestry, health, nutrition, energy, water supply, trade, industry, transport, and tourism depend on biodiversity and comprise the main concern of the country. Thus, for sustainability, conservation of biodiversity is important which can be achieved through integration of conservation priority and sustainable use of biodiversity in cross-sectoral strategies.

Key Words: Biodiversity; Conservation; Awareness; India; Economic

INTRODUCTION

Being a megadiversity nation, 7-8 percent of the world's recorded species and 4 of the 34 of the globally identified biodiversity hotspot in the world are located in India. Till now, more than 51,200 species of fauna and 45-500 species of flora reported in different biogeographic regions of the country (Goyal & Arora, 2009). India also has a variety of ecosystems from wetland to cold deserts, with hot regions of coastal zones to high altitude mountain competing diverse animals and plants. India also holds mangroves and reach marine diversity. It is 3rd largest fish producing county in the world (Goyal & Arora, 2009). The vast coastline of India extends 7,517 km in total with estuaries, mangroves, lagoons, backwaters, rocky coasts, salt marshes and coral reefs. With 21.67% of forest cover the country is reach and unique in biodiversity component.

This rich biodiversity is steadily declining due to the value of biodiversity and lack of awareness for inadequate forest protection planning. According to the International Union for Conservation of Nature. According to the International Union for Conservation of nature (IUCN, 2020). 78 species of birds, 94 species of mammals, 30 species of reptiles, 66 species of amphibians, 113 species of invertebrates, 122 species of fish, and 255 species of plants are listed as 'Critically Endangered', 'Endangered' or 'Vulnerable' in India.

India's forest is amongst biologically-reach terrene systems. Different forest types like temperate, tropical, and boreal forests provide varied sets of habitats for organisms and cherish the overwhelming majority of the world's terrene species. In past timber collection was one of the major purpose of forests. But now a day it is realized that forests are also important for natural disaster mitigation, drinking water purification and for overall welfare of human civilization (Bolund & Hunhammar, 1999). Environmental degradation, population explosion etc. threatening the forest biodiversity of India. As a signatory of convention on Biological diversity (CBD), India has taken initiatives on conservation of biodiversity and it's sustainable and equitable. India already impose a strong legal and policy programs for biodiversity conservation (Bhattacharya, 2018).

LITERATURE REVIEW

Benefits and value of Biodiversity:

1. Consumptive use Value: Direct use of wood, food, fuel wood, animal by local communities.

2. Productive use Value: Biologists use biologically rich areas to explore the potential genetic characteristics of plants or animals that can be used for the propagation of improved varieties of crops used in agricultural and afforestation programs or for the development of improved livestock. To healthcare providers, through biodiversity new drugs are recognized from animals or plants. Industrialists consider biodiversity to be a rich storehouse from which new products can be made. According to agricultural scientists, biodiversity is the basis for the development of improved crops. The pharmaceutical industry constantly identifying wild species of plants located in free natural forests producing compounds of economic value.

3. Social Values: The social concern of Traditional communities closely linked to the useful and productive value of biodiversity. 'People of the ecosystem' value biodiversity through cultural and religious sentiments as part of their way of life. The conventional agricultural system has large crop cultivation and it gives legitimacy to a wide range of crops for production and marketing throughout the year.

4. Ethical and Moral Values: Ethical values related to the conservation of biodiversity are based on the consequences of all kinds of life saving. All kinds of life have the right to exist on earth. Humans are part of the world's largest species of family. Considerable numbers of sacred groves are preserved by tribal people in several states of India, one of the major philosophies of our culture.

5. Aesthetic Value: Biodiversity is a magnificent and gorgeous natural aspect. The appreciation of information and the presence of biodiversity for its own benefit is another reason to preserve it. Other than source of food wildlife is a vital tourist attraction.

6. Sustainable Value: Sustainable value is the ability to keep future possibilities open for their use. Biodiversity connects the full range of living organisms, from which humans have been selected by enviable traits; Biodiversity through cost, adaptation and rearing has helped to cope with drought periods by providing crop varieties that are able to withstand such environmental pressures more than others. Characterized by its diverse climate and terrain, and 10 distinct biogeographical regions, India supports a wide variety of forests and includes three global terrestrial biodiversity hotspots. Mainly the forests nurture majority of the terrestrial biodiversity. Instead of taking several measures biodiversity loss continuing mainly for human interference. Constant monitoring of loss of biodiversity is needed as biodiversity conservation remidies.

Threats to Biodiversity in India:

India faced an incredible rate of industrial growth and urbanization over decades. Though development is indispensable for nation's growth, it has frequently been at the expense of some environmental loss without the consideration that development and environment can effort hand in hand. The natural assets of our planet are sinking rapidly due to anthropogenic activities. The IUCN (2020) revealed the extinction of 784 species of flora and fauna in last 500 years. Universally over 15,500 species are facing the threat of extinction. It is now accepted that global biodiversity will be considerably affected by climate alteration, although its exact impacts are still imprecise (Hunde, 2007). In India main causes of biodiversity depletion include:

1. Water pollution: Biodiversity can be lost due to eutrophication of water body for nutrient enrichment.

2. Air pollution: Air pollution leads to biodiversity loss. Climate change caused by greenhouse gas emissions (CO, CH, etc.) and eutrophication of vegetation caused by excessive nitrogen emissions (NO, NH, etc.).

3. Land use change: Land use pattern is a major cause of biodiversity loss. Agricultural lands and

grasslands are on the way out and becoming more and more patchy leading to ultimate disappearance.

4. Soil pollution: Microbial population may influence soil pollution modifying nutrient recycling in the soil.

5. Invasive non-native species: Invasive non-native species exert threat to biological diversity as they out compete and displace native flora and fauna.

6. Climate change: Climate change is expected to worsen the pressures on biodiversity caused by the drivers above.

7. Habitat loss and fragmentation: This is the one of the major factors lashing animals and plants to extinct. Tropical rain forest facing major habitat loss.

Ultimately, loss of biological diversity may lead to (a) loss of agricultural crop, (b) loss of resistance to climatic disasters like drought and (c) enlarged changeability in ecosystem processes like plant productivity, water use, pest and disease cycle (Roe, 2019).

DISCUSSION

Efforts of Indian Government for Wildlife Protection:

Functioning of Biodiversity Board: - National Biodiversity Authority (NBA), the national level authority, in collaboration with State Biodiversity Boards (SBB's) at the provincial level and Biodiversity Management Committees (BMC's) at the local stage works together to implement biodiversity strategies and conservation practices. The NBA is a statutory and independent body that performs facilitative, advisory and regulatory functions for the Government of India. It focuses on conservation issues and sustainable utilization of biological wealth and fair and equitable sharing of these biological resource profit. NBA is in charge of maintaining the Indian Biodiversity Information System (IBIS) and giving approval to individuals and entities that want to use biological resources or biodiversity knowledge.

Local populations in urban and rural areas set up BMCs as autonomous bodies. They are responsible for promotion of conservation, sustainable use and documentation of biological diversity, conservation of land races, folk varieties and cultivars, domesticated stocks and breeds of animals and micro-organisms and documentation of knowledge relating to biological diversity. Since BMCs are at the ground-level, they do most of the work and report to the NBA via their respective SBBs.

BMCs consist of a Chairperson and six appointed officials of which one-third are women. The six members of the council appoint the Chairperson for the Panchayat or Municipality. BMCs, in consultation with the local villagers are responsible for creating and updating People's Biodiversity Register (PBRs), a database comprised of information on accessibility and knowledge of local biological assets, medical knowledge of resources etc. The database is maintained and validated by the BMC's and prepared through consultative processes with research universities, surveys, governmental departments, NGOs, academicians and panchayats. The PBRs are accessible to the general public but foreign entities and NRIs need approval from the NBA to access its knowledge (Emerton, 2001).

BMCs are aided by researchers, scientists, and students to document information. Thereafter, the information is compiled in an electronic database, IBIS. This information is created to manage natural resources in a decentralised system and create a means of equitable benefit sharing for commercial uses. However, because most information lies in oral, written and folk tales, it is not documented.

BMC's collect money for their funds by levying fees from foreigners who wish to access their database and by some funding provided by the SBBs and NBA. All three levels are ultimately under the jurisdiction and funding of the Ministry of Environment, Forest, and Climate Change (MoEFCC). The funds are managed primarily by the SBBs and used for the conservation of biodiversity and the

betterment of the community. The Management Committees also prepare an annual financial report, which is audited in discussion with the Accountant General of the State. Grants and loans are issued from the NBA and SBB as well. Funds are kept in a bank and accessible to the local authority (Bhattacharya & Tangri, 2017).

Wildlife Conservation:

The wildlife conservation is a method of protecting wild species and their natural habitat from the various threats like poaching, killing, smuggling etc. by protecting them; we can enhance, restore and protect the ecosystem. For wildlife conservation, several measures are taken at the national and international level. Many NGO's are working towards wildlife conservation. Convention on International Trade in Endangered Species of Wild Flora and Fauna commonly known as CITES in 1973 is one of the prominent agreements at International level (Bolund & Hunhammar, 1999). It lists the various species into different -different categories.

There are two types of wildlife conservation: In-Situ conservation and Ex-Situ conservation.

In- situ conservation: In this, the species remain in their natural habitats and the places is protected through protecting the whole ecosystem of the place—example: wildlife sanctuary.

Ex- situ conservation: In this, the protection of biodiversity or wild animals are taken from their natural habitat and transferred to a new place. Example: the so many efforts are made by countries at the national level. India also launched various campaigns, acts and policies to curb out this issue.

Policies for Legislation

Agricultural Policies: - The National Agricultural Policy (NAP) was created in 2000, initiated by the Indian Ministry of Agriculture and made public by the NDA Government. However, it is no longer existent. The National Policy for Farmers (NPF) of 2007 is independent of the NAP but places a lot of importance on biodiversity and was initiated by the Ministry of Agriculture as well. India has a long history with implementing and revising fishery policies, starting with the Deep-Sea Fishing Policy that was created due to fishermen concerns and protests, in 1977. The Deep-Sea Fishing policies of 1991 were instated, with the 1994 policy being enacted by the Ministry of Agriculture. This was followed by a revised version in 2002. Later, the Comprehensive Marine Fishery Policy was created in 2004, but it is not a replacement for the deep fishing policies.

National Land Use Policies: - The Ministry of Rural Development, the Ministry of Agriculture, and the Ministry of Environment and Forests are liable for conservation and management of land assets. The National Land Use Board in 1984 framed a draft on National Land Use policy, which was endorsed by the National Land Use and Conservation Board in 1986. The current draft is derived from the National Land Use Policy of 1988.

Water Policies: - The National Water Policy of 2012 is a revision from the 2002 version, neither of which mentions biodiversity. The Ministry of Water Resources manages the National Water Framework Bill of 2016.

Tourism Policies: - In 1982, the Indian Government introduced National Tourism Policy, which got revised in 1997. In 2002, the New Tourism Policy was introduced. Subsequently, using the existing framework of National Tourism Policy 2002, the Ministry of Tourism drafted the New Tourism Policy 2015 and it is still being discussed.

CONCLUSION

For the protection of environment, the Constitution of India includes precise measures. Article 48-A states that “the state shall endeavour to protect and improve the environment and to safeguard the forests and wildlife of the country.” Article 51-A (g) states that “It shall be duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have

compassion for living creatures." These measures highlight the national principles on the significance of environment security. The need of the hour is to develop a catalogue of recorded species. Over 200 years of various surveys and research have resulted in a lot of information. But it is unorganised. Thus, it needs to be digitised and made easily accessible while protecting intellectual property rights. Human resource development activities need to be created for those who interact mostly with biodiversity (for example, wide variety of users, data generators, data managers and different policymakers). Many emerging areas can help in preventing biodiversity erosion. But they need to be done sustainably.

ACKNOWLEDGEMENT

The authors express their sincere thanks to Department of Biotechnology, Government of India for the funding from DBT-STAR College grant, under which this review project was conducted. They are also grateful to the Principal and the DBT-STAR Coordinator, Surendranath College, for their support and encouragement in implementing this review project at undergraduate level.

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Study of Wetland Ecosystem

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ABSTRACT

A wetland is a particular biological system that is overwhelmed by water, either forever or occasionally. it is recognized by its interesting hydric soil and presence of trademark vegetation around it. Ramsar Convention held in Iran in the year 1971, characterizes the wetland to be a remarkable regular body which support the jeopardized species and furthermore upholds species significant of biodiversity of that geographic terrain. While we might be uninformed about the significance of wetland, it is the help for the people groups who lives around it. Also, it supports the neighborhood biodiversity and goes about as a cushion against cataclysmic events like flood and cyclone. The loss of wetlands in the recent times is very disturbing. This can be because of filling of the land, expulsion of vegetation, land Clearance for agrarian or mechanical employments. The effects of these activity can be extremely serious. It can bring about immense biodiversity misfortune, changes in the topographical territory, loss of business and other long-haul results.

Keywords: Wetlands; Biodiversity; Biogeography; Ramsar Convection; Endangered Species; Hydric Soil.

INTRODUCTION

Wetlands are regions where water coverts to the soil, or it is available close to the outside of the dirt the entire year is changing timeframes during the year, including during the developing season. Water immersion (hydrology) generally decides how the dirt creates and the kinds of plant and creature networks living in and on the dirt. The delayed presence of water makes conditions that favor the development of uncommonly adjusted plants (hydrophytes) and advance the improvement of trademark wetland (hydric) soils. The dirt around there is either waterlogged or lowered under shallow water for a significant stretch – from a little while to the entire year (Finlayson *et al.,* 2018). These regions are covered by plants which normally don't happen in the encompassing damp or dry land as they require flooding for no less than half a month during their life cycle.

LITERATURE REVIEW

As per Ramsar Convention held in Iran in the year 1971, the models to be a wetland are: -

- It contains a delegate, uncommon or exceptional illustration of a characteristic or close normal body found inside the suitable biogeographic district.
- It upholds helpless, endangered or basically imperiled species or threatened biological communities.
- Its help plant and additionally creature species imperative to keep up with the biodiversity of that geographic area.

Figure 1: Ramsar Wetland Chilika Lake

Ecological substance of wetlands

Most supplements, like sulfur(S), phosphorus(P), carbon(C), and nitrogen(N) are found inside the dirt of wetlands. Anaerobic and vigorous breath in the dirt impacts the supplement cycling of carbon(C), hydrogen(H), oxygen(O), and nitrogen(N) and the dissolvability of phosphorus(P) in this manner adding to the synthetic varieties in its water. Wetlands contains a ton of particles got from biochemical pool and pathways. Those are:

1.Calcium particle, magnesium particle, sodium particle, sodium particle, potassium particle, chlorine particle, SO_4, HCO_3, SiO_2.

2.Dissolved oxygen.

3. Corrosive.

4. Methane.

5. Iron and sulfur.

6. Silica.

7. Phosphorus and Nitrogen.

Types of wetlands

Two sorts of wetlands could be found along the Atlantic Coast for example Flowing or Coastal wetlands and Non-flowing or Freshwater wetlands (GKToday, 2016).

i. Flowing Wetland

Flowing Saltwater and fluctuating water levels brought about by flowing activity couldn't be an appropriate climate for the vegetation. Evidently, many shallow seaside regions remain unvegetated mud pads, however plants like Spartina figured out how to embrace this climate.

ii. Non-Tidal Wetlands

Freshwater wetlands are generally seen inside floodplains, waterways, and streams. Arranged in disconnected despondencies, they are regularly encircled by uplands, along the edges of lakes and lakes. They are likewise situated on other low-lying regions where groundwater blocks the dirt surface. These swamps support the development of different bushes and trees.

Figure 2: Types of Wetlands

iii. Wetlands of India:

1. Andhra Pradesh- Kolleru Lake

2. Assam- DeeporBeel

3. Gujarat-Nalsarovar

4. Himachal Pradesh- Pong Dam Lake, Chandertal Wetland, Renuka Wetland

5. Jammu and Kashmir-Surinasar-Mansar Lakes, Hokera Wetland Wular Tsomoriri

6. Kerala-Sasthamkotta Lake,Vembanad-kol wetland, Ashtamudi Wetland

7. Manipur-Loktak Lake

8. Madhya Pradesh-Bhoj Wetland

9. Odisha Bhitarkanika Mangroves, Chilika Lake

10. Punjab Ropar, Kanjli, Harike Lake

11. Rajasthan Keoladeo National Park, Sambhar Lake

12. Tamilnadu -Point Calimere Wildlife and Bird Sanctuary

13. Tripura- Rudrasagar Lake

14.Uttar Pradesh-Upper Ganga River

15. West Bengal- East Calcutta Wetlands

Significance of wetlands

- **Wetlands are various worth frameworks**

Wetlands don't simply do a certain something. They perform many cycles all the while and hence they give a set-up of qualities to people. Enhancing for one is typically to the detriment of another.

- **Wetlands are among the most useful environments on the planet**

Environment, geography, topography and development and wealth of water decide the plant and creatures in every wetland. An enormous assortment of species can be found going from microorganisms, plants, bugs, creatures of land and water, fishes, reptiles, birds and vertebrates.

- **Flood control**

Wetlands work as a wipe which soaks up water that accompanies tides or flooding stream.

- **Amusement and Tourism**

When visiting a wetland, anyone can appreciate between bird watching, climbing and so on It goes about as a Hub for nature sweethearts.

- **Storage facility of Raw Materials**

They have plenitude of assets like food, water, crude materials for structures and clothing's which offer help to nearby people.

- **Boundary against catastrophic events**

It goes about as a characteristic cradle against crushing impacts of typhoons and tornadoes.

- **Carbon Sink**

In view of the dirt's found in the wetland, they can store carbon for many years. They assume a significant part in battling environmental.

Figure 3: Illustration on Importance of Wetland

Wetland's misfortunes a danger to environmental equilibrium

Wetlands are perhaps the most undermined territories of the globe. Indian wetlands are progressively confronting a few anthropogenic pressing factors. These have prompted hydrological bothers, contamination and their effects. The topping off wet regions with soil comprises intense misfortune while the continuous end of backwoods cover with ensuing disintegration and sedimentation of the wetlands over numerous many years is named as constant misfortune.

Intense wetlands misfortunes

Hydrologic adjustment – Hydrological alteration can modify the presence of wetlands. The progressions of hydrology incorporate the expulsion of water from the wetlands and raises the land-surface, with the end goal that it does not flood anymore (Bruni, 2016). Beginning expansion in the yield usefulness has given a way for the decreased of richness and salt gatherings in soil because of inundated cultivating of dry soil.

Persistent wetland misfortunes

Presented species and eradication of local biota. Addition of intriguing aquatic plants like water hyacinth (terror of Bengal) has undermined the wetland and obstructed those streams contending with the local vegetation. In a new endeavor at prioritization of wetlands for protection, someone noticed that near about of 700 potential wetlands don't have any information to focus on a large number of these wetlands.

Figure 4: Invasion of Local Water Body by Water Hyacinth

Urbanization and land use changed urbanization applies extensive effects on the capacity and design of wetlands, basically through altering the hydrological and sedimentation systems, and the elements of compound toxins supplements and synthetic pollutants. Further, helpless administration of water bodies, absence of substantial protection plans, rising contamination, and fast expansion in restricted requests for water are pushing these valuable eco-balancers to elimination. Horticultural, metropolitan and mechanical contamination as outcome of heightening of agrarian exercises during recent many years. According to gauges, 10-15% of the supplements added to the dirt through composts eventually discover their direction to the surface water framework. High supplement substance energizes algal development, prompting eutrophication of surface water bodies. Studies show that inorganic nitrogen and natural phosphorus(P) in water by a large animate bothersome algal development in the surface of water. Water from lakes that experience algal sprouts is more expensive to clean for drinking or other mechanical employments. Eutrophication can decrease or dispose of fish populaces and it can likewise bring about loss of a considerable lot of the social administrations given by lakes. The travel industry and fisheries-Water Pollution in wetlands of Kerala is developing as the quantity of houseboats and fishing boats increments. There is huge expansion in the quantity of backwater the travel industry focuses just as houseboats working from such focuses.

Public aspect:

Ramachandra and Ahalya (2001) underscored on the reclamation and preservation of wetland assets in Bangalore in "Wetland rebuilding and protection". The water quality checking of various lakes uncovered the exceptionally eutrophic nature of the lakes. The vast majority of the formative exercises amassed in and around the city and this populace pressure prompts the vanishing of lakes. The quantity of lakes diminished from 379 of every 1973 to 246 out of 1996 which influence the groundwater level. The groundwater table had been bringing from 80 feet down to 300 feet in specific areas. Along these lines, the creators proposed some reasonable methodologies for the reclamation. Sahu *et al.,* (2013) considered East Calcutta Wetland as a new water peri-metropolitan inland wetland biological system in "Ground water likely drafting of a peri-metropolitan wetland of South Bengal Basin, India".It represented the significance of deciding the groundwater capability of inland freshwater wetlands. Ramachandra *et al*., (2016) shows the transient changes of land cover from 1973 to 2013 in the paper to be specific "Rotting pools of Bengaluru and the present unreasonable chiefs".

Worldwide aspect:

Whigham (1999) underlined on protection of the dry wetlands than the other made or individual wetlands in the paper "Biological issues identified with wetland safeguarding, reclamation, creation and evaluation". According to a biological viewpoint, dry-end wetlands, for example, confined occasional wetlands and riparian wetlands related with first request streams might be the most significant landscape elements. Stratford, Acreman & Rees (2011) applied four strategies for the weakness appraisal of Rupa Lake, Phewa Lake and Gokyo Lake in Nepal in "A basic technique for surveying the weakness of wetland environment administrations". It comprises of evaluation of wetland esteems, appraisal of dangers to wetland, joins between wetland esteems and dangers to wetland and the weakness evaluation. The last evaluation table shows the unmistakable arrangements of qualities under danger and exceptionally compelling for the site activity plan.

Wetland protection

Monitor wetlands in India started in 1987 and the primary focal point of administrative endeavors was on natural strategies for preservation as opposed to taking on designing alternatives. The national committee on wetlands, mangroves and coral reefs, comprised for prompting the government on suitable approaches and measures to be taken for preservation and the board of the wetlands, has distinguished 93 wetlands for protection and the executives on need premise. 19 wetlands in India have been classified for looking for worldwide help to save them from obliteration (Bassi *et al*., 2014).

Wetland preservation is pointed toward ensuring and safeguarding regions where water exists or close

to the earth's surface. Wetlands cover near around 6% of the earth and it turns into a central issue for protection, due to the ecosystem services. Multiple billion individuals, around a large portion of the total populace, get their essential water needs from freshwater wetlands.

Figure 5: An Urban Wetland Undergoing Restoration

A Case concentrate on: East Calcutta wetlands

There is someone who used to travel each day from Kolkata to inspect the wetlands. A garbage collector, he had approached to research that what happened to Kolkata's wastewater. The city delivered a great deal of sewage, but didn't have any treatment plants, also they didn't even appear to have any contamination issues. The wastes are simply kind of vanished. He found at the wetlands was a kind of a metropolitan biology that consolidated the double advantages of ecological insurance and asset recuperation.

Figure 6: East Kolkata Wetlands

Figure 7: A File Picture of The Road Cutting.

Institutional techniques embraced for wetland the executives in India

In India, wetlands are continued to be found in seclusion and barely in water assets. Essential obligation regarding the administration of the biologically touchy biological systems is in possession of the ministry of environment and forests

Lawful structure

However, there is no different lawful arrangement for wetland preservation in India, it is in a roundabout way impacted by other lawful instruments. These include: Indian fisheries act, Indian Forest Act 1927, Wildlife (Protection) Act 1972, Water (Prevention and Control of Pollution) Act 1974, Territorial Water, Continental Shelf, Exclusive Economic Zone and other Marine Zones Act 1976, Water Cess Act 1977, Maritime Zone of India (Regulation and fishing by unfamiliar vessels) Act 1980, Forest (Conservation) Act 1980, Environmental (Protection) Act 1986, Wildlife (Protection) Amendment Act 1991, Biodiversity Act 2002, and Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act 2006.

CONCLUSION

The approach support for wetland preservation in India was basically nonexistent. The activity on wetland was principally affected by the worldwide responsibilities made under ramsar convention and by implication of other approach measures. Wetland ecosystems support different exceptional living spaces and they are conveyed across different geographical and climatic systems. They are viewed as a crucial part of hydrological cycle and profoundly useful frameworks in their regular structures. Wetlands support huge organic variety as well as a wide cluster of biological system labor and products. In India, wetlands offer numerous types of assistance, including water system, homegrown water supply, freshwater fisheries and water for amusement. They are likewise assuming significant part in groundwater re-energize, flood control, carbon sequestration and pollution reduction. Nonetheless, the board of wetlands has gotten insufficient consideration in the public water area plan. Thus, a large number of the wetlands in metropolitan and country regions are dependent upon anthropogenic pressing factors, including land use changes in the catchment; contamination from industry and families; infringements; the travel industry; and over double-dealing of their normal assets. India is signatory to ramsar convention on wetlands and has drafted wetland rules. The principal reason is that lone chose number of wetlands has gotten critical consideration under the wetland conservation programmes, while the leftover ones keep on being in ignored state. Thus, more examination accentuation on the physical, financial and institutional components affecting state of wetlands and their utilization is needed to show up at better and far reaching the executives systems for wetlands that are confronting developing pressure from an assortment of anthropogenic and climatic facts.

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Climate Change

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ABSTRACT

The global climate change is the change in long-term weather that mark the world's regions. Scientists have expressed in the universe that the earth is warming. Only natural climate variable can not explain this trend. The human activity, especially coal and oil burning, the heat-trapped gas density of the atmosphere, has dramatically warm the earth. The more people of this gas are put in the atmosphere, the more the world will be warm in the decades and the century. The effect of warming in the sea level is increasing from the ice and ice to be changed from the ice and the ice to change the weather type. Climate change is already affecting ecosystem, sweet water supply and human health. Although climate change can not be completely avoided, but the number of gas in the atmosphere does not reduce the number of gas in the storm and the most deadly effects of climate change can be avoided. However, it is less time available to start serious steps to avoid serious global consequences. This paper reviews the evaluation of the impact of such climate change on various components of ecosystems with epologies. The most horrific problem of global warming has also been discussed. With this special attention on carbon request and cleaner development mechanism (CDM), this paper further reviewed the mitigation system. The importance of combination of climate change has been discussed in the importance of coordination and adaptation. An overview and policies of relations between economics and emissions including carbon taxes and emissions trading have been present.

Keywords: Global Warming; Climate Change Mitigation Adaptation; Clean Development Mechanism (CDM); A Greenhouse Gas

INTRODUCTION

Global warming:

Human activity, especially the combustion of fossil fuels that pump carbon dioxide (CO_2), methane, and other greenhouse gases into the atmosphere, is responsible for the progressive warming of the Earth's surface, oceans, and atmosphere.Global warming is already having a noticeable impact on the earth.

When carbon dioxide (CO_2) and other air pollutants accumulate in the atmosphere, they absorb sunlight and solar radiation that has bounced off the earth's surface, causing global warming.The method of trapping and storing atmospheric carbon dioxide is known as carbon sequestration.It is one way of lowering carbon dioxide levels in the atmosphere in order to mitigate global climate change.The USGS is assessing the situation (Ackerman & Sundquist, 2008).

Geologic and biologic reservoirs that retain carbon and keep it from entering Earth's atmosphere are known as carbon sinks. For example, deforestation is a source of carbon emission into the atmosphere, but forest regrowth is a form of carbon sequestration, with the forests themselves serving as carbon sinks.

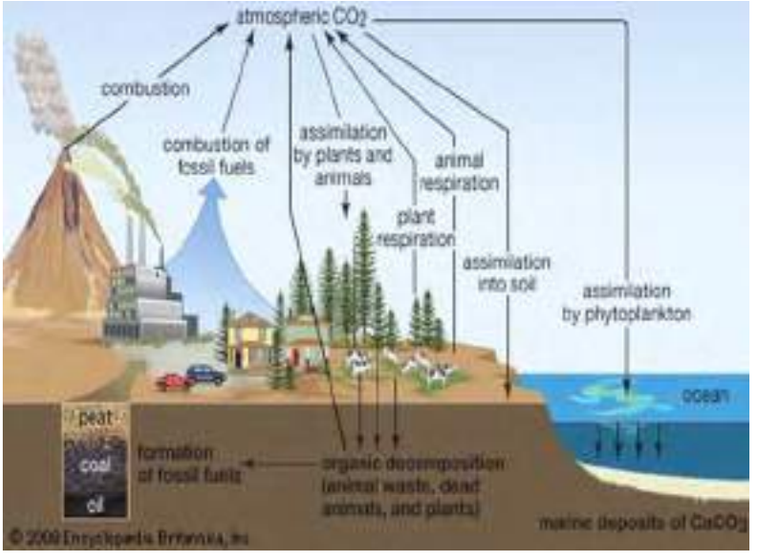

Figure 1: *Global Warming, Greenhouse Effect, Climate Change and their Relationship*

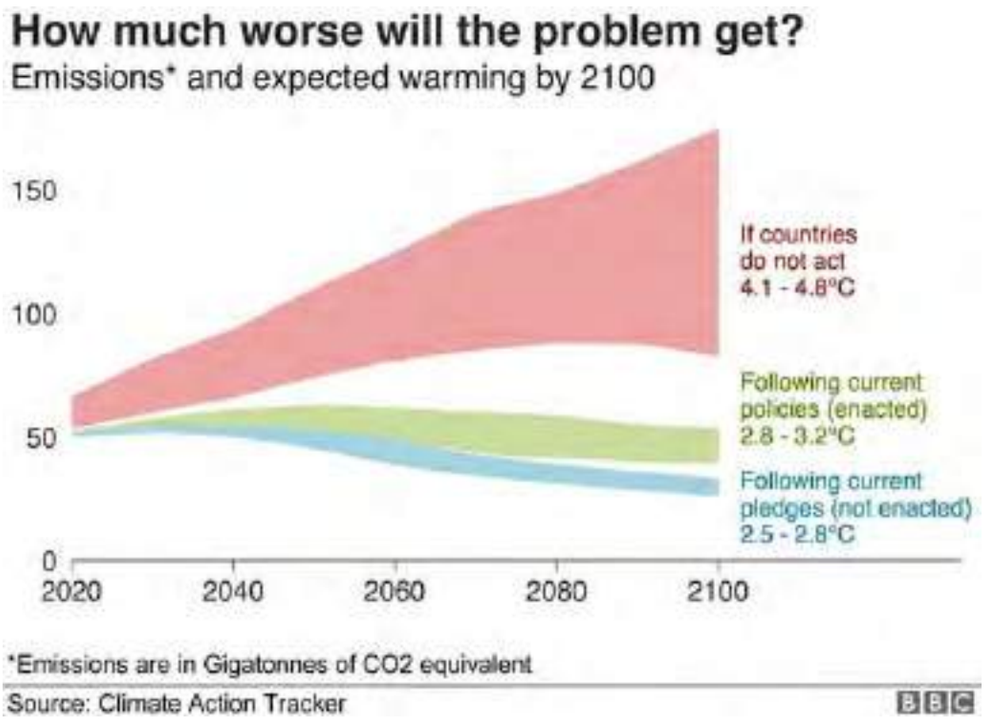

Figure 2: *Graphical Presentation of Climate Change*

LITERATURE REVIEW

Climate change mitigation adaptation:

The difference between climate change mitigation and adaptation strategies is that mitigation focuses on addressing the causes and minimising the potential impacts of climate change, whereas adaptation focuses on reducing the negative effects of climate change while also taking advantage of any opportunities that may arise (Adams & Inman, 2009; VijayaVenkataRaman, Iniyan & Goic, 2012).

The Red Cross, for example, is utilising climate science to better prepare for disasters so that it can better provide food, water, and medical supplies to vulnerable areas. To protect against future flooding, Cedar Rapids, Iowa is creating a levee and floodwall system, as well as raising bridges.

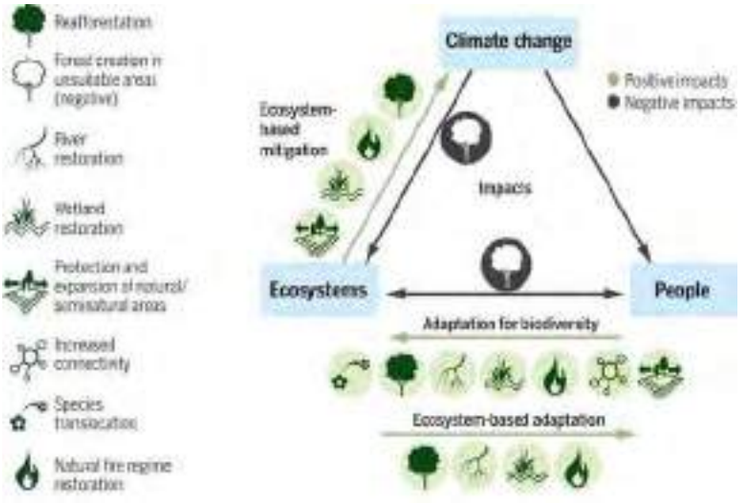

Figure 3: *Climate Change Mitigation Adaptation*

Clean development mechanism:

The Clean Development Mechanism (CDM) is a UN-run carbon offset programme that allows governments to fund greenhouse gas emission-reduction projects in other countries and claim the avoided emissions as part of their efforts to fulfil international emissions objectives (Subbarao & Lloyd, 2011).

Advantages of the CDM The clean development mechanism was created with two goals in mind: to assist rich nations in meeting their emissions reduction commitments, and to help developing countries fulfil their emissions reduction commitments. To help poor countries achieve long-term development.

Figure 4: *Clean Development Mechanism*

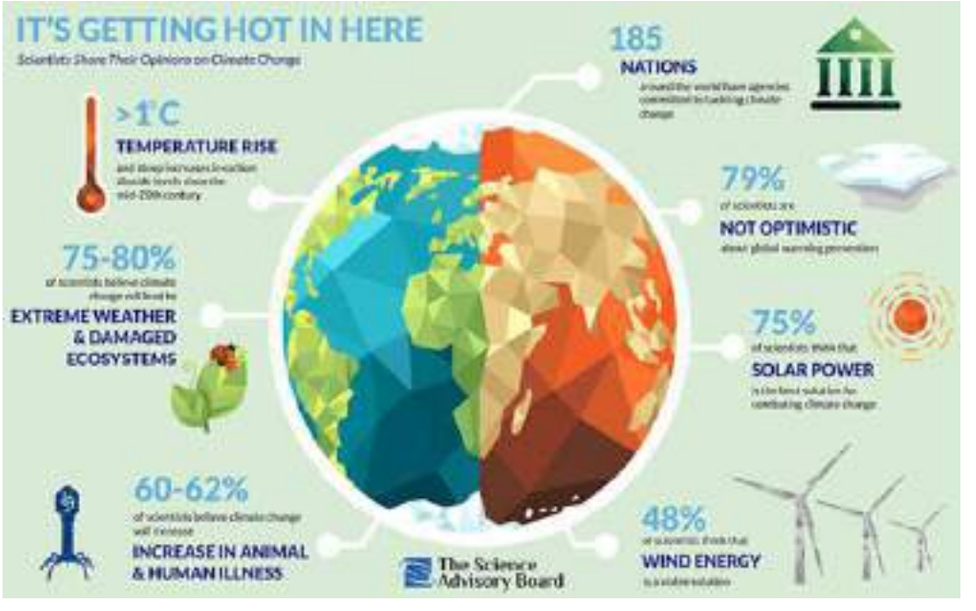

Figure 5: *Social and Economic Impact of Climate Change*

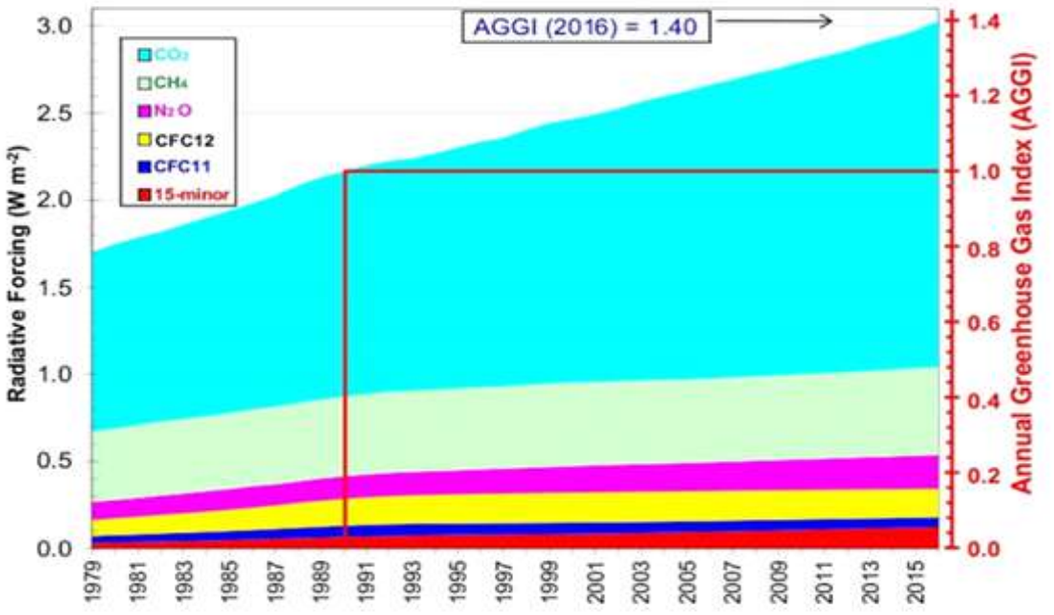

Figure 6: *Graphical Presentation of How Greenhouse Gas Increase Day by Da*

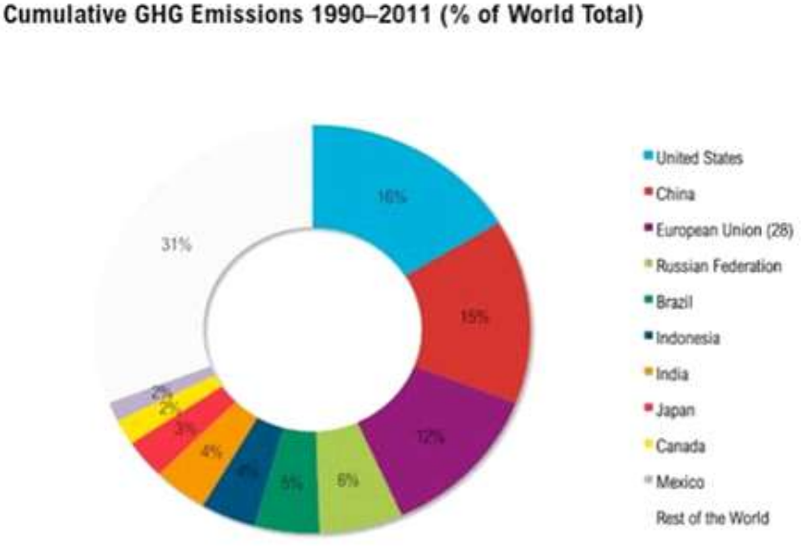

Figure 7: *Cumulative CHG Emission*

Effect of Climate Change:

The sea level is rising at an alarming rate.

- Glaciers are melting, ice sheets are thinned, and Arctic Sea ice is rapidly vanishing.
- Permafrost is beginning to defrost.
- The snowpack in North America is dwindling.
- There are fewer frigid days and nights on the horizon.
- There are more hot days and nights on the way.
- Heat waves will occur more frequently and for longer periods of time.
- Severe rainstorms and snowstorms will increase in intensity and frequency.
- Precipitation in high latitudes and the equatorial Pacific will increase overall. Dry areas will

become dryer, while wet areas will become wetter in the mid-latitudes.

- Species extinction is occurring at an alarming and accelerating rate.
- Most plants, small mammals, and ocean species are unable to adapt quickly enough to keep up with the changing environment.
- Global temperature rises of more than 2 degrees Celsius will jeopardise global food supplies.
- Human health issues will worsen.

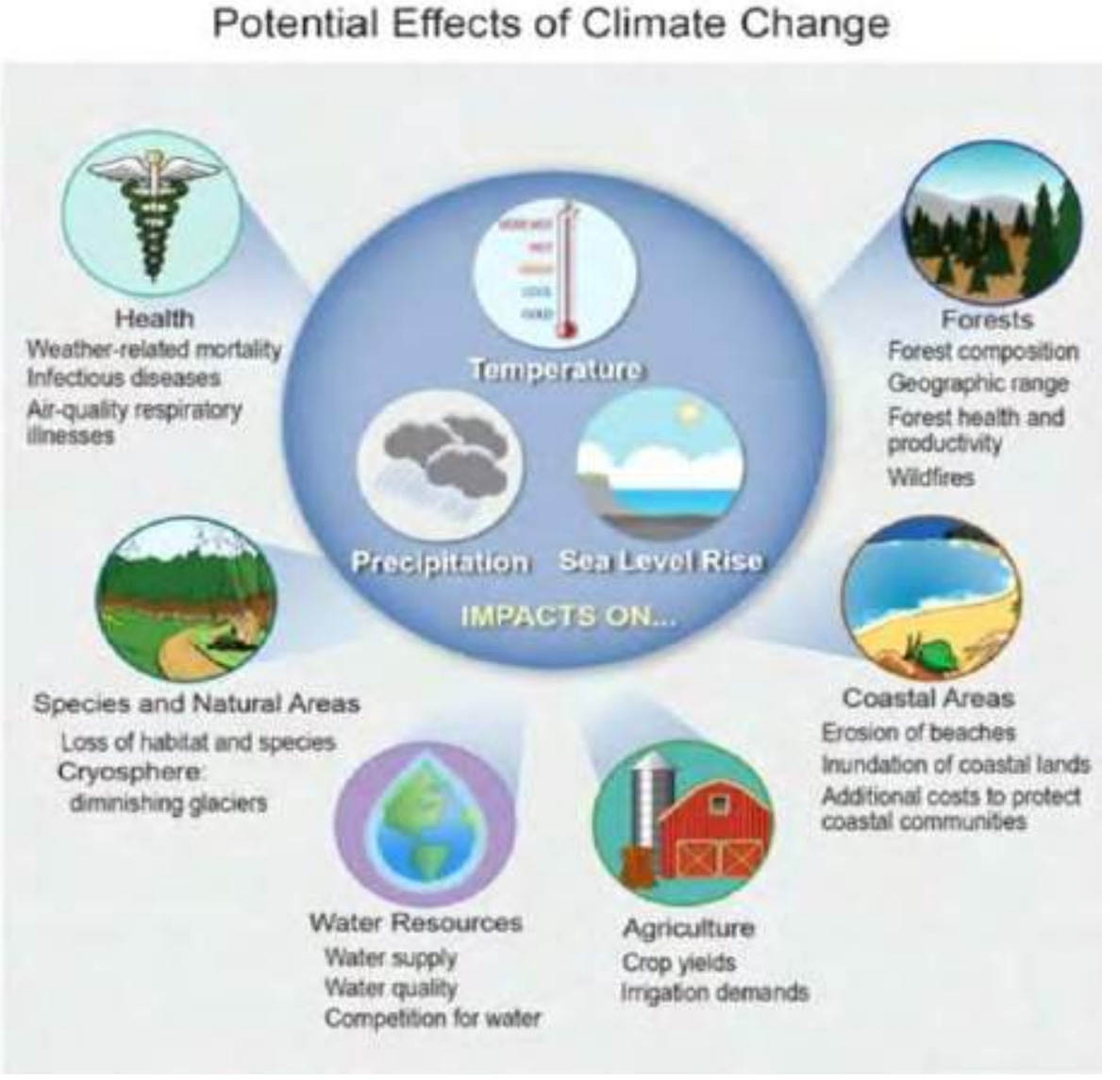

Figure 8: *Potential Effects of Climate Change*

DISCUSSION

Preventions:

- **Make Your Commute Green:**
  Make Your Commute Green: Every day, millions of people drive to work. In today's world, it's simply inescapable. The disadvantage is that millions of cars emit greenhouse gases, which degrade our environment. When it comes to the leading contributors of climate change, vehicle emissions are a close second (Paavola, Adger & Huq, 2006). There are always other choices for making your journey to work more environmentally friendly. Taking public transportation to work, for example, is a terrific method to reduce pollution. Riding your bike

to work is both environmentally friendly and a fantastic way to get some exercise.

- **Get active and vote:**
  Helping those who will combat climate change get elected is one of the most effective methods to improve the situation. This entails supporting legislation and politicians who work to mitigate the negative effects of climate change. Many corporations employ politicians and utilise them to push against legislation that would impose further rules on them. By electing the appropriate individuals to government, we will be able to implement legislation that will allow us to combat the corporations that are primarily responsible for climate change.
- **Recycle:**
  Manufacturing plants emit a significant amount of greenhouse gases each year. It is unavoidable in the manufacturing of everyday items. Investing in recycling, on the other hand, is a greener option. Recycling is a cost-effective and environmentally beneficial waste-reduction method that produces no greenhouse gas emissions. Make sure to take your old paper, glass, plastic, and electronics to a recycling centre near you. These products will be transported to a processing facility where they will be converted into other recyclable materials.
- **Teach yourself and others:**
  In today's world, the need of teaching others about climate change cannot be stressed. There are a variety of platforms that we may use to easily spread our message. There are always methods to educate others on what climate change is happening to our planet, whether through word of mouth or social media. You may aid in the protection of the environment by informing others about the hazards of climate change and how to combat them.
- **Encourage the use of renewable energies:**
  The greatest method to have a positive effect in your community is to concentrate your efforts on spreading renewable energy awareness. You can persuade others to invest in renewable energy by informing them about how it is superior to using fossil fuels.

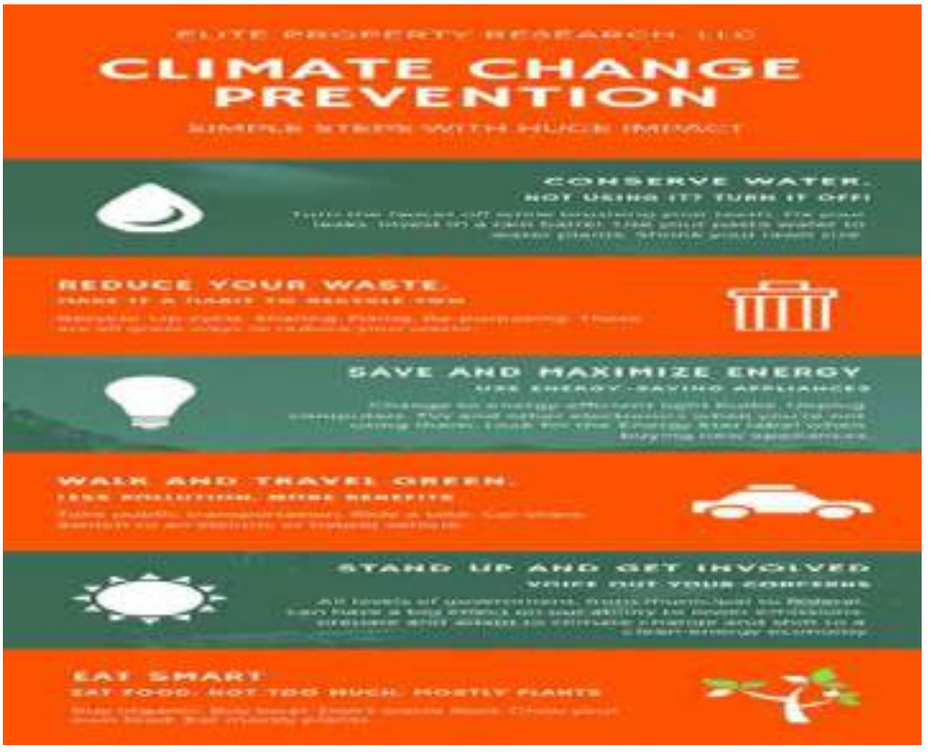

Figure 9: *Prevention of Climate Change*

CONCLUSION

Extreme weather patterns are altering around the globe as a result of human-caused climate change, from longer and hotter heat waves to heavier rains. All weather events are now linked to climate change on a broad scale. While natural variability continues to play a part in extreme weather, climate change has moved the odds and changed the natural limitations, increasing the frequency and intensity of certain types of extreme weather.

Although our understanding of how climate change affects extreme weather is still evolving, research suggests that extreme weather may be impacted even more than previously thought. Extreme weather is becoming more common.

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Importance of Bryophytes

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ABSTRACT

After angiosperms, bryophytes are considered the second largest group of land plants. Few reports are there about the importance of bryophytes. Bryophytes are used to cure different diseases and used in day to day lives of the villagers. They can be used to cure different dis orders, used as antipyretic, antimicrobial, wound healing and many more other ailments by different tribal communities. The authors have tried to compile a short review on the importance of bryophytes.

Keywords: Bryophytes; Importance; Medicinal Properties

INTRODUCTION

The division bryophytes are represented by approx. 16000 species in the different corners pf the world. The mosses contains approximately 8000 species, liverworts 6000 species and hornworts 200 species (Hallingbäck & Hodgetts, 2000), (Marko, Aneta & Dragoljub, 2001). In India, mosses represented by 1786 species and 355 genera, liverworts 675 species and 121 genera and hornworts 25 species and 6 genera(Pande & Arora, 2014, Sathish, Kavitha & Kumar, 2013) Among them 133 are threatened species, of which 78 species are mosses, 53 are liverworts and 2 are hornworts. (Dandotiya *et al.,* 2011).

They play an important role in balancing environment act as buffer system in nature (Harris, 2008). They are omnipresent. They can act as pollution indicator, soil erosion control, bio indicators of heavy metals, aquatic bio indicators, genetic engineering and for soil conditioning and culturing (Saxena, 2004, Glime, 2007). The active constituents of bryophytes are widely used as antibacterial, antifungal, cytotoxic, antitumor and insecticidal (Asakawa, 2007, ÜÇÜNCÜ *et al.,* 2010) also in medicinal and agricultural areas (Saxena, 2004, Pant & Tewari, 1990).

LITERATURE REVIEW AND DISCUSSION

Ethno-medicinal Properties

Liverworts are used to treat many disorders (Miller & Ellsworth, 1979).The oil extracted from these species were used by women on their hair in ancient times (Glime, 2007). The tribal people used these for treatment in their day to day lives. India used Plagiochasma appendiculatum for treating skin diseases (Kumar *et al.,* 2000). Frullania ericoides is used for hair-related disorders because of its long-stemmed and hair-like thallus (Remesh & Manju, 2009)

Other Miscellaneous Uses

The insecticidal property of bryophytes has gained importance over the past decades. (Abay *et al.,* 2013; Ande, Wahedi & Fatoba, 2010; Alyokhin *et al.,* 2008, Whalon *et al.,* 2012). Many reportsconfirmed the importance and activities of plants extract worked against insects fumigant contact repellent and antifeedant effects on stored product pests (Polatoğlu *et al.,* 2011; Susurluk *et al.,* 2007; Papachristos & Stamopoulos, 2002).

Peat mosses are the best sources of heat generation among the mosses because they regenerate quickly, have a low sulphur content, and have a higher heating value than wood. Peat mosses are the best sources of heat generation among the mosses because they regenerate quickly, have a low sulphur content, and have a higher heating value than wood. (Saxena, 2004). Because bryophytes do not have a leaf cuticle, they can receive and lose water more quickly. Other use of bryophytes include

the use of liverworts and mosses as environmental indicators, growth regulators (auxins, gibberellins, cytokinins, and ethylene), and mosses as stuffing material(Sabovljević *et al.*, 2007).

CONCLUSION

Research on medicinal use of bryophytes is studied in most institutes and universities. As we can see that although they are a part of primitive group of plants, they have a huge role to play both economically and ecologically. They have immense importance and active research is being carried out worldwide. The biological compounds extracted from themshould be studied and evaluated more scientifically.

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