EXPLORE, ENGAGE, EVOLVE : NAVIGATING THE FUTURE VOL - I


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# EXPLORE ENGAGE EVOLVE :
# NAVIGATING THE FUTURE

## VOLUME - I

## INTERNATIONAL CONFERENCE

## 2024 JANUARY 24 - 25

*In Association with* **The Kerala State Higher Education Council Thiruvananthapuram**


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# INTERNATIONAL CONFERENCE

# EXPLORE, ENGAGE, EVOLVE: NAVIGATING THE FUTURE

**(Volume – I)**

**2024 JANUARY 24-25**

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THE KERALA STATE HIGHER EDUCATION COUNCIL

THIRUVANANTHAPURAM


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# PREFACE

In a world of fast changing technology, academic organizations play vital role in conducting gatherings which promote technological and innovational enthusiasm among scholars and academicians. Emergence of technological innovations pave new paths in scholarly ponderings. Workshops and conferences are organized in order to exchange ideas and thoughts among academicians and scholars. With such a broader vision of bringing together multiple thoughts and concepts under one roof, MES Kalladi College, Mannarkkad organized an International Conference- MESKCON in collaboration with Kerala State Higher Education Council on 24-25 January 2024. The conference was under the theme of "Explore, Engage, Evolve: Navigating the Future"

The conference was inaugurated by Prof. Istvan Perczel (Central European University, Hungary). Special address was made by Prof. Tasy Aspiranti (Bundang Islamic University, Indonesia). Eminent speakers from various countries enriched the sessions and about 700 scholars participated in the conference.

We are extending our gratitude to all the dignitaries who decorated the inaugural session of the conference with their presence and encouraging words. We are grateful to all the speakers who deliberated upon innovative ideas and thoughts.

We extend our gratitude to the Management Committee for their fervent support and encouragement given to the conference and thereby improving the academic inputs in the institution.

## ABOUT MESKC

The Muslim Educational Society, Calicut, is delighted to offer MES Kalladi College, Mannarkkad as a sign of its commitment to advancing higher education in Kerala, particularly in the educationally underdeveloped regions of Malabar. This is the first college established by the MES and the happy result of the community's and the late Kalladi Cheriya Kunhammed Sahib's tremendous endeavor. A large portion of the college's land was donated by the late Janab Valayadi Kunhayammu Haji.

In 1967, the college opened as a junior college and was upgraded in 1971 when degree programs in commerce, history, economics, mathematics, and botany were added. In addition, it was promoted to a postgraduate college in 1978 when the M.Com program was added.

In 2016 and 2017, the Chemistry and History departments underwent an upgrade to become Research Centres, complete with modern laboratories, research halls, and research cubicles. The university is now reviewing the application for the departments of commerce and economics to be upgraded to research centers. Currently, the institution offers 17 undergraduate, 9 graduate, 1 integrated master's degree, and 3 bachelor's degree programs in various subject areas; 11 are self-financed. This institution's Chemistry, Botany, Zoology, Physics, Mass Communication, Food Technology, and Computer Science laboratories are well-equipped. Over fifty thousand books and journals with bar codes are automatically scanned in the College Library.

The college is well-known for its national and international competitions and sports accomplishments. The infrastructure includes a gymnasium for physical training and fitness, an indoor stadium, and a playground with a 400-meter track. The college's performance in the A-Zone and Inter-Zone art festivals is impressive. For the academic improvement of low-income and weak students, the college offers UGC-aided minority coaching. Additionally, customized coaching is offered for exams like the NET, SET, PSC, and bank tests. By actively participating in national seminars and other academic programs, all students have exposure to them.

A wide range of opportunities are provided for students to develop their talents and their overall well-being by various clubs and forums, such as the NCC-Navy & Army, Debate Club, Science Club, English Club, ED Club, Women Cell, Career Guidance & Placement Cell, Media Club, Tourism Club, Yoga Club, Cycle Club, Forestry Club, Bhoomitra Club, Agri-Horti Cultural Society, Apiculture Society, Debate Forum, etc. An ambulance-equipped MES Medical Centre at Kakkuppady (Atappady) is one of the college's notable Extension Projects. Additionally, as part of its institutional social responsibility, it implements other best practices.

# MESSAGE FROM THE PRESIDENT

I would like to express my happiness and appreciation to MES Kalladi College Mannarkkad for organizing MESKCON International conference. The conference with the theme "Explore, Evolve, Engage: Navigating the Future" promises to be an outstanding journey into various domains of knowledge.

Muslim Educational Society always promotes research and innovation in all its higher education institutions. I am confident that this conference will not only contribute significantly to the academic and research output of the college but also elevate its international perception.

I wish that the shared insights from MESKCON pave the way for a future marked by progress and collaboration

Warm regards,

**Dr.P.A. Fasal Ghafoor**

President

MES Kerala

# MESSAGE FROM THE GENERAL SECRETARY

It is with great pleasure and excitement that I extend my warm wishes to MESKCON2024 - the International Multidisciplinary Conference organized by MES Kalladi College, Mannarkkad. The theme for this conference, "Explore, Engage, and Evolve: Navigating the Future," reflects our commitment to fostering an environment of intellectual curiosity and collaboration.

The interdisciplinary nature of MESKCON 2024 promises a rich embroidery of perspectives that will undoubtedly enhance our understanding of the challenges and opportunities that lie ahead.

I wish a great success for MESKCON 2024.

**K. K. Kunjumoideen**

General Secretary

MES Kerala

# MESSAGE FROM THE CORPORATE MANAGER

As the Corporate Manager of the MES Aided Colleges, I am thrilled to witness the convergence of diverse talents and expertise under one roof in MESKCON 2024 organised by MES Kalladi College, Mannarkkad.

I hope that an International Multidisciplinary Conference will serve as a catalyst for meaningful collaborations and the generation of ideas that transcend disciplinary boundaries.

I wish you all a productive and enriching experience at the conference.

Best regards,

**Dr. K. A Hashim**

Corporate Manager

MES Aided Colleges

# MESSAGE FROM THE CHAIRMAN

With immense pleasure and enthusiasm, I take the opportunity to announce the “MESKCON 2024”. It is our privilege to extend a warm welcome to all participants of the International Conference.

This conference, with its focus on academic rigor and exploration of diverse knowledge domains, is a testament to our commitment to fostering excellence in education and research.

MES Kalladi College campus, with its vibrant atmosphere, is poised to provide a welcoming backdrop for intellectual exchange and collaboration. I am confident that MESKCON 2024 will not only contribute significantly to the academic landscape of our institution but also foster a sense of global camaraderie among participants.

The theme, "Explore, Evolve, and Engage: Navigating the Future," summarizes the essence of our collective journey towards a progressive tomorrow. Your active participation and contributions will undoubtedly enrich the multidisciplinary discourse that lies ahead.

I extend my best wishes for the success of MESKCON 2024 and look forward to the valuable contributions that will emerge from this conference.

**K.C.K. SYED ALI**

Chairman

MES Kalladi College Mannarkkad

# MESSAGE FROM THE PRINCIPAL

It is with great pleasure that I welcome you to the “MESKCON” International Conference 2024. The theme of the conference is "Explore, Evolve, and Engage: Navigating the Future" and it is hosted in association with the Kerala State Higher Education Council. It is the first time that MES Kalladi College Mannarkkad is hosting this kind of a multidisciplinary academic gathering.

Our theme encapsulates the spirit of progress that invite you to delve into the realms of exploration, evolution, and engagement. This event promises to be a remarkable journey into the realms of diverse knowledge domains, featuring scholars and experts from various fields who will converge to explore the frontiers of research and innovation. Our college is proud to host such a prestigious gathering, and we are especially excited about the diverse array of topics that will be discussed – from technology to humanities. The renowned speakers set to grace the event will undoubtedly impart their wisdom and insights to an eager audience, creating a unique environment for intellectual exchange and collaboration.

I am confident that this conference will not only contribute significantly to the academic landscape of our institution but also elevate our global standing. I request everyone to actively participate and make the most of this opportunity for knowledge sharing and networking.

I look forward to witness the exchange of ideas and insights in MESKCON that will undoubtedly shape the future.

Best regards,

**Dr. C. Rajesh**

Principal

MES Kalladi College, Mannarkkad

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# EVALUATING DIVERSITY OF PTERIDACEAE IN PALAKKAD GAP OF KERALA, INDIA

***Kalathil Sethumadhavan Abhilash[1], Alex Philip Alen[2], Thekkekara Suresh Gayathri[3] and Lakshmanan Leeja[4]****

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## Abstract

The Pteridaceae family, sometimes referred to as Pteroid ferns, is one of the biggest groups of Pteridophytes because of the great diversity of its morphology and ecology. Pteroid ferns are characterized by the presence of false indusia/pseudo indusia, free leaf veins, linear sub-marginal sori and often trilete spores, the family comprises five subfamilies and has an estimated 1211 species in 53 genera globally. There are 206 species belonging to 21 genera in India, whereas 74 species from 14 genera are found in South India. The objective of the present study is to evaluate the distribution and occurrence of Pteroid ferns in Palakkad Gap of Kerala. The Palakkad Gap, which separates the Nilgiris and Anamalai hills, which climb to altitudes of more than 2,000 metres above sea level, is a spectacular geological feature that runs roughly 40 km in width and is regarded as one of the most significant discontinuities in the Western Ghats. Extensive field trips through the study area could report the presence of 20 Pteroid ferns distributed through different localities of the gap. Among the various plants collected, the majority belonged to the genera *Pteris* and *Adiantum*. The abundance of Pteroid species in the Palakkad Gap might be attributed to the area's ideal climate and the greater variety of habitats that support their growth.

**Keywords:** Pteridophytes, Pteroid Ferns, Pteridaceae, Palakkad gap, Kerala

## Introduction

The first vascular plants, Pteridophytes, alternate between generations, with sporophytes—which produce spores—being the dominant phase. Among Pteridophytes, the fern family Pteridaceae is one of the largest with over 1000 species, which may be ascribed to the wide spectrum of morphological and biological diversity that its constituents inhabit. Members of this family usually lack true indusia, the sporangia's protective covering layer, although certain genera routinely develop



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recurved leaf margins in order to serve the same function. These structural changes in the leaves are known as pseudo or false indusia. The family also sets itself out by loose leaf veins, linear submarginal sori, and spores that are frequently trilete to very rarely monolete. PPG1 (2016) identified 5 subfamilies, 53 genera and around 1211 species. Smith *et al*. (2006) united 15 families under the Pteridaceae clade and categorised 50 genera and 950 species. Fraser-Jenkins *et al*. (2016) classified 44 genera in the Pteridaceae family.

The Western Ghats stretches over 1600 km from Gujarat in the north to Kerala in the south, nearly exactly parallel to India's west coast (Soman *et al*., 1990). This hill range contains three large geological splits or gaps. The Palakkad Gap, located at 11° N, is the widest of them at around 40 kilometres. According to the India Meteorological Department, the average annual temperature is 32.4 °C, with the lowest temperature being 23.2 °C and the maximum temperature being 1838 mm. This gap has an average elevation of around 200 metres. Despite disagreements over its origin, the Palakkad Gap is thought to have originated around 500 million years ago (Santosh *et al*., 1992). The present study focuses on evaluating the Pteroid fern diversity of Palakkad gap.

## Materials and methods

### Study area

Palakkad gap is situated in Kerala connecting the Palakkad district in Kerala, and coimbatore in Tamilnadu. The areas cover over 40 sq kilometres spanning from 10.811878, 76.695923 in north to 10.579113, 76.705286 in south (Figure 1).

### Collection of plant specimens

A series of field trips were conducted to collect plants in both the vegetative and reproductive stages between July 2022 and December 2022. Every field excursion involved gathering specimens that contained spores, sporophyll and rhizomes. The date of collection, the rhizome's habit, environment and structure, as well as the kinds of leaves were all documented from the collection's actual site. Preparing the herbarium and taking pictures were done. Utilising floras Manickam and Irudayaraj (1991) and Madhusoodhanan (2015), as well as the IUCN status and Raunkiaer life forms (Raunkiaer, 1934) were also investigated, the gathered plants were identified.

## Results and discussion

A total of 20 Pteroid ferns from the Palakkad gap were reported from the present investigation. The two dominating genera were found to be *Adiantum* and *Pteris,* each have six species, while



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*Actiniopteris*, *Ceratopteris*, *Mickeliopteris*, *Doryopteris*, *Pityrogramma* and *Vittaria* each have one species (Table 1; Figure: 1,2).


Figure 1. a. *Actiniopteris radiata* (Sw.) Link; b. *Adiantum caudatum* L.; c. *Adiantum concinnum* Humb. & Bonpl. ex Willd.; d. *Adiantum incisum* Forssk.; e. *Adiantum philippense* L.; f. *Adiantum raddianum* C. Presl.; g. *Adiantum latifolium* Lam. h.*Ceratopteris thalictroides* (L.) Brongn.; i. *Cheilanthes opposita* Kaulf.; j. *Cheilanthes tenuifolia*.



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Figure 2. a. *Doryopteris concolor* (Langsd. & Fisch.) Kuhn.; b. *Mickelopteris cordata* (Hook. & Grev.) Fraser-Jenk.; c. *Pityrogramma calomelanos* (L.) Link.; d. *Pteris confusa* T.G. Walker; e. *Pteris praetermissa* T.G. Walker; f. *Pteris biaurita* L. subsp. *fornicata* Fraser-Jenk.; g. *Pteris biaurita* subsp. *walkeriana* Fraser-Jenk. & Rajkumar.; h. *Pteris otaria* Bedd.; i. *Pteris vittata* L.; j. *Vittaria elongata* Sw.



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Table 1. Pteroid Ferns of Palakkad gap

| Sl. No. | Name of Plant | Life form | IUCN Status |
|---|---|---|---|
| 1 | *Actiniopteris radiata (Sw.) Link* | MI | NE |
| 2 | *Adiantum caudatum L.* | MS | NE |
| 3 | *Adiantum concinnum Humb. & Bonpl. ex Willd* | MS | NE |
| 4 | *Adiantum incisum Forssk.* | MS | NE |
| 5 | *Adiantum philippensie L.* | MS | NE |
| 6 | *Adiantum raddianum C. Presl* | MS | NE |
| 7 | *Adiantum latifolium Lam.* | MS | NE |
| 8 | *Ceratopteris thalictroides (L.) Brongn.* | AQ | LC |
| 9 | *Cheilanthes opposita Kaulf.* | MS | NE |
| 10 | *Cheilanthes tenuifolia* | MS | NE |
| 11 | *Doryopteris concolor (Langsd. & Fisch.) Kuhn.* | MS | NE |
| 12 | *Mickelopteris cordata (Hook. & Grev.) Fraser-Jenk.* | MS | NE |
| 13 | *Pityrogramma calomelanos (L.) Link* | MS | NE |
| 14 | *Pteris confusa T.G. Walker* | MS | NE |
| 15 | *Pteris praetermissa T.G. Walker* | MS | NE |
| 16 | *Pteris biaurita L. subsp. fornicata Fraser-Jenk* | MS | NE |
| 17 | *Pteris biaurita subsp. walkeriana Fraser-Jenk. & Rajkumar.* | MS | NE |
| 18 | *Pteris otaria Bedd.* | MS | NE |
| 19 | *Pteris vittata L.* | MS | LC |
| 20 | *Vittaria elongata Sw.* | EP | NE |

The IUCN Red List is the most significant global indicator of biodiversity status. In addition to conservation activities, it provides information on ecology, risks, range, population size, habitat and conservation efforts—all of which are crucial for guiding conservation decisions. Among the 20 Pteroid plants, two are classified as Least Concern (LC) and the remaining as Not Evaluated (NE).

Plant adaptation to certain ecological circumstances is a key physiognomic characteristic of a life form and has been utilised extensively in vegetation research. It shows micro and macro climates (Shimwell, 1971) as well as human disturbance in a specific place (Cain and Castro, 1959). Using it as a descriptive tool, Raunkiaer (1934) classified different plant life forms according to the location



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and level of protection of their renewing buds, which are in charge of regenerating the aerial body of the plant when a favourable season arrives. 17 of the total plants are Meso cryptophyte, 1 Micro cryptophyte, 1 Aquatic and 1 Epiphyte (Table 1: Figure 3).

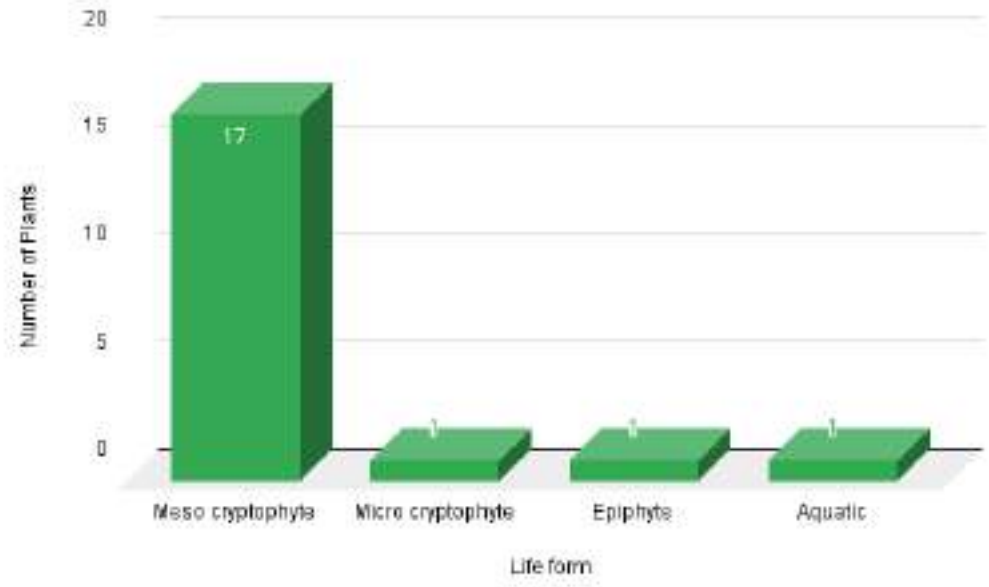


Figure 3: Life forms of Pteroid ferns of Attappady

## Conclusion

The recent investigation indicated that Palakkad gap is home to various Pteroid ferns, the bulk of which are from the genus *Adiantum* and *Pteris*. The abundance of Pteroids species in the Gap might be attributed to the area's ideal climate and the greater variety of habitats that support their growth.

## Acknowledgement

The authors thank The Principal, Government Victoria College, Palakkad, Kerala; University of Calicut & The Director, Department of Collegiate Education, Kerala for supporting the work. Authors also thank Council of Scientific and Industrial Research (CSIR), New Delhi, India for financially funding the work.

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# AN ANALYSIS ON INTERLINKED DIGITAL AND HRM IN BUSINESS PERSPECTIVE

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**Abstract**

Nowadays changes in conventional communication towards technical communication in the business environment are increasing productivity at a rapid pace. In the course of digitalization, every single function is now being converted into a digital format. These changes in technological development are accelerating digitalization and enabling HR professionals to manage services and requirements in a more modern way. Currently, conventional HR functions are moving to digital platforms at a faster pace. Operational, strategic and rational HR functions are now being handled via a digital platform. This makes the function faster, more accurate and more user-friendly. Digital HR management helps in massive productivity impact, saving HR professionals time and enabling them to focus on activities that are of greater strategic value to organizations. As technology advances, the organization should implement this technology to its existing HR system to educate its workforce to restructure for the future. In this era of globalization, HR leaders are addressing these challenges and creating a digital platform for HR management by using cloud-based computing, machine learning, artificial intelligence, virtual reality, social media platforms, mobile technologies, etc. The digitalization of HR is therefore a mix of technology and people that is captivating the organization. The introduction of new systems offers the opportunity to achieve both employee and organizational goals for better and sustainable performance. The aim of the study is to know the various digital HR functions being implemented in different organizations and also to know the role of digital HRM in modern human resource management for business performance.

**Key Words:** Techno tic, Digitalization, Operational, Rational, Strategic business, Artificial Intelligence.



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**Introduction:**

Digitization has rapidly changed the world in every sector. It generates the opportunities for every individual and business organization as well as for society. It is a mode of transforming information into a digital platform. In the present years almost every sector of government and private bodies have initiated to recognize the prominence of archiving digital information and some initiatives are already proceeding such as the digital India platform by govt. of India. In order to the augmentation of digital India format HR professionals responds these initiatives to make digital platform for Human Resource Management by adopting Cloud based Computing, Artificial Intelligence, Machine Learning, Virtual Reality, Social Media platform, Mobile technology etc. So, digitization of HRM is the combination of a human & technology, which create many opportunities in organization for sustainable growth. Use of this technological progression in terms of Digital HRM increases employee competence, confidence, improvement in employee relation, enhancement in customer satisfaction, achieving organizational goal and growth of productivity. Digital HRM is technology enabled mode that the HR professional's responsibilities have gradually become broader and more strategic. In this contemporary age, many organizations are implemented digital HRM systems to increase organizational efficiency and empower the role of human resource as a strategic business partner. In this digital age everyone has a cheerful prospect to convert the lives in to numerous ways by using digital information. Digitalization of HRM provides the employee recruitment, payroll system, attendance, performance management, employee engagement, talent acquisition, employee retaining, effective communication, relation, data analysis, learning and wellness of employees digitally. Digital HRM is a technology-enabled the mode of work that leverages neo age sciences to make HRM transactions and decisions instinctive, informed and moving to make possible organizational effectiveness. Most of the organizations came forward to contribute for achieving India a digitally equipped country and coming forward to spread digitalization among rural areas which enhance the economic condition of every individual, organizations and country as a whole.

**Review of Literature**

Stolterman and Fors (2004) described digital transformation as digitalization, it is a business model driven by the changes associated with the application of digital technology in all aspects of human society.

Srivastava and Dev Kanungo (2010) examined that, the optical character recognition (OCR) software used and its advantages over other OCRs, the search interface used, browsing and searching facilities, navigation facilities provided in the CD, etc.



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Piccinini et al. (2015) study that the determine, amongst others, how the customer behavior is hanging due to digital technologies. Consumer information has been greatly increased due to increased accessibility and availability of products and services through digital devices, anytime, anywhere to everybody.

Biddappa BP (2016) role of the HR in digital information journey at unillever says that, this help us tremendously in a couple of ways enhanced transparency and efficiency. Digitization also enabled culture change.

Priyank Kumar (2016) examined that the digitization clearly associates itself with the overall business goal of an organization as it implies that HR is not the administrative function but is accountable for delivering more strategic and revenue driven results.

Akshay Kanchan and George Sheba (2017) study on the impact of digitization on human resources. The study found that the HR professionals in this era of technological advancement, every field has transforming itself towards digitization.

## Materials and Methods

Present study the following specific objectives are: i) to understand the different digital HR functions implemented by various organizations; and ii) to analyze the impact of digital HRM in organizational performance. To achieve the goal of the objective the researcher opted a convenience sampling method. A sample of 50 HR professionals from various sectors like Manufacturing, Education Institute, Service and construction sectors etc. were taken. The data were accumulated both primary and secondary sources. The secondary data were assembled from online sources such as company websites, reports, blog of experts, research papers and magazines have been used.

## Result and Discussion

### Digital and HR Function of the Organization

### 1. Jindal Steel and Power Limited (JSPL)

- ✓ Performance Management System (PMS) – Employees sets their goals, records KPAs and competency mapping through online.
- ✓ Online Employee Self Service'- This platform gives basic information for the employee, payroll, attendance, leave, and entitlements etc.
- ✓ Learning and Development System- Gyan Drishti - It provides the skill enhancement training material on the functional, behavioral and technical field.
- ✓ JSPL Connect – It is the platform which provides employee engagement, they have an intranet portal called 'JSPL Connect' which showcases company information to employees



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like policies, recent achievements, awards received, important announcements, messages to employees from the leadership team, posting of internal jobs, provision for any suggestions that employees would want to give to management etc.

**2. Tata Steel Limited**

- ✓ Employees punch time and biometric records - It manages the attendance, leave and payroll system of every employee.
- ✓ Leave management through mobile - The managers will have real time notice of his or her employees leave requests, any pending approvals etc. and HR department, this means leave requests can be submitted digitally through mobile app and employees can monitor the status of their request in real-time.
- ✓ Online learning and training - Cloud base learning and training solutions help employees to work and collaborate at peak skill and different learning and development programs, which boost employee productivity and job satisfaction.
- ✓ Analytical report in HR for better strategy - It helps leaders make decisions by analyze data through cloud base software and maximize employee productivity.

**3. Odisha Power Transmission Corporation Limited (OPTCL) -**

- ✓ Analyzing talent by conducting online Computer Based Test (CBT) for recruitment of best and niche candidates.
- ✓ 3C in our work culture i.e. Connect, Collaborate and Communicate with the people for the overall development of the organization.

**Conclusion**

In the next few years, digitalization is modifying the way the organization operate and is here to radically break up the old HR system and redefine the future of the human resources function. Digitalization is not merely a automation of transactional systems and processes, but is inherently a mindset changes that seeks to adapt, upgrade and modify our working process through the front end technology. Accelerating digital adoption is changing in the way organizations are working for inclusive growth and sustainability. The primary intent of this paper was to find out the meaning of digital transformation in Human resource management and how HR functions are taking benefit of it. Artificial intelligence, Data analytic & Cloud base etc. are some of the tools that companies are using in making their HR functions and employees, stronger, quicker and smarter. The papers also have talked about the opportunities and challenges of it. Most of the HR



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professionals are strongly agree that digital HR helps on reducing cost of production with increasing of productivity and develop the economy of country as well as enhancing the efficiency of the HR professionals without cutting the job opportunity. The present study concludes that the digitization and digital transformation in human resources should be implemented for sustainable growth of the organization.

**Acknowledgement**

We are thankful for the collection of data and reports from the above organization official website to access and used for the study and collecting information.

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# ANALYSIS OF DIGITAL PAYMENT METHODS IN INDIAN BANKING SECTOR POST DEMONETISATION

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**Abstract**

The banking sector plays an important role in the economic development of a country. It is planned and there is no doubt that the economic situation will be strengthened. The banking sector was in high demand from the financial sector, as it provided loans and bought and sold its own stocks on behalf of various industries. At that time, the banking sector of the economy was dependent on activities such as account opening, deposits, and providing various types of loans such as personal loans, home loans, education loans, home loans to account holders and the industry, and its the process of banking took a long time. After liberalization in 1991, there were many changes in the banking sector that enabled new technological methods and India began a revolutionary transition from paper-based to electronic methods. The second path for the banking sector came after demonetization in 2016. At this time, digital platforms allowed digital payment methods across the public sector, and the banking sector introduced digital platform applications associated with the banking sector to the private sector after the demonetization of new account holders. People have it in the countryside with little problem. The specific objectives of this research are as follows. i) To investigate digital payment methods in the Indian banking sector. ii) Analyze digital payment methods during the demonetization period. This study is based on the qualitative nature of the data. Data has been collected from various sources such as National Payments Corporation of India, Reserve Bank of India Report, 2023, working papers, discussion papers, reports, and sources in print or electronic format used in the study. Preliminary results of the study indicate that digital payment methods are playing an important role in the banking sector and driving a growth shift towards the country's economic development.

**Keywords:** Digital payment, Banking sector, Financial sector, Post-Demonetization, and Economic development.

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**Introduction**

The banking sector plays an important role in the economic development of a country. It is planned and there is no doubt that the economic situation will be strengthened. The banking sector was in high demand from the financial sector, as it provided loans and bought and sold its own stocks on behalf of various industries. At that time, the banking sector of the economy was dependent on activities such as account opening, deposits, and providing various types of loans such as personal loans, home loans, education loans, home loans to account holders and the industry, and it's the process of banking took a long time. After liberalization in 1991, there were many changes in the banking sector that enabled new technological methods and India began a revolutionary transition from paper-based to electronic methods. The second path for the banking sector came after demonetization in 2016. At this time, digital platforms allowed digital payment methods across the public sector, and the banking sector introduced digital platform applications associated with the banking sector to the private sector after the demonetization of new account holders. The recent times most of the business activities have been depending upon the digital platform of the transactions of the amount transaction increasing through application like Paytm, Google pay, Phone pe E-wallet, Aadhar transaction in modern society.

**Research Problem**

Digital payment methods have been increasing in recent years in India. Since the most of business activities have been depending upon and transfer from sender to receiver through the digital payment's methods like real time gross settlement, national electronic fund transfer is an inter-bank or inter branch online within the India. According to National Payment Corporation of India established and came has been functioning speed up of the digital payments like payment transfer of money, phonepe, g-pay, e-wallet, quick response code, Aadhar payment system etc. The digital payment methods boom of the business activities with wholesale and retail business have believe and trust of transaction has allowed in run business efficiently. Post demonetization period in India there is lot bank had face lot issues and strict rules and regulations implemented by central bank of India to hit of common people issues such transfer issues, deposit issues, stand long que for the front of the banking and automatic teller machine was not properly replaced. Digital payments have good, solid authentication methods, but for fund transfers there is one- and two-factor authentication. However, challenges with digital payments continue to arise and account holders face calls from bank managers asking for account details, receiving unknown messages, web links, fake digital offers, scratch card offers, online fraud, poor digital literacy, etc. are facing the problem.



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**Review of Literature**

Ashish Baghla (2018) study on the future of digital payments in India. The study set up that both the government and private sector companies have-wallets apps like Paytm, Phone Pe etc. The biggest challenge for the government is the lack of knowledge and mindfulness among people and the fear of losing plutocrat by using digital payment styles and the threat of hacking. The study conclude that the government needs to attack these challenges to have cashless frugality and to give a boost to digital payments to payments to give sustainable profitable development to the country in the long run.

Desai et al (2017) analysed India's pre- and post-demonetization digital payment systems. According to the study, with this faceless, paperless and cashless idea, Prime Minister Shri Narendra Modi launched a digital campaign in India on July 2, 2015. Control black money, stop corruption and strengthen the banking sector. After demonetisation, digital payments are essential, for example, NIFT, Interbank ATM, CTS Check IMPS, Mirco ATM, their numbers are increasing after demonetisation and their volume in terms of rupee value is increasing significantly. The study concludes that demonetisation has given a positive impetus to the development of digital payment systems and cashless payments in India.

Vijai (2019) analysed the mobile wallet and its future in India. The study was conducted with a sample of 100 users in Chennai. The study revealed that out of the 100 respondents, 60 per cent of the respondents are in the age group of 20 years and below. 65 per cent of the respondents are female, 87 per cent of the respondents are graduates, 65 per cent of the respondents are businessmen, and 45 per cent of the respondents have a monthly income between 25001 and 35000. The study concluded that mobile wallet is a great platform for a new technology that will promote financial institutions in India through digital technology and also help increase the customer base and usage of mobile wallet.

Shobha (2020) analyses the present status of digital payment and challenges in India. The study found that there is a growth in the phase of digital payments, but still cash is playing a dominant role in many of the urban and most of the rural areas. The reasons may be lack of infrastructure and awareness presence of unorganized sectors and security issues with regard to digital payments. The study suggest that the Reserve Bank of India (RBI) and Commercial banks need to handle the possible negative outcomes of digital payments and implement necessary policies to overcome those challenges.

Pandey et al (2021) studied the growth and future of the Indian digital payments industry. They found that people of all ages made the most of digital industries during the pandemic era, as most of the population was stuck at home and banks were on standby. Over 40% of the total population relied on BHIM UPI, Google Pay and Phone Pe apps adopted by Indian consumers. The



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growth trend from the era of currency closure to the present has been the growth of the digital industry. The study concluded that the shift towards cashless or digital industries in India has seen positive changes from the pandemic period to the present.

Sharma and Agarwal (2022) examined the role of sustainable finance practices and their impact on digital banking services in India. The study found that the frequency of internet use for various digital banking services provides an opportunity to build the banking industry have been provide with various online payment services and was conducted on 325 respondents. The study suggests that the three is gradual increase in the adoption of internet banking at that same time major barriers in adoption are a threat of security privacy and trust of digital payment method.

**Research Gap**

Digital payment method significant role of the modern society. Those days people had depended upon and trust of the physical bank functions after that came in economic reforms since 1991 onwards has been gradually change banking functions shift from traditional methods to online method developed in India, due to financial growth of the nation. That changes hit to the demonetization in 2016 from withdraw of the old currency and introduced new limited currency announced by government of India and central bank have been promoting digital platform to access all the business activities such retail and whole sale. There are many studies focused for the digital payment post demonization for negative studies and impact few of the study has examined positive way of digital payment method in India. However, the present study to identify of the research gap between digital payment methods during post demonization in India.

**Materials and Methods**

The specific objectives of this research are as follows. i) To investigate digital payment methods in the Indian banking sector. ii) Analyze digital payment methods during the demonetization period. This study is based on the qualitative nature of the data. Data has been collected from various sources such as National Payments Corporation of India, Reserve Bank of India Report, 2023, working papers, discussion papers, reports, and sources in print or electronic format used in the study. Preliminary results of the study indicate that digital payment methods are playing an important role in the banking sector and driving a growth shift towards the country's economic development.

**Analysis and Discussion**

In modern society, trust in the digital business world has grown in recent days. This is because digital literacy has risen from a lower to a higher position in the online transaction of



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amounts on all accounts and in all sectors after the 2016 demonstration. The main objective of the demonstration was to control counterfeit money and promote the cashless economy. Hence, most of the people have been using different types of digital applications like, PhonePe, G-Pay and Paytm.

**1. Banking Cards**

Bank cards offer consumers more security, convenience, and control than other payment methods. It is offers great flexibility as you can use a variety of cards, including credit cards, debit cards, and prepaid cards. The card offers two-factor authentication for secure payments, such as a secure PIN and OTP. RuPay, Visa, MasterCard are just some examples of card payment systems. Payment cards allow you to purchase goods in stores, online, through mail-order catalogs, and over the phone. Simplifies transactions by saving time and money for both customers and sellers.

**2. USSD**

*99#, an innovative payment service, operates on the principle of "atypical additional services." Data Channel (USSD). This is a service that allows you to conduct mobile banking transactions using the basic functions of your mobile phone. You do not need mobile internet to use USSD-based mobile banking. this It is envisaged to ensure financial deepening and inclusion of unbanked societies in mainstream activities. banking services.

**3. AEPS**

AADHAAR PAYMENT SYSTEM (AEPS) is a banking operating model that allows: Online compatible financial transactions through PoS (Point of Sale/Micro ATM) Business Correspondent (BC)/Bank Mitra for all banks using Aadhaar authentication.

**4. Unified Payments Interface (UPI)**

UPI is a system that allows manifold bank accounts. Combines multiple banking functions (from participating banks) into a single mobile application; Seamlessly route funds and transaction proceeds in one place. This also means "Peer to Peer" is a request for collection that can be booked and paid according to your requirements and convenience. Each bank offers its own UPI application for Android, Windows and iOS mobile platforms.

**5.Mobile Wallet**

The mobile wallet has a digital payment method way to carry cash. You can link Your credit or debit card information from your mobile device in the mobile wallet app, or You can transfer money online to your mobile wallet. Instead of using an actual plastic card You can pay for your



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purchases using your smartphone, tablet, or smartwatch. personal account to deposit money, you must be connected to a digital wallet. Most banks and some private companies have electronic wallets.

**6. Prepaid card:**

The expenses volume is preloaded on the prepaid card. If you "option" to your bank's overdraft program, use your bank account debit card. this This means your bank may charge you a fee to cover the cost of your purchase or ATM costs. Withdraw funds in your account that exceed the available funds.

**7. Point of Sale (POS)**

Point of Sale (POS) is the place where sales occur. At the macro level PoS can be a shopping mall, market or city. On a minicomputer level, shops reflect a PoS to be the area where a customer completes a transaction, such as a checkout counter. It is also known as a point of purchase.

**8. Internet Banking**

Internet banking, also known as online banking, e-banking or virtual banking, is an electronic payment system that enables customers of a bank or other financial institution to conduct a range of financial transactions through the financial institution's website. It includes National Electronic Fund Transfer (NEFT), Real Time Gross Settlement (RTGS), Electronic Clearing System (ECS) and Immediate Payment Service (IMPS).

**9. Mobile Banking**

Mobile banking is a service provided by a bank or other financial institution that allows its customers to conduct different types of financial transactions remotely using a mobile device such as a mobile phone or tablet. commonly used software For this purpose, it refers to an application provided by a bank or financial institution. all banks It offers its own mobile banking applications for Android, Windows and iOS mobile platforms. For example, Pay tm, Phone Pe, and Google pay.

**10. Micro ATM**

Micro ATMs are expected to become devices used in millions of businesses. Correspondents (BCs) provide basic banking services. Through the platform, companies Correspondent (could be a local kirana store owner and would act as a "micro-ATM") Perform transactions immediately.



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## Conclusion

The digital payment methods world is becoming more powerful by the day. One of the most important components of digitalisation are digital payment methods that make society less dependent on physical cash and enable payment in the most convenient and easy way through digital payment platforms. The post demonetization periods digital payment methods like transparency, accuracy, easy access, time management to utilise the digital payment system need an hour of modern society in India. The study concluded that the stringent Digital Banking Act and the guidelines and regulations of the Reserve Bank of India as well as the protection of the National Payment Corporation of India spread over to digital payment gateways.

## Acknowledgement

We are thank you for collecting data and reports from the above-mentioned government agencies and using them for information research and collection by accessing them through their official websites.

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# MICROWAVE-ASSISTED SYNTHESIS OF CARBON DOTS: A RAPID AND EFFICIENT APPROACH

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**Abstract**

Carbon quantum dots (CQDs) have emerged as a compelling class of fluorescent carbon nanoparticles, showing promise as alternatives to traditional semiconductor quantum dots. Their optical characteristics and attributes such as low toxicity, environmental friendliness, and cost-effectiveness make CQDs versatile candidates for various applications. The presented research introduces a facile, rapid, and cost-effective bottom-up synthesis method for generating UV-photoluminescent carbon dots. Utilizing Gallic acid and Ethylene diamine as precursors, this approach yields water-soluble carbon dots exhibiting emission at 410 nm, regardless of the excitation wavelength within the range of 330–380 nm. Physicochemical characterization indicates intrinsic surface functionalization of the nanoparticles, emphasizing their suitability for a wide array of applications.

**Keywords:** carbon quantum dots, microwave-assisted pyrolysis, emission spectra.

## Introduction.

Fluorescent carbon nanoparticles, also known as carbon quantum dots (CQDs), have emerged as a novel class of carbon nanomaterials, capturing significant attention as potential rivals to traditional semiconductor quantum dots. Their optical properties and advantages such as low toxicity, environmental friendliness, cost-effectiveness, and straightforward synthetic routes make CQDs a promising candidate for various applications [1–3]. The ability to control physicochemical properties through surface passivation and functionalization further enhances their versatility. This class of carbon nanomaterials, which includes nanodiamonds, fullerenes, carbon nanotubes, graphene sheets, and CQDs, has sparked extensive research due to its immense potential across various technical applications. CQDs have garnered increasing interest among these materials, particularly for their unique optical properties and fluorescence emissions. While semiconductor quantum dots have been extensively studied for their tunable fluorescence properties, the use of heavy metals in their production raises concerns about toxicity, limiting their applicability in clinical studies.

Inspired by a wide array of potential applications, there is an increasing interest in revolutionizing the synthesis of new carbon dots. Numerous synthetic pathways, such as laser ablation



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of carbon targets, electrochemical exfoliation of graphite, hydrothermal treatments, plasma treatment, pyrolysis, ultrasonic treatment, and microwave heating, have been investigated for the generation of C-dots. Notably, among these methods, hydrothermal treatments utilizing autoclave and microwave techniques have surfaced as the predominant routes[1,4–7].

In this study, we present an uncomplicated, swift, and cost-effective bottom-up synthesis method for producing UV-photoluminescent carbon dots (CDs) using Gallic acid and Ethylene diamine as precursors. The outcome is water-soluble CDs demonstrating emission at 410 nm, regardless of the excitation wavelength, when exposed to UV light within the range of 330–380 nm. Physicochemical characterization of the CDs revealed intrinsic surface functionalization of the nanoparticles.

## Experimental

### Materials

Materials used include Gallic acid (GA) and Ethylene Diamine (EDA).GA was purchased from Sigma Aldrich and EDA from Spectrochem. The ultrapure water provided by the Labostar TWF water purification system (18.2 MΩ.cm, Siemens Ultrapure Water Systems) was used for all experiments.

### Synthesis of carbon nanoparticles

Microwave–assisted pyrolysis was adopted for the synthesis of carbon quantum dots (CQDC). In a typical experiment, we used 0.5 g of GA mixed with 10 ml DI water under magnetic stirring at a temperature of 60 $^{\circ}$C followed by the addition of 1 ml EDA. The solution was then subjected to microwave irradiation. Upon microwave heating, the solution turned to a dark brown precipitate which was further dispersed in 10ml DI water and then centrifuged at 13000 rpm for 20 minutes to remove the bulk unreacted materials. The supernatant was collected for further characterization.

### Characterization

Transmission electron microscopy (TEM) characterization and high-resolution transmission electron microscopy (HRTEM)using JEOL, JEM-2100 F(Japan) were used to study the morphology of CQD. The functional groups on the surface of the CQD were studied using Fourier transform infrared spectroscopy (Perkin Elmer Spectrum). UV –visible absorption spectra were carried out using JASCO V-550 spectrophotometer and steady–state fluorescence spectra were obtained using Cary Eclipse (Agilent technology) fluorescence spectrophotometer.

The samples for TEM were prepared by drop-casting aqueous dispersion of nanoparticles onto a Copper grid. The spectrophotometric and fluorescence studies were done after dispersing the



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nanoparticles in ultrapure water. FTIR and Raman measurements were carried out using powder samples, collected from the aqueous dispersion after lyophilization.

## Results and discussion

### Physico-chemical characterization

The morphology and structure of CQD were confirmed by TEM. Fig. 1 (a) shows the TEM result of CQD. All CQDS show a uniform dispersion without apparent aggregation. From the HRTEM image, these CQD were observed to have a discernible lattice structure. The lattice plane can be identified with a spacing of 0.28 nm.

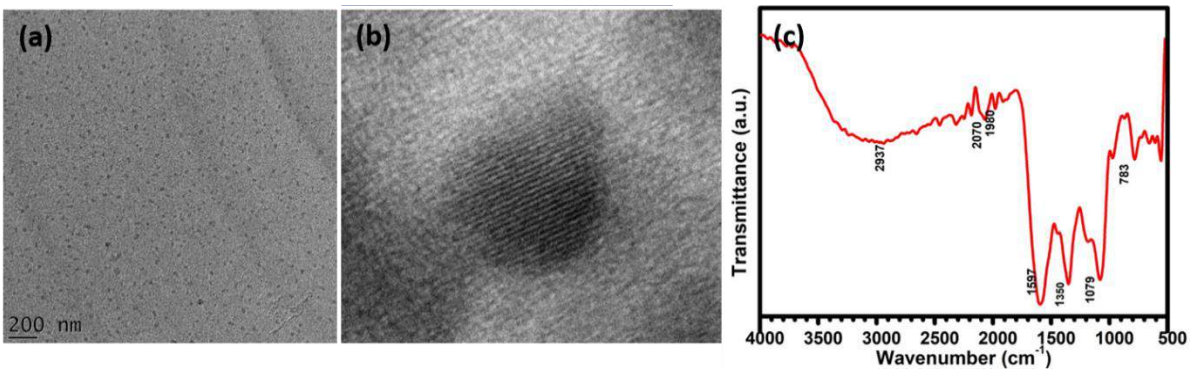


Fig. 1 a) TEM (b) HRTEM (c) FTIR of synthesized CQDs.

The surface structure and composition of the as-prepared carbon nanomaterials are investigated using FTIR. The infrared spectrum of the sample is presented in Fig. 1 (c), which exhibits an intense broad peak around 3000 $cm^{-1}$, attributed to the stretching vibration of hydrogen-bonded –OH. The broadness of the peak suggested the presence of a large number of residual OH groups. The synthesized nanoparticles were highly hydrophilic and well dispersed in water which may be due to the polar functional groups on the surface. The peak at 1597 $cm^{-1}$ can be assigned to the C=O group.

### Optical properties

The optical properties of carbon nanoparticles as aqueous dispersion were investigated by UV-Visible spectroscopy and steady–state fluorescence measurements. The UV-visible absorption spectrum is displayed in Fig. 2 (a) which has an absorption peak at 239 nm and 300 nm. The peak at 239 nm may be due to π-π* transitions and the peak at 300 nm may be due to n-π* transition of the functional groups present on the surface of carbon nanoparticles.



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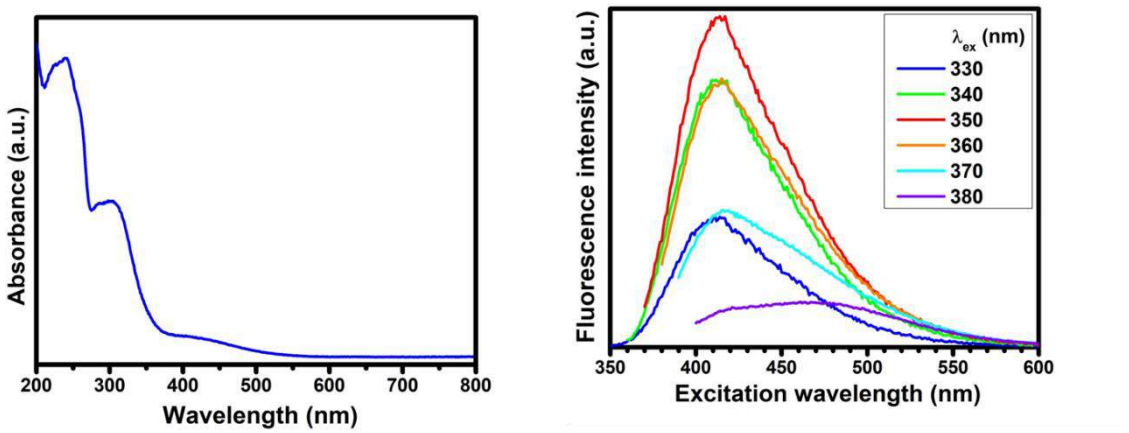


Fig 2 (a) UV-Vis absorption spectra (b) Emission spectra of synthesized CQDs.

The emission spectra at different excitation wavelengths are shown in Fig. 2 (b); We could observe that the emission fluorescence intensity is independent of excitation wavelength. The fluorescent intensity reached the highest value when excited at 350 nm.

## Conclusion

The synthesis of UV-photoluminescent carbon dots (CDs) through a straightforward, swift, and cost-effective microwave-assisted pyrolysis method using Gallic acid and Ethylene diamine as precursors has been successfully demonstrated in this study. Water-soluble carbon quantum dots were synthesized, and a comprehensive investigation into their morphological and optical characteristics was conducted.

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# FLUORESCENCE SPECTROSCOPY AS A TOOL TO INVESTIGATE THE HYDROGELATION OF FMOC-PHENYLALANINE AT PHYSIOLOGICAL pH

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**ABSTRACT:**

Hydrogels are a fast-growing area of research owing to their outstanding characteristics and diverse range of applications. Hydrogels, especially those derived from small biomolecules like amino acids and their derivatives, have drawn a lot of attention because they are one of the best biodegradable and biocompatible materials that can be used in biological applications like tissue engineering, wound healing, and drug delivery. However, sometimes their uses become limited as a result of the difficult conditions and processes involved in synthesis, as well as the complex material design. Fmoc-modified amino acids are widely discussed because of their biocompatibility, cost-effectiveness, ease of synthesis and self-assembly in response to triggers, and ability to adapt different morphological nanostructures. We studied the hydrogelation of Fmoc-phenylalanine in an aqueous sodium phosphate buffer of physiologically relevant pH 7.4 using a simple process of sonication, heating, and cooling and the self-assembling process in detail with the help of fluorescence spectroscopy.

## INTRODUCTION

Gels are important class of soft materials with substantial research promise. A large amount of solvent is trapped in between the three-dimensional network structures of gels. Hydrogel is one of the most significant types of gels, where water is present in the three-dimensional network.[1] Gel formation is clearly visible when the gel does not flow downward while the gel-containing vessel is flipped.[2] Hydrogels are one of the most fascinating areas of research and have numerous potential uses in different fields because of their unique and attractive features, such as being capable of holding a significant amount of water while maintaining their original structure and the ability to swell in water.[3] Because of their highwater content and ability to mimic natural tissues, hydrogels are excellent choices for use in biomedical applications.[4,5,6] Both small molecules and low



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molecular weight molecules have received the most attention because of their high abundance, diversity in structure, and variety of tunable properties that give a variety of applicability.[7,8,9] The use of biomolecules, especially amino acid-based hydrogels, has grown overwhelmingly in the past decades. Physical or chemical interactions cause molecules to self- assemble into ordered higher order structures like hydrogel. These interactions can be covalent or non-covalent and can include hydrogen bonding, electrostatic interactions, hydrophobic interactions, and π-πstacking.[10,11,12] Studies on the hydrogelation of amino acids modified with N-9-fluorenylmethoxy carbonyl (Fmoc) have drawn a lot of interest because of its unique properties, which include low immunogenicity, low cytotoxicity, biocompatibility, and biodegradability.[13,14,15,16,17] Fmoc is used as a primary protecting group for amine in the synthesis of peptides.[18,19,20] Fmoc protected amino acids are able to rapidly self -assemble into hydrogels under suitable conditions with the introduction of the Fmoc group.[16,17] Among the twenty naturally occurring amino acids found in proteins, phenylalanine belongs to the category of aromatic and hydrophobic amino acids and is widely used in the production of proteins.[21] Due to its significance for human health, phenylalanine has been the subject of numerous studies. Herein, we discuss the details of the hydrogel formation by Fmoc-l-phenylalanine in an aqueous buffer of pH 7.4 involved in its formation. The pH 7.4 is physiologically relevant because it is the normal human pH.[22] Under similar conditions, hydrogel formation is not specific to the D or L configuration of the Fmoc-phenylalanine molecule.[16] We have used physiologically relevant sodium phosphate buffer for the forming hydrogels. The choice is made by keeping the applications of hydrogel in the biomedical field in mind because it has the ability to mimic some components in the extracellular fluid of the human body. Sodium phosphate buffer is highly water-soluble, making the preparation of buffer solutions easier, and it has a wide buffer capacity (5.8 to 8.0). The other advantages of this buffer include its non-toxicity to cells; there is only a small change in pH with temperature; and the buffer is stable up to several weeks at 40 °C. The present study focuses on the utilization of fluorescence spectroscopy to understand the self-assembly and gelation of the formed hydrogels. It is possible, since the fluorescence studies give useful and important details regarding the changes in the microenvironment of the fluorophore molecule during the self-assembly and gelation processes. In the present study, the use of any extrinsic fluorescent probe is not required since phenylalanine has intrinsic fluorescence and Fmoc has remarkable fluorescence properties.[23,24]It is known that the fluorescence emission maxima of Fmoc amino acids are located around 320 nm and the adsorption maxima are located approximately 290 nm. [24]The aggregation kinetics behind the self-assemblies can also be investigated using the fluorenyl moiety's fluorescence peak positions. Specifically, the wavelengths blue shift and red shift are associated with the formation of H-aggregates (H denotes hypso chromic) and J-aggregates (J denotes Jelley) aromatic rings. [25,26,27,28] Also, the morphology



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and properties of hydrogels formed at different pHs are compared and analysed with the use of various spectroscopic and microscopic techniques.

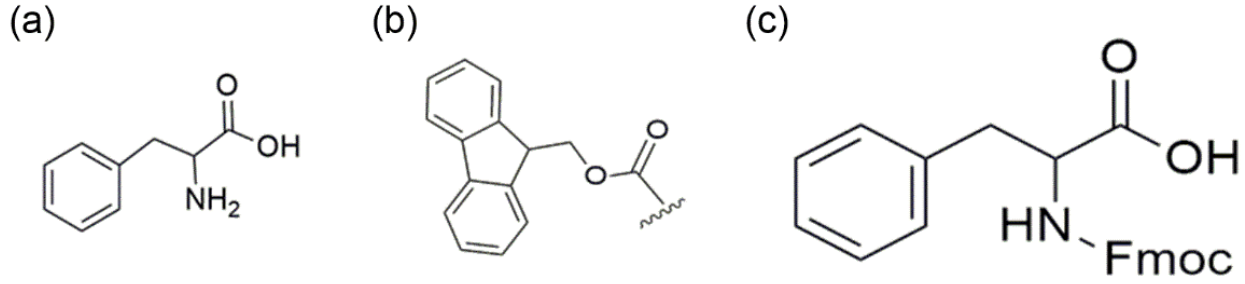


Figure 1. The chemical structure of (a) Phenylalanine, (b) Fmoc group, (c) Fmoc- Phenylalanine.

## EXPERIMENTAL

### MATERIALS

N-(9-Fluorenylmethoxycarbonyl) (Fmoc) -l-phenylalanine (Fmoc-l-phe) (min. 99% pure) was purchased from Spectrochem Pvt. Ltd and Disodium hydrogen phosphate anhydrous (Na2HPO4), sodium dihydrogen phosphate monohydrate (Na2HPO4. H2O) were obtained from Merck. All the chemicals were used as received. The water used throughout this study was of Millipore Milli-Q grade (18.2 mΩ cm).

### HYDROGEL PREPARATION

Fmoc-Phenylalanine (Fmoc-F) Hydrogel was prepared based on the previously reported procedure.[16] In brief, Fmoc-l-phe was dissolved in 50 mM sodium phosphate buffer of pH 7.4 by sonication (Analab ultrasonic bath sonicator) at room temperature for 30 minutes. Sodium phosphate buffer (SPB) of various pH was prepared using disodium hydrogen phosphate anhydrous (50 mM) and sodium dihydrogen phosphate monohydrate (50 mM) in Milli Q water using standard protocol. A calibrated Milwaukee pH meter (Mi 150) used for the pH measurement. The homogenous solution was obtained after sonication heated gently at 80 °C in a water bath till the formation of a clear and transparent solution. The solution was kept at room temperature undisturbed until the hydrogel was obtained. The vial inversion test was used to identify the formation and stability of hydrogel.[29]

The effect of concentration was studied at pH 7.4. A stock solution of Fmoc-F powder in 50 mM sodium phosphate buffer with a pH of 7.4 was prepared using the above-described procedure. The clear and transparent stock solution (8 mM) obtained after heating and sonication was diluted to various concentrations from 2 mM to 7 mM in a glass vial using buffer solution by the simple dilution method. To ensure homogeneity, each sample was gently heated again for a few minutes



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and then allowed to cool to room temperature. A vial inversion test was used to identify hydrogels were formed. Observations noted for 5 days in an interval of 1 hour, 24 hours and 5 days.

## SPECTRAL CHARACTERIZATIONS OF HYDROGELS

### Fourier transform infrared spectroscopy (FT-IR)

FT-IR spectral measurements were obtained for hydrogels on a PerkinElmer 400 FT-IR spectrometer equipped with an attenuated total internal reflection (ATR) accessory. Aliquots of the sample were placed on a diamond ATR unit (PerkinElmer, IR Version 10.6.0) and scanned between 4000 and 400 $cm^{-1}$ over 16 scans at a scanning resolution of 4 cm-1 and an interval of 1 $cm^{-1}$. FT-IR spectral measurements were taken for hydrogels after 24 hours of rest at room temperature.

### UV-Visible spectroscopy

Absorption spectra of Fmoc-l-phenylalanine powder and hydrogels were obtained using a Shimadzu (UV-2600) UV-Visible spectrophotometer with a measuring range of 200–800 cm with a slit width of 5 cm and a tungsten halogen lamp and a deuterium lamp as the light source. Sodium phosphate buffer of the respective pH is used as the baseline for hydrogels, and barium sulphate is used for Fmoc-l-phenylalanine powder. The Fmoc-F solution was transferred to a quartz cell with a 1 cm path length, and the hydrogels were formed inside the cell. Spectral measurements were taken for hydrogels after 1 hour, 24 hours, and 5 days of rest at room temperature.

### Fluorescence spectroscopy

Fluorescence measurements were carried out with a Shimadzu (RF-6000) Spectro fluorophotometer with a 150 W Xenon lamp as the light source. The scan speed was kept at 2000 nm/min. The excitation and emission spectra were recorded with slit widths of 5 and 5 nm for excitation and emission, respectively. The emission spectra of hydrogels were measured with excitation over a range of 280–305 nm, and the emission data ranged between 300 and 600 nm. Hydrogels were formed in a rectangular quartz cell of path length 1cm. Fluorescence measurement of Fmoc-l-phenylalanine was taken in powder form itself and was taken for hydrogels after 1 hour, 24 hours, and 5 days of rest at room temperature.

## RESULTS AND DISCUSSION

### Preparation of the hydrogel

Phenylalanine is hydrophobic and aromatic in nature. Its hydrophobicity is further increased by the addition of the Fmoc moiety. This causes the low solubility of Fmoc-phenylalanine in water. Thus, the molecule was solubilized by sonication and heating, which served as physical stimuli in



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the formation of hydrogel.[30] The Fmoc-F hydrogel was formed in sodium phosphate buffer using the previously reported procedure that involves sonication and heating techniques.[16] Figure 2 schematically summarises the different processes in the Fmoc-F hydrogel as well as the observations obtained at each step. At pH 7.4, Fmoc-phenylalanine has a negative charge, and this negative charge may cause electrostatic repulsion and hinder hydrogel formation by preventing self-assembly. Interestingly, hydrogel formation occurs at this pH. Considering the hydrophobicity of the Fmoc-F molecule, it can be explained. According to previous reports, the pKa value of the Fmoc-F appears to increase from its expected value because of its higher hydrophobicity. This causes negatively charged carboxylate ions in a hydrophobic environment. This promotes hydrogel formation at pH 7.4.[16,31,32,33] The thermo-reversible properties of the hydrogels were examined by heating the gels to 80°C and allowing the clear solution to remain undisturbed at room temperature. The hydrogel remains in a solution state at higher temperatures, but it returns to its gel state when allowed to cool to room temperature. Even with repeated heating and cooling cycles, we observed similar results. A schematic representation of sol- gel transition is given in Figure 3. The importance of studying the hydrogelation at this pH is that it is the human body's pH in the absence of any kind of pathogen (the human body pH is between 7.35 and 7.45, with an average pH of 7.40).[33] The influence of concentration was examined by preparing the stock solution of Fmoc-F was prepared in sodium phosphate buffer at a concentration of 8 mM using and the stock solution was diluted with the respective buffers to obtain a final hydrogel concentration of 2 mM to 7 mM.

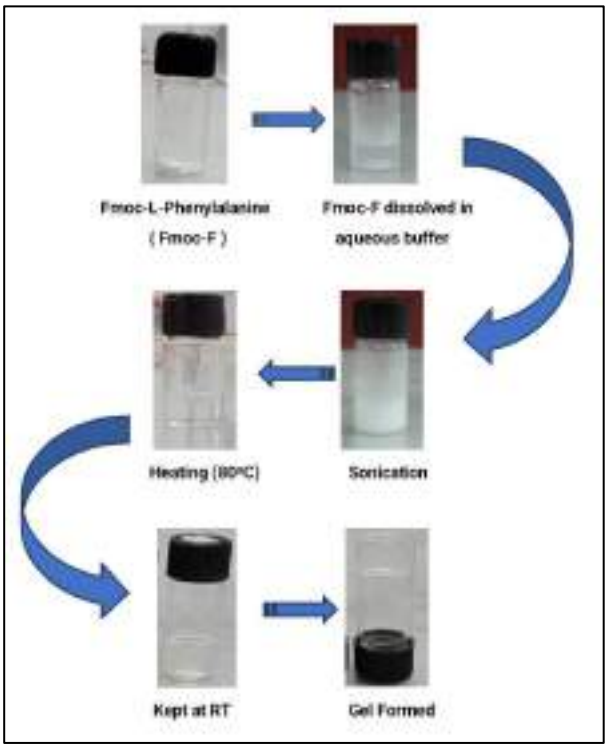


Figure 2. A schematic of representation of steps involved in Fmoc-F hydrogel formation



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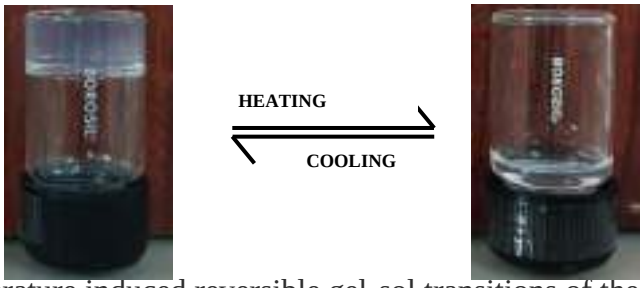


Figure 3. Temperature induced reversible gel-sol transitions of the Fmoc-F hydrogel.

| CONCENTRATION (mM) | AFTER 1 HOUR | AFTER 24 HOURS | AFTER 5 DAYS |
|---|---|---|---|
| 8.0 | Gel | Gel | Gel |
| 7.0 | Gel | Gel | Gel |
| 6.0 | Gel | Gel | Gel |
| 5.0 | Gel | Gel | Gel |
| 4.0 | Semi gel | Gel | Gel |
| 3.5 | Solution | Semi gel | Gel |
| 3.0 | Solution | Solution | Semi gel |
| 2.0 | Solution | Solution | Solution |

Table 1. Formation of Fmoc-F hydrogels in buffer at pH 7.4.

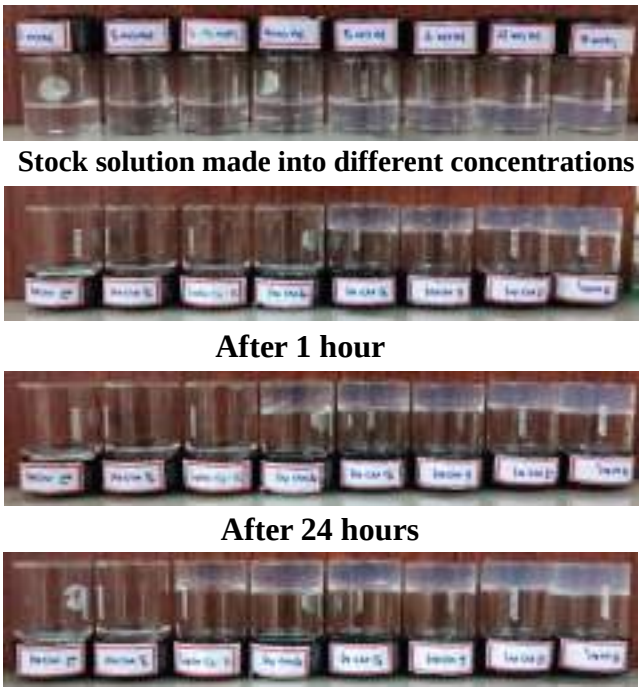


Figure 4. Formation of Fmoc-F hydrogels in buffer at pH 7.4



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## SPECTRAL CHARACTERIZATION OF HYDROGELS

### Fourier transform infrared spectroscopy (FT-IR)

The factors favouring hydrogel formation are not clear from FT-IR studies. The FT-IR spectra of hydrogels at pH 7.4 are similar for all concentrations, irrespective of their solution and gel state. A broad peak centred at about 3305 $cm^{-1}$ was due to the water absorption, and the absorption peak at 1629 $cm^{-1}$ were due to the C = O group. FT-IR spectra of Fmoc-F hydrogels in buffer at pH 7.4 are shown in Figure 5.

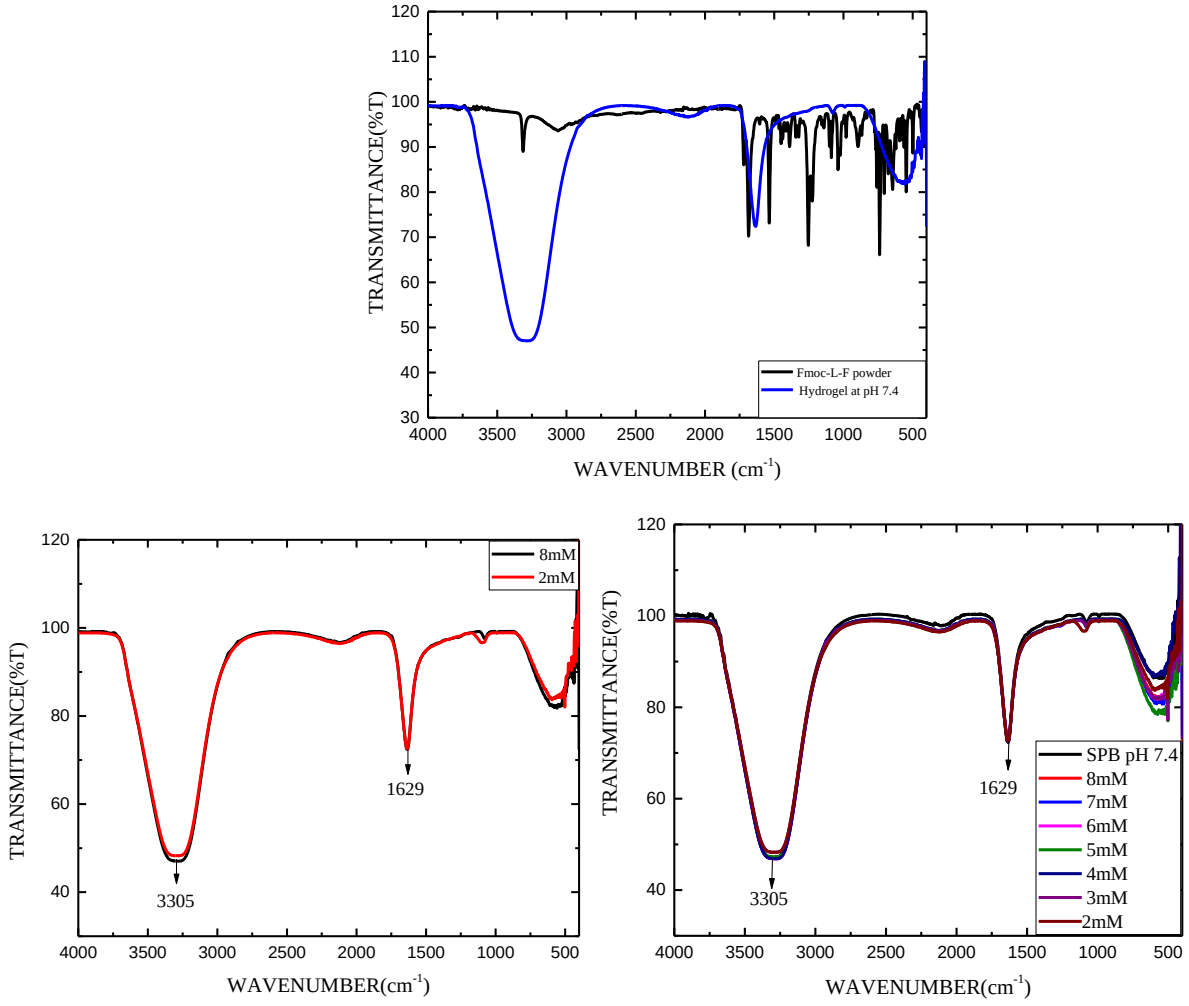


Figure 5. FT-IR spectra of Fmoc-F hydrogels in buffer at pH 7.4.

The UV-visible spectra of Fmoc-l-phenylalanine and its hydrogels formed in sodium phosphate buffer of pH 7.4 measured are presented in figure 13a. Fmoc-l-phenylalanine powder had broad absorbance peaks at 214, 264, and 303 nm. This absorption peak is attributed to the π -π * and n-π* transitions of c=c and C=O bonds. All the hydrogels had similar absorbance spectra with different intensities of the peak. When hydrogels are formed from Fmoc-l-phenylalanine, the peak at 303 nm is retained with a slight shift to 305 nm and a high increase in absorbance correspond to n-π*transitions of carbonyl groups. The broad peaks at 214 and 264nm of powder samples were absent in the hydrogel sample. But many highly intense shoulder peaks appeared, of which 233 and



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294 nm are major.[34] The difference in the spectra of hydrogels from the powder samples clearly shows the possible self-assemblies and aggregation in the hydrogel matrix.

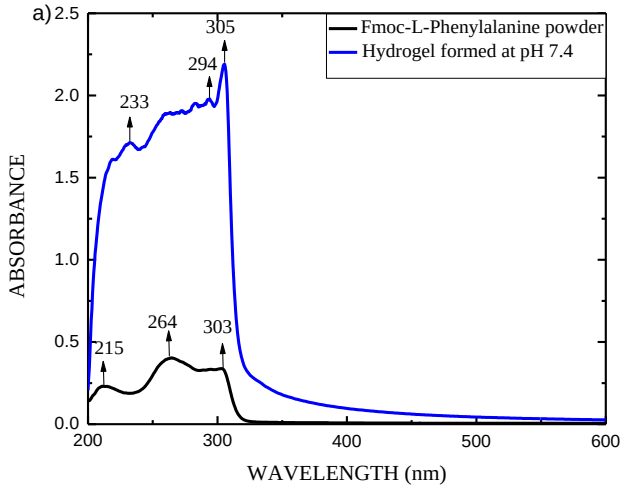
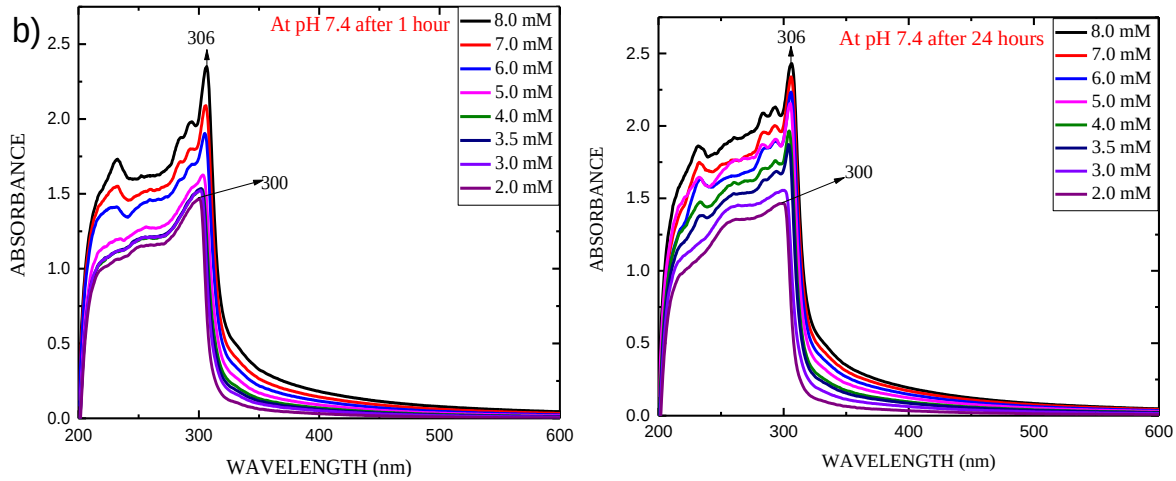



Figure 6. UV-visible spectra of (a) Fmoc-l-phenylalanine powder and hydrogels formed at pH 7.4.

The effect of concentration in hydrogels was studied at each pH, and the absorbance was measured at a time interval of 1 hour, 24 hours, and 5 days of keeping the samples at room temperature (figure 7). From the measurements, it was clear that the samples that formed hydrogels have an absorption maximum in the range of 305nm and those that were in solution state the absorption maxima are blue shifted to 300 nm with the absence of some shoulder peaks compared to those that hydrogels had. When samples were allowed to remain at room temperature for more time, gelation was induced, even though it was invisible to the eyes, which was confirmed by the shift of their absorption maxima towards 305nm. The intensity of absorption peaks increased with an increase in concentration. The concentration intermediate in the gel and solution states had absorption maxima in the range of 305 nm.



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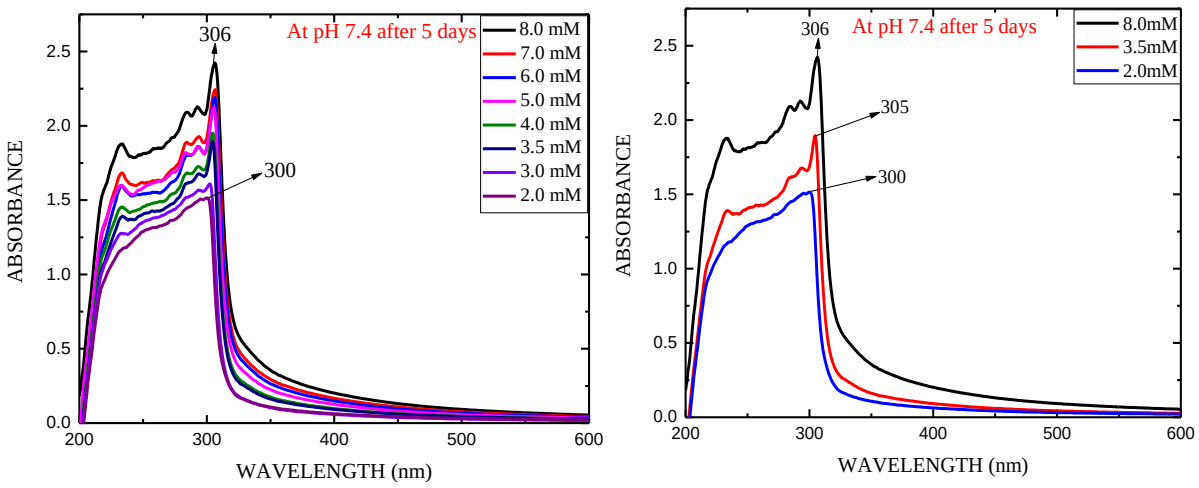


Figure 7. UV-visible spectra of Fmoc-l-phenylalanine hydrogels of different concentrations after 1 hour, 24 hours, and 5 days formed at pH 7.4

**Fluorescence Spectroscopy**

Fluorescence experiments were used to gain insight into the molecular assembling nature of molecules within hydrogels. The changes that occur in the microenvironment of the fluorophore moiety during gelation can be easily understood using fluorescence studies. The important and useful information regarding concentration-dependent fluorescence is easily studied. Fmoc-l-phenylalanine has a fluorenyl group and fluorescence properties.[35] Also, phenylalanine has intrinsic fluorescent properties.[23] Therefore, the gelation studies of the prepared hydrogels can be studied without the use of any external fluorescent molecule. For Fmoc-l-phenylalanine, an emission maximum centred at 322 nm has been obtained for the excitation at 297 nm. The fluorescence spectra of Fmoc-l-phenylalanine powder and hydrogels at pH 7.4 shown in the figure 8. A weak shoulder peak at 360 nm, which corresponds to the existence of intermolecular π–π interactions of Fmoc groups in antiparallel orientation in the gel state.[36] However, due to the higher intensity of the peak at 322 nm, it is considerably invisible, but increasing the slit width will comparably enhance the shoulder peak with the other peak to saturation. The concentration-dependent fluorescence was studied with Fmoc-F concentrations ranging from 2 mM to 8 mM in buffer solution of pH 7.4; this gave information about the minimum gelation concentration. For the study of gel formation at different concentrations, fluorescence measurements were carried out after 1 hour, 24 hours, and 5 days after the hydrogels were allowed to cool down to room temperature at each concentration. This is because changes in fluorescence with time give information regarding self-assembling kinetics. The fluorescence spectra of Fmoc-F hydrogels formed at pH 7.4 measured over an interval of 1 hour, 24 hours, and 5 days are shown in figure 17. At pH 7.4, after 1 hour, fluorescence intensity slowly increases by increasing the concentration from 2 to 3.5 mM, and when the samples are excited with 297nm. This could be caused by an increase in the number of gelator molecules. By



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increasing the concentrations of Fmoc-F, the fluorescence intensity decreased, i.e., from 4 to 8 mM. When all the concentration samples are excited with the same wavelength, emission maxima were obtained at 316 nm to 322 nm for 2 to 8 mM. But after 24 hours when the same samples were excited with 297 nm, the fluorescence intensity slowly increases by increasing the concentration from 2 to 3 mM, followed by a decrease from 4 to 8 mM. While fluorescence measurements were taken for the samples after 5 days with a 297nm exciting wavelength, the fluorescence intensity slowly decreased 3 to 8 mM compare to fluorescence intensity of 2mM. But the emission maxima were obtained in the range of 316 to 322 nm in all the measurements. It is also observed that when samples were kept at room temperature for longer duration gelation is induced in more concentrations. This is evident from the shift in the emission wavelength when comparing the previous fluorescence measurements. But after 5 days, the 2 mM concentration was also in the solution state emission peat at 316 nm, but for 8 mM, it was at 322nm. In the solution state, the gelator molecule shows a peak corresponding to the emission at 316 nm with an excitation at 297 nm. However, in the gel state at the same excitation wavelength, the emission had been red-shifted to 322 nm. The red shift of the sol-to-gel state clearly indicates the aggregation of hydrogelator molecules. The red shift of the sol-to-gel state clearly indicates the aggregation of hydrogelator molecules. The increase in fluorescence intensity followed by a decrease in fluorescence spectra is attributed to the presence of aggregation-caused quenching (ACQ), and the minimal gelation concentration was approximately found at 3 mM, which is consistent with experimental observation.[37,38]

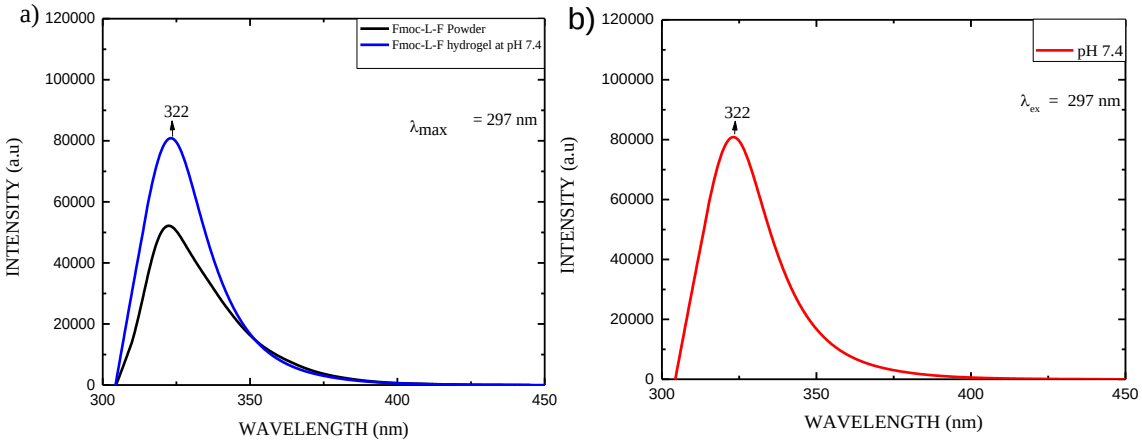


Figure 8. Fluorescence spectra a) after 24 hours at Fmoc-l-phenylalanine powder and hydrogels formed at pH 7.4 b) the hydrogel reformed after reheating and cooling at room temperature for 24 hours $\lambda_{ex}$ = 297 nm.



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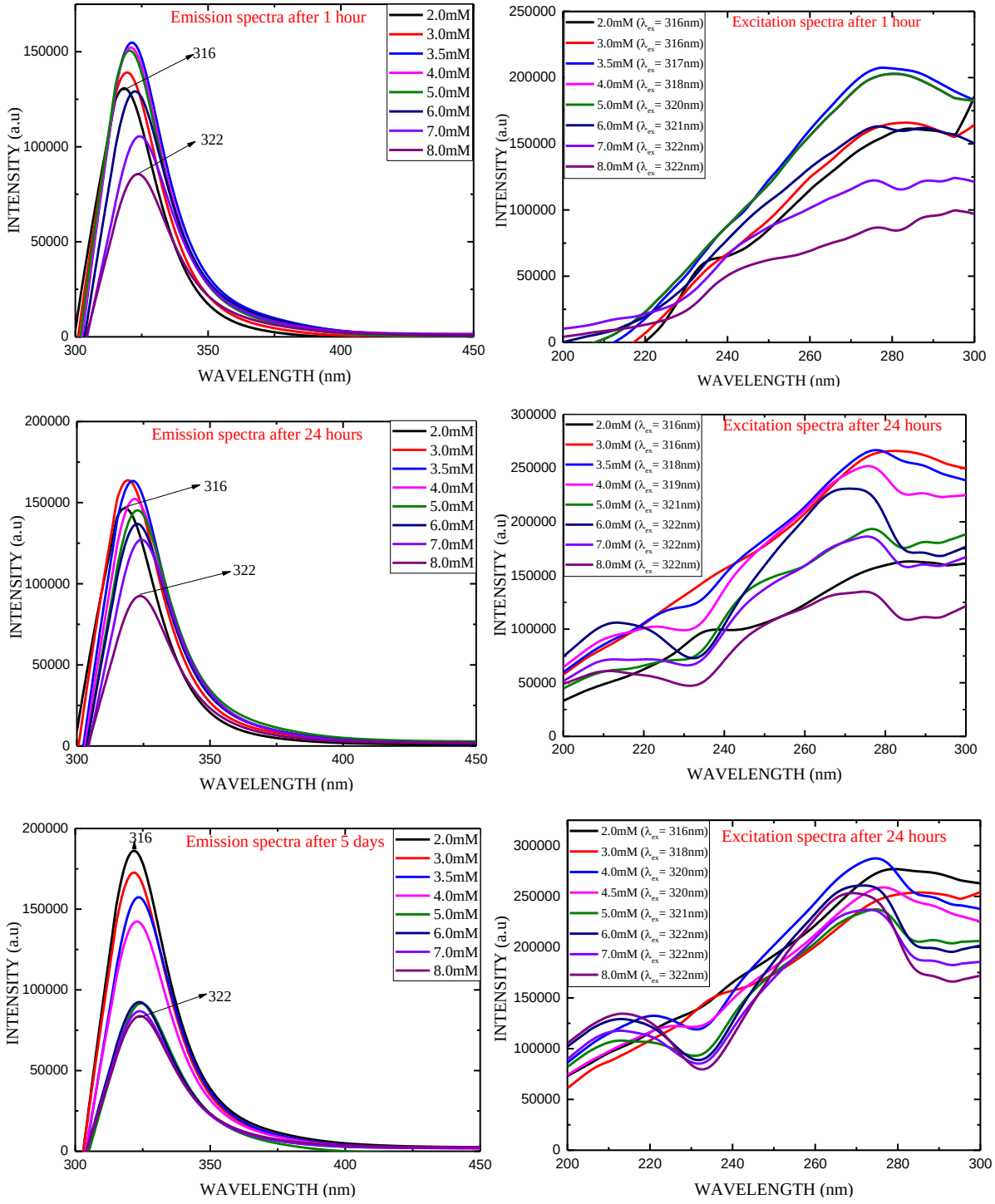


Figure 9. Emission and excitation spectra of Fmoc-l-phenylalanine hydrogels of different concentrations formed at pH 7.4 after 1 hour, 24 hours, and 5 days.

## CONCLUSION

Hydrogels are an evolving field of study because of their exceptional characteristics and wide range of applications. Due to the need for biodegradable and biocompatible materials in order to be applied in biological applications like tissue engineering, wound healing, and drug delivery,



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hydrogels We studied the hydrogelation of Fmoc-phenylalanine in aqueous sodium phosphate buffer at pH 7.4, and the interesting fact is that both buffer solution and pH are physiologically relevant. We employed fluorescence spectroscopy to gain more insight into the hydrogel formation.

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# CLIMATE CHANGE AND ITS IMPACT ON LAND USE OF AGRICULTURE WITH SPECIAL REFERENCE TO PALAKKAD DISTRICT IN KERALA

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**ABSTRACT**

Land is a distinctly limited resource which is central to all human kind needs activities of all our resources, land, the most tangible one, by definition is the solid part of the earth's surface. It is a finite resource, so great care should be taken to preserve it. Land has been part to many uses, apart from traditional ones like agriculture and horticulture, housing , lying of roads and railway lines, industries, mining of resources, cattle grazing, forest wealth for timber, fuel etc. Land use is one of the most important drivers of the global environment changes. It involves the management and modification of natural environment or wilderness into built environment such as settlements and semi-natural habitats such as arable fields, pastures and managed woods. The core of land use conflicts is due to the growth of metropolitan areas. Climate change causes challenges to land use which increase the chance of related non-climatic challenges like population growth, land degradation etc. Improper land use management and unsustainable development can intensify various hazards like flooding, heat stress etc. Climate change cause severe impact on the land use especially on agriculture like changes in cropping patterns, degradation of land etc. This article contributes to the disclosure of knowledge on climate change and its land use impacts on agriculture in Palakkad District, Kerala. The study aims to throw light on the issue and challenges which has to be resolved. The theoretical framework incorporates the change in land use and land cover on agriculture in Kerala context. Keywords: Land use, agriculture, climate change, environment, sustainable development, crop pattern

## INTRODUCTION

Land use is core to many environmental and socio economic issues faced by the economy. In global aspect, greenhouse emissions adversely and seriously affect the ecosystem. Addition to this, the growing population too contribute to the challenges on environment. Many factors contribute to the change in land use pattern especially on agriculture like population, urbanization, degradation of land etc. Among those factors, climate change is the prominent one.



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As we all know, climate change refers to long-term shifts in temperature and weather patterns. Such a shift can be natural like due to changes in the sun's activity or volcanic eruptions etc. But since 18$^{th}$ century, human activities have been the prominent driver of climate change. Climate scientists have showed that humans are responsible for fundamentally all global heating over the last two centuries. The last decade (2011 to 2020) was the warmest on record, and each of the last four decades has been warmer than the previous decade since 1850. This climate change you have caused serious consequences which includes indents drought, melting polar ice, flooding etc.

Land plays a key role in the climate system. Land use pattern affects climate and in turn climate change affects land use. Our land is under rising pressure from deforestation, urbanization, industrial development, agricultural shifting and unsustainable farming practices that are unmining its ability to sustain food production and maintain fresh water and forest resources, air quality etc. At the same time, a climate change, in turn exhibits land degradation through drought, desertification, crop shifting, unsustainable land use etc.

While looking into agriculture, climate change affects agriculture at the global regional and local levels. Climate change can disrupt the food availability reduce access to food and affect food quality which results in finally to change in land use pattern on agriculture. So it has become inevitable to study on the same as feeding the population is most essential one than anything else.

## LITERATURE REVIEW

According to Kanhaiya Lal, Manish Raj and Sanju Kumari (2020), climate change and agriculture are interrelated. Climate change and its variability are likely to intensify the food security issues by putting stress on agriculture. The direct effect of climate change can be observed on agricultural productivity which is likely to decline in most tropical and subtropical regions. Soil moisture is being reduced, increasing demand for irrigation. This scarcity of water pressure farmers to reduce areas of crops under irrigation and to shift to rainfed agriculture. Further, soil fertility is also reduced contributing to land degradation. In such a circumstance, adoption of agronomic measures of mitigation and adoption becomes essential which reduces greenhouse gas emissions and simultaneously helps agriculture to sustain its future.

Climate change and land use in Indian agriculture,( Land use policy volume 109 October 2021) shows that using large panel of district level data, they has assessed the acreage response of crops to climate change, mainly to the rising temperature explaining a two-step economic procedure presuming that climate change influences farmers' acreage allocation decisions through its differential impact on crop yields. Their finding showed that excess temperature reduces crop yields, but the extent of reduction differs across crops.



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Cho and Mccarl(2021) found that human land uses increase resistance to movement or after movement routes and thus influence climate connectivity across North America.

Azadi. et. al(2021) discussed the relationship between climate change and agricultural land conversion based on the data of countries in different income groups, and they found that agricultural land area in high income countries is decreasing but $CO_2$ emissions are increasing, while in low income countries, agricultural land area has increased and $CO_2$ emissions have decreased.

Shuaishuai Jia, Cunyi Yang, Mengxin Wang, Pierre Failler (2022) studied on 'heterogeneous impact of land-use on climate change' which is showed that land and climate interact in complex ways through multiple biophysical and biochemical feedbacks. The study took temperature change as the observation index to reflect climate change and analyze the process of land use type adjustment affecting vegetation cover and climate change. They realize that there is heterogeneity in the impact on climate change among same countries of different latitudes. Also, a country's climate change was affected by both its own land use structure and the land used structure of neighboring countries and the latter made crucial.

## OBJECTIVES

1. To gain an insight to the pros and cons of climate change on agriculture and its land use.
2. To identify methods to maintain sustainable land use pattern in agriculture or sustainable farming.

## RESEARCH DESIGN

This study has designed based on both primary and secondary data in order to analyze how climate change influence agriculture and farmers and how they are to tackle the issue. Primary data has been collected through a well-structured questionnaire depicting all the aspects of the issues regarding agriculture by the farmers. Further, reports of several agencies have also been incorporated in this study. The study is focused in Palakkad district of Kerala.

## DISCUSSION AND RESULT

Palakkad is known for its rice and paddy fields, due to which it earned the moniker of 'Rice Bowl of Kerala'. Hence the district is also known as the 'Granary of Kerala'. Here, the major crops are paddy, coconut, tapioca, fruits, spices, vegetables etc. Majority of the people are engaged in agriculture and allied activities. As per the geographical diversity, Palakkad is a vast stretch of fertile plains interspersed with hills, rivers, mountain streams and forests. The Palakkad Gap, a 40 km western ghat mountain pass, act as a corridor of unique climate in the district.



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**CROP COMBINATION AND CROP DIVERSIFICATION IN PALAKKAD DISTRICT**

Among different block panchayaths, Attapadi has the most cultivated area with a crop combination of spices, rubber, coconut and fruits, followed by Alathur, Chittur, Kollengode and Kuzhalmannam. The district has monocrop, dual-crop and tri-crop combinations.

Table 1.1- Crop Combination in Palakkad District

| **Sl.No.** | **Block** | **Crop Combination** | **Name of crops** |
|---|---|---|---|
| 1 | Alathur | 2 Crop Combination | Rice and Coconut |
| 2 | Attapady | 4 Crop Combination | Fruits, Rubber, Coconut and Spices |
| 3 | Chittur | 3 Crop Combination | Rice, Coconut and Fruits |
| 4 | Kollengode | 2 Crop Combination | Rice and Coconut |
| 5 | Kuzhalamannam | 3 Crop Combination | Rice, Pulses and Oilseeds |
| 6 | Malampuzha | 3 Crop Combination | Rice, Coconut and Fruits |
| 7 | Mannarkkad | 3 Crop Combination | Coconut, Rubber and Fruits |
| 8 | Nenmara | 2 Crop Combination | Rice and Coconut |
| 9 | Ottapalam | 3 Crop Combination | Coconut, Fruits and Rice |
| 10 | Palakkad | 2 Crop Combination | Rice and Coconut |
| 11 | Pattambi | 4 Crop Combination | Coconut, Rubber, Fruits and Rice |
| 12 | Sreekrishnapuram | 3 Crop Combination | Fruits, Coconut and Rice |
| 13 | Thrithala | 3 Crop Combination | Coconut, Rice and Fruits |

Palakkad has a tropical wet and dry climate. Temperature remains moderate throughout the year, with the exception being March and April, the hottest months. A very high amount of precipitation is received in the area due to south-west monsoon.



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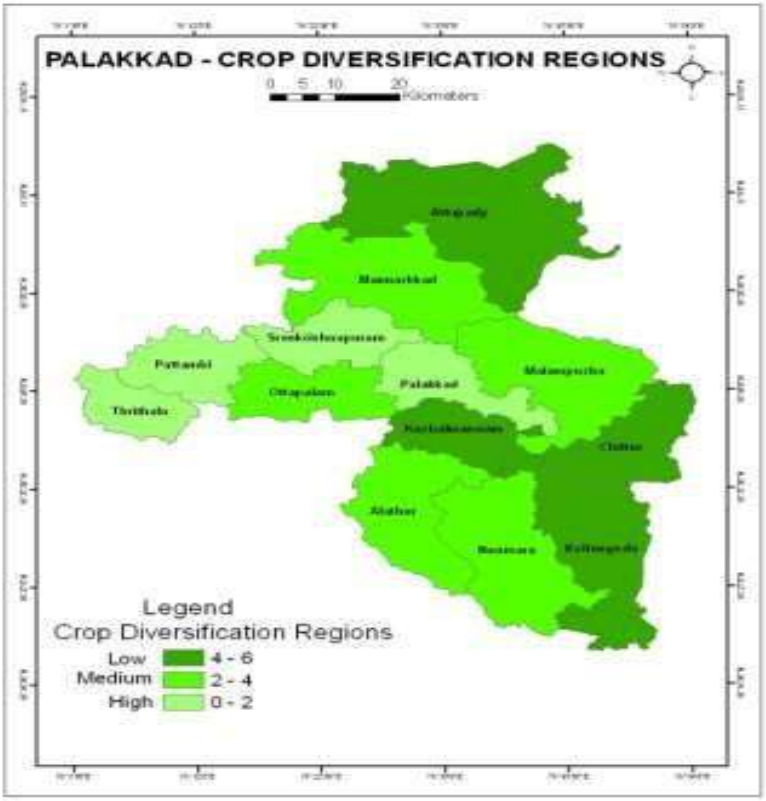


Figure 1.1- Crop Diversification Regions

**CROPPING PATTERN FOR LAST FIVE YEARS**

The district ranks first in the state in production of almost all types of food and cash crops. It is abundant in the production of field crops like rice, ragi, jowar, fruits, vegetables and spices. From 1956-57 to 2016-17, Palakkad remained the composite district with the highest extent of area and highest level of production under rice cultivation. Kharif is the main rice growing season in the region, it is known as Winter Rice. It has been harvested around April. 'Vishu' is considered as the new farming year all over the district. From the beginning of south-west monsoon in June to September will be the growing time of rice and paddy cultivation. Hence, paddy cultivation is done only in those areas where minimum rainfall is 115 cm. The average rainfall in the study area in past five years shows remarkable decline. This decrease in rainfall in the region in recent years is being contributed to a combination of natural climate variability and human induced climate change. Followed by this situation, the amount of land used for rice cultivation in the district has been declined for the last few years. Also, the imbalance in the precipitation threatens the paddy cultivators. Apart from these, the farmers face issues like water storage capacity of land and water availability. Although there is problem of poor return and high labour cost, climate issues are of greater importance. To resolve these, rainwater harvesting technologies, subsidies for paddy cultivation, compensation for natural calamities have been suggested. Still, favourable monsoon is the key to success paddy cultivation.



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## CLIMATE CHANGE AND LAND USE PATTERN

Climate change has a lot of impact on land use pattern of agriculture. In the study, area have a diversified soil pattern and land use pattern have experienced notable changes. A shift in the land use and land cover can alter the human settlement patterns and other economic developments, which ended with environmental degradation. The cropping pattern depends on the abundance of soil in the cultivated area. While alluvial soil is suitable for paddy; seasonal crops like banana, tapioca and vegetables; laterite soil provides for spices and other cash crops; and unique black soil in Chittur Taluk provides for cotton production. Here the issue is, some crops are suitable only in specific type of soil. This is the case of paddy and other wet crops. With a high temperature of about 40 degree celcius, the chance for survival of these kinds of crops are less. Furthermore, study shows that most of the farmers are depending upon soil and its fertility which is less impacted by the climate change. A number of farmers adjust their crops to a new one, which is less challengeable to the soil fertility, irrigation and climate change. As a result, the cultivation of dry crops like coconut, arecanut, tapioca, yams, pepper, pineapple etc; are done. Thus, the decline in rainfall and increase in atmospheric temperature is the very first reason for the change in the cropping pattern. Hence, climate change play a key role in the change in cropping pattern; at the same time profitability factor is not being neglected.

## PROS AND CONS OF CLIMATE CHANGE

Climate change has altered the cyclical timing of seasons all over the world. It changes the regularity of monsoon, imbalances in the capacity of land and variation in atmospheric temperature. It leads to severe impacts on farming activities. Coming to the study area, the major issue is outdated traditional methods of cultivation. It make farmers difficult to predict the cropping time, storage issues of seeds, harvesting etc. Palakkad, being a huge cultural diversity, have most of the farmers as the advocates of traditional rituals in farming practices.

A major feature of Palakkad District, which is dry wind, is another reason for the shift in land use pattern. Strong dry wind will detach, transport and redeposit the soil particles. Its most familiar result is loss of topsoil and nutrients which reduces the soil's ability to produce crops in sufficient quality and quantity as well.

Another issue with high concern is the changing cropping pattern. Because of climatic issues which adversely affect the water availability, soil fertility, water storage capacity of land, inadequate irrigation etc became the challenges faced by the farmers. As a result, in some areas, farmers switch their water-intensive crops like paddy to less water-intensive crops like coconut, spices, millets, tapioca etc. Because of this, the farming practices shift from traditional crops to more drought-



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resistant crops. Thus many crop areas are shifted to cash crops like rubber, arecanut, and other dry crops. Thus, less profitability and advance farming conditions lead to the bottleneck of food production. Furthermore, it creates more environmental issues like soil erosion, declining of wetlands and inconsistency to the sustainable development too. Acid rain, another major threat to agriculture which acidifies soils and freshwater, dissolving and releasing aluminium in concentrations toxic to fish and plants, which leach nutrients from soil, thereby lowering their fertility, and in turn damages the root system, prevents seeds from developing, and kills beneficial soil organisms.

Here, increased use of pesticides and chemical fertilizers which result in severe land degradation cannot be neglected as well.

At the same time we should also realise that agricultural sector is directly responsible for greenhouse gas emissions mostly due to methane emissions from livestock and rice, and from nitrous oxide emissions from fertilizers. As we say, a boomerang effect, it in turn have a reverse affect on the agricultural production.

On the other hand, climate change has some positive effects too. As we know, mankind always search for the solutions for the problems faced by them. To cop up with the climate change, farmers are adopting new technologies and practices like optimizing water use techniques, inter cropping for better soil fertility, rainwater harvesting techniques etc. Also, shift from food crops to cash crops improved the standard of living of the farmers by concentrating on more profit.

**SUGGESTIONS**

Climate change adaptation techniques in agriculture are to be introduced like Climate Smart Agriculture (CSA) which means an integrated approach to manage landscapes-cropland, livestock, forest and fisheries that address the inter-linked challenges of food security and climate change.

As weather inconsistency is a common phenomenon in the present-day world and a threat to agriculture, farmers have to be alert in sudden and frequent weather changes to ensure high yields and manage risks.

Proper water infiltration prevents flooding and water-logging as well as helps to avoid chemical and water leakage which enables farmers to reduce the usage of water resources and tackle soil erosion.

Another major area to be resolved is irrigation deficiency. As irrigation is vital for vegetation in the lack of rainfall, water supply should be sufficient to ensure stable plant development. Improved irrigation systems, drip or tape irrigation, mulching and crop residue can be adopted.

Rainwater harvesting is another solution. Collecting rainwater is valuable in drought-subjected areas and it saves water resources, yet involves extra inputs to operate rainwater storages.



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Small or Precision Farming is an important achievement in climate change and agriculture solutions. Precision agriculture based on site-specific farm management helps to save farmer's resources and reduce environmental pollution.

Planting cover crops is another successive method that helps to prevent soil erosion, promotes water retention, and nitrogen fixation.

No or Minimum Tillage prevents soil erosion and promotes carbon sequestration, which is beneficial regarding climate change and farming.

Use of adaptive crops vibrant to unfavourable climatic conditions can be done.

Crop rotation and diversification is beneficial for the ecosystem biodiversity and gastronomic experiences of mankind.

At the same time, immediate and effective policies and actions must be taken by the respective authorities from the root level to control carbon emissions and severe climate changes which hinder the livelihood of each and every species.

## CONCLUSION

In the study we identified the interconnection of climate and agriculture. Even a small change in climate has a drastic impact on agriculture adversely affecting the productivity and the production rate. We can see that the farmers are shifting from their customary crops to crops that will have higher economic return under changing climatic conditions which their attitude towards the risk element in customary crops as well. So, immediate action must be taken from the part of government and concerned organizations to adopt sustainable agriculture or farming which helps in reducing greenhouse emissions, thereby playing a significant role in combating climate change. By most estimates, the world population is projected to reach 9.6 billion people by 2050. This implies that food production must increase by 70 percent to meet the demands of such a huge population. Therefore, it is becoming more apparent to, control climate change through control of carbon emissions and, require serious reforms in the agricultural sector to ensure that our food system is ready to meet the challenges of a burgeoning world population. Otherwise, world will have to face undesirable consequences, which will be a huge threat to lives.

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# ENHANCING RESILIENCE: KERALA'S ROBUST NATURAL DISASTER MANAGEMENT

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**Abstract**

Kerala faces different threats of natural disasters. The lush landscape and long coastal belt , also add risks to the state. Kerala is vulnerable to calamities like Cyclones, floods, and landscapes. The experience of heavy rainfall in monsoons prompts the state to develop a robust natural disaster management system. Kerala developed a preparedness and resilience mechanism to reduce the risk of calamities with community engagement. The early warning system helps to reduce the casualties from frequently facing landslides and also helps to reduce the death toll in coastal areas. Kerala's experiences of flood on 2018, and its resilience is really a wonder to other states.

**Key words:** disaster management, resilience, adaptability.

## Introduction

The geographical peculiarities and climate have made Kerala vulnerable to natural disaster, like floods, landslides, cyclones, and earthquakes. The experience of natural disasters made Kerala develop an early warning system for timely evacuation. The community engagement in disaster management has helped to evolve a systematized resilience and preparedness to mitigate the casualties from calamities.

The Kerala state is experiencing multifaceted challenges due to the unique geographical features, monsoon patterns, the length of coastal areas and through the exploitation and crazy actions of human beings. The unique geographical peculiarities make the state more vulnerable to natural disasters. The Western Ghats is having more steep slopes, is adding the risk of frequent landslides in monsoons. The state has a vast network of rivers and backwaters make more vulnerable to floods. The heavy rainfall on monsoons has adding more risk to the life's of people on coastal belts. Kerala has experiencing two major monsoon seasons, the south west monsoon , which starts from June to September and the northeast monsoon from October to December. The monsoons bring heavy rainfall and make the state more prompt to flood landslides and riverbank



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erosion. Kerala is also facing the threat of cyclones that originate from Arabian Sea. The cyclones make the area vulnerable to storm surges, strong winds and heavy rainfall. Cyclones affect more on coastal areas.

The state also is exposed to Seismic Activity. The Earth quakes are rare, but it provides a potential threat to big dams. The state has developed a preparedness system for meeting such threats and tries to minimize the causalities form such events. The actions of human beings also led to the challenge of disasters. The change in land use patterns and process of urbanization is further adding the vulnerability to natural disasters. The encroachment of forest areas and water bodies and unplanned developmental activities also can intensify the risk of natural disasters.

**The Objectives**

To understand the working of disaster management system of Kerala

To study resilience of disaster on the experience of flood 2018

**Methodology**

The secondary data is used to evaluate and study the resilience ad preparedness of people of Kerala. The flood happened I 2018 is being analyzed to understand the major resilience activities. The present study uses a literature review to study the disaster management

The flood of 2018 in Kerala has made to develop resilience and preparedness to the people of Kerala on natural calamities. The following figure shows the excess monsoon rain the state experienced in past 100 years. The flood of 1924 had severely affected many districts from Thrissur to Alappuzha and some parts of Idukki. The flood also brings landslides in steep hilly areas , for example the Munnar roads faced such misfortunes in 1924. Next major flood happened in 1961 at Periyar basin as a result of 52% increase of rainfall. The disasters are comparatively lower due to the lesser occupancy in that areas.

**Kerala Flood 2018**

The flood took in 2018 due to heavy rain fall on monsoon from 2018 June to August Kerala received 42% excess rain fall. (UNDP 2018) The heavy rain fall also caused several landslides. The sudden release of excess water from 37 dams further intensified the situation.( Ali, S., & George, A. (2021)) 5.4 million people were affected in the flood of 2018 and its landslides and it result a death tool of 433 lives ,consisting 268 men, women were 98 and 67 children [World Bank (2018].The major reason for flood was pointed out as untimely release of excess water from dams (Prasad R (2018)).The heavy rain from 14 to 19 th August intensified the disaster.it affected all the districts in Kerala.



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Table 1.1The Month-wise rainfall and percentage departure from normal (Directorate H (2018)

| Period | Normal rainfall (mm) | Actual rainfall (mm) | Departure from normal (%) |
|---|---|---|---|
| June 2018 | 649.8 | 749.6 | 15 |
| July 2018 | 726.1 | 857.4 | 18 |
| 1–19 August 2018 | 287.6 | 758.6 | 164 |
| Total | 1649.5 | 2346.6 | 42 |

Source: Ali, S., & George, A. (2021)

1.The media reports stated that the flood affected many villages, destroyed 75% roads and thousands of houses. The relief camps were started functioning with community engagement. The Central Government, state Government, and National Crisis Management Committee were coordinated the rescue and relief operations (Directorate H (2018))


source: Ali, S., & George, A. (2021)

Figure 1: Classification of Stakeholders involved in response and relief activities . (Central Water Commission New Delhi: Central Water Commission,2018)

The disaster management Authorities The Kerala State Disaster Management Authorities (KSDMA) is the authorized body in Kerala. They ensure that proper planning and recovery methods are implemented in the state during the disaster.



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The management was formed under the Disaster Management Act, 2005. They began their operations on May 7th, 2007. It is a non-autonomous body. The chairman of the management committee is the Chief Minister of the state. Besides the Chief Minister, the management comprises 10 members. It is by the Additional Chief Secretary, Revenue and Disaster Management. There is also the Kerala State Emergency Operations Centre (KSEOC). They take care of technical matters and emergency operations. Other committee members include Minister for Home and Vigilance, Additional Chief Secretary, Home and Head of State Emergency Operations Centre, and Minister for Agriculture. The resilient activities were took by the co-operation of government and private individuals, NGOs etc. The above chart give a brief description on the resilience activities undertaken by different agencies and its compilation for evolving a great success of achieving faster resilience.

**Classification of NGO involved in response and relief activities [Directorate H (2018) KERALA FLOODS OF AUGUST 2018. New Delhi: Central Water Commission)**

| NGO | No. of houses | Source |
|---|---|---|
| Co operative Department | 1500 | [Sumeesh (2018)] |
| Muslim Jamaath | 1000 | [Hindu T (2018)] |
| Peoples Foundation | 500 | [People's Foundation (2018)] |
| Act On | 300 | [Anon (2018)] |
| Joy Allukas | 250 | [TOI (2018)] |
| Muthoot Group | 200 | [News Time Network (2018)] |

Source: New Delhi: Central Water Commission 2018

The various clubs NGO's and Kudumbasree members helped a lot for resilience. They actively participated in the following duties.

| |
|---|
| Help to clean houses and public offices |
| Providing counseling support to more than ten thousand families. |
| Collect and distribute necessary items to needy people. |
| Providing local level coordination to all such activities |
| Providing support to volunteers |
| Finding temporary shelter for houseless |
| Cleaning public properties |

Source: Ali, S., & George, A. (2021)

The political support and cooperation also facilitated faster relief. The ruling and opposition parties joint hands in providing support to victims and tried to re build Kerala (The Hindu Business Line (2018)) The involvement of fisherman community in flood relief activities were really



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commandable.4537 fishermen with 669 boats recued around 65,000 lives.( World Bank (2018). The community involvement in relief field bought wonderful results .When shelter camps were started the camps the people took the responsibility to run camps through community engagement. The camps were started at hospitals, schools, stadiums and even in worship places. The social media also played a major role in coordinating the relief activities. government messages got wide attention through social media. Social media also help to collect donations and make it distribute to the needy. The celebrities also extended their help in relief measures. The community involvement made the resilience easy in 2018 flood the state government introduced "Rebuild Kerala Initiative" for rebuilding life in Kerala after the floods.

**Conclusion**

As Kerala navigates its unique challenges, the State Disaster Management Policy serves as a beacon, guiding the collective efforts of diverse stakeholders towards building a resilient and disaster-safe state. Through the effective implementation of this policy, Kerala aspires to uphold its reputation as 'God's Own Country' by minimizing the impact of disasters and ensuring the well-being of its residents.

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# GREEN FINANCE: A PATHWAY TO SUSTAINABLE DEVELOPMENT

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## ABSTRACT

The pathway of sustainable development requires a shift in investment away from greenhouse gas, fossil fuel, and natural resources to efficient technologies and other models. The concept of sustainability is not only limited to environmental sustainability, it's also about economical sustainability as well. However, there are instances to promote the flow of financial instruments. The financial sector will have to play a crucial role in this 'green transformation'. Green finance is the latest concept in the financial instrument which merges environmental sustainability with economic sustainability. Green finance describes activities related to the two-way interaction between the environment and finance and investment. This paper is an attempt to identify the importance of green finance and discusses the various measures taken up by the Government Initiatives for Green Finance. The last section concludes with analysis of SWOT about Green Finance related Sustainable Development.

**Keywords:** Sustainability, Green Finance, Green Bonds, Green Banks.

## INTRODUCTION

Sustainable development is familiar to all, sustainable development refers to the development that meets the current generation's needs without affecting or bargaining the future generation's own needs. The concept of sustainability is not only limited to environmental sustainability. It is also related to economic sustainability as well. It happens to improve in the financial instruments.

Sustainability is classified into four factors: Human, Social, Economic and Environmental Sustainability. In the case of Green Finance, mostly related to Economic and Environmental Sustainability. The financial sector will have to play a crucial role in the 'Green Resources'.

Green Economy is the financial stability of the economy, in which the growth of income and employment generation are handled by public and private sectors that helps to reduce environmental risks like carbon emission and pollution etc. Green growth refers to the encouragement of environmental resources and eco-friendly products.

The Green Finance simply refers to the collaboration of economical and environmental sustainability i.e, interaction between the finance and environmental projects. " Green Financing is



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to increment in the financial way to achieve economic growth and development while importance is given to environmental activities like emission of greenhouse gas, reducing the wastage of natural resources and mitigating against pollution. This paper has to identify the importance of green finance and discuss the green financing initiative taken by the government.

"Green Financing is a way to increase the level of financial flows (from banking, micro-credit, insurance and investment) from the public, private and not-for-profit sectors to sustainable development priorities."

**Source: United Nation Environmental Program**

The world has many changes, so we think the environment has to be changed. The concept of green finance is financing environmental projects like renewable energy, carbon financing, and green bonds. Green finance provides an opportunity to people to make a part of sustainable development and make saving habits in their minds.

Green finance is the one of positive impact to the environment however, increase in financial flow of the economy. It helps to mobilize save habits among investors and be more sustainable in the future. This green finance plays a primary role in the risk mitigation and helps to make sustainable and economic development. This scheme of the United Nation Environmental Program has become a crucial position and positive impact for the revenue section of the economy. Major examples of green finance initiatives are energy efficiency and renewable resources energy, Pollution control and prevention, Biodiversity and other economic initiatives.

The major aims of the Green Financing are follows:

1. Reduce environmental risks.
2. Promote environmental benefits to society.
3. Decent rate of financial profit.

## METHODOLOGY

This paper has a descriptive manner, because this paper reveals the importance of green financing and that's strength, weakness, opportunities and threat of green financing leads to sustainable development. Using tables to capture important points quickly. These methods are mainly focused in this paper.

## TYPES OF GREEN FINANCING

Green financing is the term of investments in Sustainable initiatives. The types of green Financing are:

1. Green Loans



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2. Green Mortgages
3. Green Bonds
4. Green Banks

| **Types** | **Definitions** |
|---|---|
| Green Loans | Loans given to eco friendly activities like solar panels in home, energy efficiency projects, etc. |
| Green Mortgages | Lenders allow beneficial activities among highly positive impacts to environmental contribution. |
| Green Banks | It entails financial institutions to encourage eco friendly investment and transaction using electronics and reduce usage of papers. |
| Green Bonds | It is a debt instrument by an institution to impact the environmental resources. Also known as Climate Bond. |
| Carbon Financing | Investments allocated to reduce greenhouse gas(GHG) emission. |

**GOVERNMENT INITIATIVES FOR GREEN FINANCE**

The Indian Renewable Energy Development Agency (IREDA) and Solar Energy Corporation of India (SECI) are the two institutions that have announced contributions given to the International Solar Alliance for renewable activities. Several efforts are taken by the government of India for attaining Sustainable Development Goals. Some efforts are a great contribution to the green financing also, i.e, now we know green finance is a part of sustainable finance. They are:

- Green Bonds
- Priority Sector Lending (PSL)
- Green Bank
- Crowding Fund

**1. Green Bond**

Green Bonds are those investing like fixed income deposits, in which are financing on their environmental products. In India, the first green bond was introduced by the YES Bank in 2015. In this field, many bonds are available, the “Use of proceed” Green Bond is the bond that is protected by asset, “Green Project bond” i.e bonds are handled by the help of a project’s asset and liabilities. And, at the face value of Indian currency in terms of the bond issued to the outside our country, i.e is



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known as Masala Bond. So the term "Green Masala Bond" is that bonds are sold to the public at the face value of Indian currency (Rupee) and that securities are only listed in the London Stock Exchange by the World Bank.

**2. Priority Sector Lending (PSL)**

Priority Sector Lending is one of the government initiatives for Green Financing. The Priority Sector Lending scheme was introduced by the Reserve Bank of India in 2015. The main aim of the PSL is focused on the sector of sustainable financing and renewable energy as a "Leading Sector". It helps to boost up the importance of environmental projects as a path to Sustainable Development and its competitiveness in the Indian economy.

**3. Green Bank**

Green Bank is one of the instruments of green financing and is also a government initiative. The Green Banks is a process of finance for the sector of eco-friendly practices and to reduce carbon emission processes with the help of financial institutions like public and private banks, non profit banking institutions. The main reasons for the establishment of green banks are the goals of clean green energy and mobilization of private sector funds for the environmental projects.

**4. Crowding Fund**

Crowding fund is another government initiative for the source of funds provided for the startup investment given for the eco-friendly projects. This funding is very helpful for mitigating risks of the Sustainable Projects like technical risk,etc.

**RESULT AND DISCUSSION**

Green finance works with the help of public finance. Green finance is taken up as a business profit making field by many institutions and green industries with different mannar while some green financial institutions are domestic finance, private sector finance and also international level. This funding has three levels i.e,

- Domestic Level
- Private Sector Level
- International level

The Domestic level is the funding directly given by the government while the private sector is a combination of domestic and international level banks or financial institutions. And international level are multilateral international banks and foreign banks. These are types of fund sources used for the Sustainable Development Projects.



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**GREEN FINANCING RELATED SUSTAINABLE DEVELOPMENT: SWOT ANALYSIS**

SWOT is a strategic analytical tool for assessing strengths and weaknesses of Green Financing, analyzing opportunities available to the work, as well as threats faced by the WFH. This page focuses on the application of SWOT analysis in a Green Finance context as a part of a mini paper presentation. The Strengths and weaknesses are internal i.e Green Finance are able to influence and to manipulate with their strength and weaknesses. Opportunities and Threats, on the other hand, are external.

**Strength of Green Finance**

**1. Competitiveness among the Economy**

With the help of priority Sector Lending (PSL) are the improvement in the environmental sectors and makes competitiveness between the domestic and foreign countries. Increasing the country's contribution to the green bonds and other instruments that leads to improvement in the economic stability as well as the financial and environment.

**2. Improvement in quality of life**

They have contributed to the environmental projects, it makes a change in all living beings. Increased use of eco-friendly products reduces harm for the living organisms and investment makes profits for their investors. It leads to the improvement in the standard of living and Sustainable Development.

**3. Environmental Protection**

Any infrastructural projects are started, the main source is finance. If the eco-friendly projects are, lots of funds have to be invested for the completion of the works. The completion of environmental projects was an improvement in the sustainability of the economy. It overcomes ozone depletion and reduces carbon emission. So this green finance is essential to the protection of the environment.

**Weakness of Green Finance**

**1. Lack of awareness and knowledge**

The banking institutions and their investors may not fully understand the technical terms of the green financing and its benefits. It may lead to negative impacts like financial loss or investors becoming afraid to invest in green finance.



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**2. High cost of capital**

Compared to the traditional financial institutions, green financing institutions have a high cost of capital. Green finance firms have to lower their cost of capital and interest rate. It can encourage more investment in sustainable projects.

**3. Long Term investment**

The concept of green finance, majority of the investments are long term . All investors who are profit motivators with limited tenure are interested. That's why they are not interested in investing for the long term, because their payback period is too long.

4. **Complex in accessibility of environmental impact**

An investor has to invest in eco-friendly products, he/she can access some information about sustainable projects. But, sustainable data can vary from time to time. So that's a challenge to the investors to make a decision among information.

**Opportunities of Green Finance**

**1. Encourage technical aspects.**

In India, as developing countries have effective tools are encouraged in the technical aspects. That makes it a competitive country as compared to other countries. If the government constructs infrastructure with green marketing instruments, it leads to an increase in the country's competitiveness in the economy.

**2. Encourage efficient Banking System**

Green Finance encourages to reduce the wastage of paper and promotes efficient online banking to the public. That's why it became convenient for consumers to do banking activities and also save traveling expenses and time.

3. **Encourage to develop Green Markets and Non Banking Institutions**

Green Finance helps to develop the green marketing for carbon trading and their funding will be easier for the non banking institutions promoting finance to environmental projects. Non banking institutions have low cost of capital and interest will motivate the green financing.



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**Threats of Green Finance**

**1. Green Project has technology Risk.**

If the solar energy panels have uncertainty about the storage of energy and weather conditions, therefore it makes it difficult for the financial institutions to evaluate the financial risks for this type of green projects.

2. **Insufficient information regarding Green Projects**.

Many institutions aren't openly sharing their environmental performance regarding use of green products. This available information makes it difficult for financial institutions to identify price and manage their environmental or financial risks.

3. **Maturity Mismatch**.

Many green infrastructure projects only payoff in the long term. However, the financial system is dominated by short- or medium-term investment that results in a mismatch in the maturity. That's why most people could deposit money in the bank.

Green Finance is the essential tool for Sustainable Development through investing in environmental projects with the aim of protecting natural resources. Using green finance in the economy as well became a positive impact to the environmental resources.

## CONCLUSION

In the present scenario, sustainable development is the most widely used term to protect our environment. The 17 Sustainable Development goals tell us about the responsibility and right to do for the Economy. This green finance will be one of the best tools to make it effectively efficient sustainable development. Nearly green finance is a familiar term for us.

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# A STUDY ON MACHINE LEARNING APPLICATIONS IN FORENSIC DNA PROFILING

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**Abstract---** A variety of potent computer algorithms known as machine learning (ML) can create predictive models by intelligently and autonomously analyzing enormous amounts of frequently unstructured data. With its numerous uses in the web, commerce, automobile, clinical diagnostics, scientific research, and, more lately, forensic science, machine learning (ML) has become an indispensable part of our everyday life. The manual examination of complicated data in the field of forensic DNA can be difficult, error-prone, and time-consuming. New machine learning techniques could help expedite this procedure while preserving the high precision and repeatability needed for forensic instruments. The forensic community is mainly uninformed of the possibilities and limits of machine learning (ML) due to the relative novelty of such applications. This paper conducts a brief review on the study of machine learning applications in the field of forensic DNA profiling.

**Keywords---** Machine Learning, Prediction, DNA, DNA Profiling, Machine Learning Applications.

## Introduction

The convergence of forensic science and machine learning (ML) has created new opportunities to improve the precision and effectiveness of criminal investigations in recent years. DNA profiling is a fundamental area of forensic science that plays a key role in identifying suspects and establishing vital connections in criminal cases. This study explores the complex field of "A Study on Machine Learning Applications in Forensic DNA Profiling," with the goal of identifying potential areas of overlap between state-of-the-art machine learning methods and the complex field of forensic science.

This work was motivated by the increasing need for more advanced and reliable instruments in forensic investigations. Even though they are quite effective, traditional DNA profiling techniques frequently run into problems when working with huge, complicated datasets. Machine learning, with its power to find patterns, classify data, and develop prediction models, has the promise of changing the area of forensic DNA analysis. Investigators may obtain hitherto unheard-



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of insights by utilizing ML algorithms, which could speed up the identification process and increase the general accuracy of DNA profiling data.

Although DNA profiling techniques have advanced, there are still difficulties in obtaining valuable information from complex and varied biological samples. Factors such as sample degradation, contamination, and the sheer volume of genetic data contribute to the complexity of forensic investigations. The urgent necessity to overcome these obstacles by incorporating machine learning techniques into the forensic DNA profiling procedure is addressed in this study. By doing this, the research hopes to aid in the creation of more durable, dependable, and effective instruments for forensic professionals.

Given the increasing dependence on DNA evidence in criminal investigations and the concurrent expansion of genetic data available, this study is clearly needed. It may not be possible for traditional methods to fully utilize the knowledge that is embedded in huge datasets, therefore a paradigm shift in favor of more intelligent and data-driven methodologies is required. By bridging the gap between traditional forensic procedures and machine learning's transformational power, this survey research eventually promotes developments that have the potential to greatly affect the model's correctness.

**Types of Machine Learning**

Machine learning can be arbitrary categorized into four main types: supervised learning, unsupervised learning, semi-supervised learning and reinforcement learning [1].

**Supervised learning**

The most popular kind of machine learning (ML) in general and forensic DNA analysis in particular is supervised learning. A sizable structured dataset comprising input and output variables is used to train the predictive model in this kind of learning [2]. In this method, the training data is provided as labeled samples. As an illustration, consider DNA fragment sequences that have labels attached to their flanking regions and STR loci. Using a training dataset of labelled examples, the learning algorithm basically learns the mapping function between the values and then applies the rules to each new case to determine the related label.

**Unsupervised learning**

The intended format for unsupervised learning is not pre-structured data. Put differently, it can create a function using the input data (X) as well, but unlike supervised learning, it does not need the matching output labels (Y) for the training set of data [3]. The algorithms require a very big and thorough dataset to handle the majority of the many instances of X-Y connections, as



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predefined labels are not available. This is necessary in order to effectively train the model to comprehend the characteristics of the data. The goal of this method is to organize the data similarly to how people do, but it depends on which features are provided to and retrieved from the data.

**Semi-supervised learning**

In essence, semi-supervised learning combines supervised and unsupervised learning strategies. When there is a lot of input data but not much labeled data, this kind of machine learning is typically employed. When gathering labelled data is expensive, time-consuming, or limited, the aim of semi-supervised learning is to use the extra information present in the unlabelled data to enhance the model's performance. To learn to differentiate an allele from background noise, for instance, a model may be given a relatively high number of raw electropherograms, but only a subset of electropherograms and/or alleles may have been pre-labelled [4].

**Reinforcement Learning**

An agent (such as a computer program or an autonomous robot) learns to make decisions through interaction with its surroundings in a process known as reinforcement learning. The agent acts in the environment, gets input in the form of incentives or penalties, gains experience, and applies this experience to iteratively improve its policy. In tasks like gaming, robotics, and autonomous systems, where an agent must learn through trial and error to make informed judgments, this kind of machine learning is frequently employed.

**Related Works**

The field of DNA analysis can particularly benefit from the application of ML techniques. Continuous developments in high-throughput genomic technologies such as massively parallel DNA sequencing paired with improved methods for bioinformatic data interpretation lead to accumulation of complicated genetic data. These data need to be processed and annotated thoroughly, which makes machine learning (ML) a perfect fit. Actually, ML techniques are used to a wide range of genetics and genomics issues, including the creation of genomic annotations, the prediction of functional genomics elements, the comprehension of gene expression mechanisms, and other issues requiring intricate analysis of sizable and frequently unstructured datasets.

The broad subject of forensic science examines and makes inferences from a wide range of sources of highly changeable multidimensional data. It is expected of forensic analysts to analyze data using a broad range of professional expertise, rigorous standards, and an impartial approach. But given the complexity and diversity of biological data, this endeavor is difficult. It includes DNA markers (STRs, SNPs, and microhaplotypes) from both human and non-human sources that



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are used for identity and research; RNA markers (mRNA and microRNA) that are used to confirm the biological tissue of origin; epigenetic markers (DNA methylation, for example) that are used to estimate biological age and biological tissue of origin; and even protein markers that can be used as a stand-in for genetic identification [5-8].

**Current applications of ML in forensic biology can be arbitrarily divided into:**

Applications pertaining to human identification, including the effective identification of STR alleles from data generated by CE or NGS, while filtering out any artifacts and supporting the interpretation of DNA mixtures, like determining the number of contributors (NoC) in a DNA mixture Applications pertaining to forensic intelligence, including biogeographic ancestry prediction and forensic molecular phenotyping.

Most published studies in this field used a similar methodology. In summary, the suggested machine learning techniques do not rely on predetermined assumptions and create models almost exclusively from raw EPG data. They also do away with the data analysis thresholds that are commonly employed in modern STR profiling. Rather than employing stochastic and static analytical thresholds (ST), they either employ a dynamic threshold [9] or do not apply any thresholds at all [10–12]. This approach's proponents assume that using a static threshold (ST) is overly conservative and could result in a considerable loss of important information (allelic peaks). This loss could be minimized by applying a dynamic threshold (DT) or applying no thresholds at all (NT).

Because of the inherent constraints of any analytical system, signals below such thresholds—for example, below AT—are regarded as unreliable in traditional procedures and are rejected. This method lessens the likelihood that genuine peaks will be overlooked or that artifacts will be mislabeled as allele peaks. As advised by the SWGDAM [13], the majority of forensic DNA labs employ a set of established static thresholds that try to minimize Type II errors (such as misclassifying real peaks as artefacts) and prevent Type I errors (such as labeling an artefactual peak as an allele). In forensic science, the potential to find false positives (Type I error) is often seen as a more serious error since it might result in incorrect inclusion and erroneous conviction [14,15].

Applying a more conservative ST, and particularly an AT, reduces the likelihood of Type I errors at the expense of Type II errors. An answer to this issue may be found in a recent study by Adelman et al. [16]. The authors present an automatic technique for identifying and eliminating fluorescence pull-ups that doesn't necessitate removing biological or technological artifacts beforehand. The raw EPG data is subjected to a symbolic regression model as part of the suggested computational workflow. The data were filtered using a static AT of 10 rfu to find the candidate



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variables for a model before being subjected to either a dynamic, locus- or sample-specific threshold.

The developmental validation of the FaSTRTM DNA analysis software in accordance with the FBI Quality Assurance Standards for Forensic DNA Testing Laboratories 2020 is described by Lin et al. in a more recent work [17]. GeneMapperTM ID-X and the created software were compared on a large dataset consisting of 3403 single-source and mixed DNA profiles produced by seven different STR profiling kits. Nearly 100% agreement in peak classifications, including a correct designation of stutter peaks, was revealed by the study. After improvements to the suggested ANN model in a more recent paper, the model was able to categorize a full DNA profile rather than just specific profile elements when combined with the larger training set [18].

Crysup et al. just released a novel and exciting method for ML-based mixture interpretation [19]. This work investigates how to improve the accuracy of allele calling in low-template DNA mixes by combining a machine learning bioinformatic pipeline with the previously reported barcoding method employing unique molecular identities (UMIs) [20]. Low-template samples, and especially low-template combinations, provide problems for forensic DNA analysis because of PCR artifacts and the issue of separating noise products from small contributors.

Swaminathan et. al. [21] detailed one of the earliest attempts to effectively interpret the NoC using a machine learning technique. In order to determine the number of contributors to a profile, the authors created the MCMC continuous probabilistic technique NOCIt, which makes use of data on peak height, deterioration, forward and reverse stutter, noise, allelic drop-out, and other factors. A follow-up study used 815 DNA profiles of different quality, contributor counts, and mixing proportions to assess the model's performance after it had been calibrated using 100 single-source ground truth profiles [22]. Notably, before being incorporated into the computational pipeline, this technique involved a human artifact removal phase.

The same research group published a more recent study in which the scientists created a new continuous model with ANN and compared the two approaches to the widely-used MAC methodology [23]. A standard collection of 214 PROVEDIt mixes [24] was used to test each approach, with the focus being on several parameters such as accuracy and precision of the true NoC estimation (based on the highest LR). As predicted, the ANN needed a lot more time to train than the NOCIt (about 24 hours vs to several minutes). After training, though, it outperformed the NOCIt, which took tens of minutes to run and had lower repeatability, in terms of speed and precision measures. The authors also point out that compared to probabilistic models, ML models in this study and others generally have significant drawbacks, such as more variability in findings (i.e., precision, accuracy, and robustness).



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**Findings and Scope of Further Research**

The results illustrate the potential of machine learning (ML) applications in forensic DNA profiling and point to further research and development directions. To reduce the observed diversity in findings, more research should focus on improving machine learning models, especially with regard to precision, accuracy, and robustness. The potential of ML in automating the identification and removal of artefacts, as proven by Adelman et al., opens options for constructing more sophisticated computational pipelines for data pre-processing.

Furthermore, the emphasis on interpreting mixes necessitates ongoing attempts to raise the precision and dependability of ML-based techniques, particularly in low-template circumstances. As Crysup et al. investigated, integrating unique molecular identifiers (UMIs) and bar-coding techniques creates opportunities for resolving issues with noise and PCR artifacts in complicated mixtures.

The changing field of machine learning approaches for determining NoC, as demonstrated by Swaminathan et al., encourages more research into hybrid models that integrate the advantages of various computational methods. For practical deployment in forensic DNA laboratories, addressing the lengthier training periods associated with particular ML models and enhancing repeatability will be essential.

**Conclusions**

As a result, the results highlight the potential application of machine learning (ML) in forensic DNA profiling, demonstrating developments in NoC determination, artifact identification, and mixture interpretation. Subsequent studies ought to concentrate on improving machine learning models for increased resilience and precision, especially in data preparation. The exploration of barcoding technologies and unique molecular IDs gives prospects for boosting accuracy in low-template DNA mixes. In order to make ML useful in forensic labs, researchers need to focus on improving repeatability and lengthening training times. These results point to a revolutionary direction for the future and motivate continued attempts to fully utilize machine learning to improve the precision and effectiveness of forensic DNA analysis.

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# HOW TO CHOOSE A COURIER SERVICE? STUDY ON A CUSTOMER PERSPECTIVE

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**ABSTRACT**

Courier services is a most demand service sector in the recent time. The aim of the study is to understand the perception of the customers to select a courier service and to identify the most influencing service quality dimension. Convenient sampling method is used for the study. The online survey was conducted for data collection and 5 -point Likert scale was used to measure the variables.100 people living in the Thrissur district was participated in this study. The descriptive statistical methods were used for data analysis. The major finding on this study was service quality dimensions, which are tangibility, reliability, assurance and responsiveness were strongly influence the customers preference towards select a courier service. Role of reliability and responsiveness were the most influencing dimension.

**Key words: -**Courier service, Service quality, Perception and service dimensions

## Introduction

In India 54 percent of the Gross value Added (GVA) be made up of service sector. Fiscal year2022-2023 India's service sector contributed a notable recovery and growth rate of 8.4%.While contributing economic growth and employability service sector in India facing a multifaced challenges like regulatory complexity, infrastructure constraints, skilled labour shortages ,technology adoption , data privacy and security and so many. The Indian Courier, Express and Parcel market size is estimated at USD 8.5 billion in 2024 and is expected to reach USD 8.50 billion in 2024 and grow at a CAGR of 16.69% to reach USD 18.38 billion by 2029. Blue Dart Express, Instakart Services (ekart logistics), Gati Ltd., DHL and FedEx are the major companies. The growth in the e-commerce segment, higher internet penetration into the masses, and the latest technological innovations in the sector have been the driving force for the market. The COVID-19 pandemic impacted every industry. However, the pandemic accelerated online purchasing, positively impacting the CEP industry's growth. The India Courier, Express, and Parcel (CEP) Market is segmented by business (B2B (Business-to-Business), and B2C (Business-to-Consumer)), by destination (domestic and international), and by end-user industries(services (BFSI (banking, financial services, and insurance),



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etc.), wholesale and retail trade (including E-commerce), life sciences/healthcare, industrial manufacturing & other end users.

Customers nowadays are well aware of the importance of service quality (Soriano, 2002). Courier companies are currently concentrating on service quality and customer satisfaction to match consumers' expectations. Improving the overall quality of a courier service might help them acquire customers' loyalty. Consequently, courier service quality is a critical component that may impact customer behavior and the courier company's business performance. The customer is the judge of quality (Evans & Dean, 2003). Thus, understanding client requirements necessitates accurately interpreting consumer requirements and expectations and providing products and services of acceptable quality. Improving service quality is especially crucial when developing a sustainable value proposition. To improve sustainable services, Baldassarre, Calabretta, Bocken, and Jaskiewicz (2017) highlighted the importance of a consumer-driven strategy. Hartono (2020) also underlined a need to include consumers in establishing sustainable courier service development. Sustainable service focuses on delivering goods and services that meet customers' requirements while making an effort about social achievement. Besides that, sustainable services should be conducted towards the identification and awareness of the customers' needs and expectations

There are several service types of organizations that make use of the SERVQUAL model, and these five dimensions are applied to promote positive results (Muljono and Setyawati, 2019). However, there are many differences in each type of service, hence, SERVQUAL is not applicable all the time. In courier services, sustaining the overall service quality can help them gain competitive advantages. Therefore, courier service quality is a crucial factor that can influence customer satisfaction and it also affects the profitability of the company. Reliability is known as the delivery of promised service accurately to the customers, it is important in service quality because most of the clients would prefer to transact with a company that holds their promises to customers. Responsiveness often deals with how the employees help their customers and address their complaints or problems promptly. The company can constantly monitor the performance of the employee in terms of how they fulfill the demand of the customers to improve this dimension. Next is the Assurance dimension, which is associated with the employee's expertise and their skills to encourage trust and confidence in their customers. The Tangibility dimension includes the appearance of physical facilities, equipment, and communication medium. These are relevant because they can help improve the overall image of the company. The empathy dimension refers to how the employee cares and pays attention to the customers. It includes personalized or series of services to better satisfy customers' different needs and wants as well as their preferences (Ramya, Kowsalya, and Dharanipriya,2019).



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**Objectives**

There are twin objectives of this study

1. Identify the influence of each service quality dimension on the customers preference in courier services;
2. Determine the most important factor influenced by customers in selecting a particular company or organisation.

**RESEARCH METHOD**

Data were collected in November 2023 via an online survey (Google Form). Our sample consisted of 100 respondents, the courier service users from Thrissur district. We set two filtering questions to ensure all participants were the courier service users. The majority of those who responded were between the ages of 30to 35 (70.3%), and half were married (50.1%). The data was gathered and analysed with descriptive statistics. The scale is a 5-point Likert scale with items ranging from 1 (Strongly disagree) to 5 (Strongly agree). The online survey was formulated to identify the impact on customer perception of different service quality dimensions on courier services. The online survey questionnaire was divided into two parts, the first part is general questions regarding demographic variables age, gender, how often used couriesr serivices . The second includes the responses to the four service quality dimensions: Tangibility, Reliability, Assurance, and Responsiveness.

The four SERVQUAL dimensions are:

**A. Tangible -** it is measured from the delivery staff of the courier, if they are professional, dressed properly, whether the service express is damaged, and can view your delivery progress online in real-time. It would give the customer the overall impression of the equipment that the staff of the courier used, and also the appearance of the staff that the customers were dealing with.

**B. Reliability -** It is measured from the ability to transport goods from one place to another meticulously. This can be measured from the condition of the ordered products up to the waiting time for the delivery. Wherein ordered packages must not be damaged and must be well packaged. As well as, the delivery is prompt, and the waiting time for the delivery is short.

**C. Responsiveness -** It is measured through the willingness of the courier to run an extra mile to deliver the goods and the ability of the courier service to quickly respond to customer queries. This can be measured from the promptness of the service of the staff and the ability of the staff to answer all customer queries correctly and honestly.

**D. Assurance -** it is measured from the staff's professional knowledge and how politely they answer the customers' questions. This is measured through the politeness of the staff, the comfortability of



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the customers to have transactions with the service provider, and the knowledge of staff about their services.

**Result and Discussion**

**Table 1. Summary of Respondents' Demographics (N=100)**

| **Response** | **Frequency** | **Percentage (%)** |
|---|---|---|
| Gender | | |
| Male | 75 | 75% |
| Female | 25 | 25% |
| Age | | |
| Below 20 | | |
| 20-29 | 56 | 56% |
| 30-39 | 14 | 14% |
| 40-49 | 15 | 15% |
| 50-59 | 11 | 11% |
| Above 60 | 4 | 4% |
| Occupation | | |
| Students | 56 | 56% |
| Private sector | 10 | 10% |
| Government sector | 34 | 34% |
| How often do you use the courier service? | | |
| None | 0 | 0% |
| Occasionally | 10 | 10% |
| Once a month | 25 | 25% |
| Once a quarter | 35 | 35% |
| Once a week | 25 | 25% |
| Seldom | 5 | 5% |

**Table 1: Verbal Description of Mean Score Range**

| **Rate** | **Service Quality Dimension** |
|---|---|
| **5** | [SA] Strongly Agree |
| **4** | [A) Agree |
| **3** | [N] Neutral |
| **2** | [D]DisAgree |
| **1** | [SD] Strongly Disagree |



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In this study, the second (reliability) and fourth(responsiveness) variables used 4 items, while the first variable (tangibility) used two items and third (assurance) three items are used.

**Service Quality Dimension**

**Tangibility :**

| **Indicator** | **Mean** | **Rank** | **SA** |
|---|---|---|---|
| The delivery men are properly dressed | **3.35** | **2** | **N** |
| The vehicles used by the delivery man are in good condition | **3.38** | **1** | **N** |

**Reliability :**

| **Indicator** | **Mean** | **Rank** | **SA** |
|---|---|---|---|
| The orders are not damaged when delivered. | **4.41** | **1** | **SA** |
| The delivery is prompt and reliable. | **4.38** | **2** | **SA** |
| The delivery's waiting time is short. | **4.31** | **3** | **SA** |
| The delivery man provides their service within the promised time | **4.25** | **4** | **SA** |

**Assurance :**

| **Indicator** | **Mean** | **Rank** | **SA** |
|---|---|---|---|
| The delivery man is polite and courteous. | **4.24** | **3** | **SA** |
| The delivery man is knowledgeable in answering all my concerns. | **4.40** | **1** | **SA** |
| The delivery man provides their service within the promised time | **4.25** | **2** | **SA** |

**Responsiveness :**

| **Indicator** | **Mean** | **Rank** | **SA** |
|---|---|---|---|
| The delivery man answered my question well enough | **4.22** | **4** | **SA** |
| The delivery man can be easily contacted. | **4.39** | **2** | **SA** |
| The delivery man gives prompt service. | **4.45** | **1** | **SA** |
| The delivery man has shown willingness to help the customer | **4.28** | **3** | **SA** |

Legend: [SD] Strongly Disagree (1.00-1.80); [D] Disagree (1.81-2.60); [N] Neutral (2.61-3.40); [A] Agree (3.41-4.20); [SA] Strongly Agree (4.21-5.00).

The service quality of the courier service influence on decision of the customers are highlighted by the customers was: the good condition vehicle used by the delivery man, The orders are not damaged when delivered, The delivery man is knowledgeable in answering all my concerns and prompt service provided by the delivery man.



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**Conclusion**

The research paper turned around the four service quality dimensions (tangible, reliability, assurance, and responsiveness) how it influences on customer decision making. The growth in the e-commerce segment, higher internet penetration into the masses, and the latest technological innovations in the sector have been the driving force for Courier, Express and Parcel Market. The COVID-19 pandemic impacted every industry. However, the pandemic accelerated online purchasing, positively impacting the CEP industry's growth and increasing its market share. During this pandemic, many consumers shifted from traditional shopping to online shopping, therefore, courier services are in demand. With the data gathered it is safe to conclude that the four dimensions of service quality influence the in-service decision on courier services. Among the four responsiveness dimension has the biggest influence followed by dimensions of reliability, assurance, and tangibility.

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# TAXONOMY, MICROMORPHOLOGY AND CONSERVATION OF SOME SELECTED *SELAGINELLA* P. BEAUV. SPECIES OF SOUTH INDIA

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**Abstract**

Pteridophytes are an ancient lineage of vascular plants which are often divided into ferns and fern-allies/lycopods based on their morphology, reproduction, and development. The class Lycopodiopsida diverged early and has a rich fossil record spanning over 420 million years. Within the class Lycopodiopsida, there are three orders: the homosporous Lycopodiales, which are represented by the family Lycopodiaceae; the heterosporous Isoetales, which includes the family Isoetaceae, and the Selaginellales, which includes the family Selaginellaceae with an approximate 700 spp. worldwide. The sporophyte of *Selaginella* is made up of a well-developed root system, a rhizophore (in certain species), a stem, branches with heterophyllous leaves and a terminal strobili carrying heterosporous sporangia. Morphology being the primary factor in taxonomy, micromorphology supports the branch by adding more information. The present work aims at the taxonomic and micromorphological observations of some selected *Selaginella* species of South India. Five species viz. *Selaginella ciliaris* (Retz.) Spring, *Selaginella crassipes* Spring, *Selaginella chrysorrhizos* Spring, *Selaginella ganguliana* R.D.Dixit and *Selaginella tenera* (Hook. & Grev.) Spring is selected. Due to their great degree of habitat selection, they are primarily found to be growing in damp, shaded and humid locations that are frequently free from human interference, invasive weeds and disruptive natural forces. Compared to ferns, lycophytes in particular are a more delicate category of primitive plants that need more care to develop than ferns do. Effective techniques for propagating these lycophytes, such as spore culture and vegetative methods using appropriate substrates, are also discussed.

**Keywords**: Fern-allies, *Selaginella*, Taxonomy, SEM, *Ex-situ* conservation



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## Introduction

Pteridophytes are vascular plants without seeds. They are classified into two classes: the phylogenetically distinct lycophytes (1500 species) and the ferns (10,500 species) (PPG 1, 2016). Both groups of plants grow abundantly and frequently in wet woods, but they can also be found in arid areas, where some genera may have many different species (Della *et al*., 2019). The single genus of the plant family Selaginellaceae, *Selaginella* (spike moss), contains over 700 species that are widely distributed throughout the world, with roughly40 species in South India (Smith *et al.*, 2006, Fraser-Jenkins *et al*., 2016, Zou *et al*., 2016).

According to Zhou and Zhang (2015), the genus is characterized by the presence of rhizophores, heterosporous (holding both microspores and megaspores) and usually four rows of sporophyll and different-sized dorsiventral leaves with ligules at the bases of each leaf. Both taxonomic identification and delimitation, as well as the study of ancient plants, rely on spore morphology. Two distinct spore types are produced by *Selaginella*: the smaller spores, called microspores, are generated in microsporangia, while the bigger spores, called megapores, are produced in megasporangia.

The current study attempts to document the micro-morphological and taxonomic characteristics of a few chosen South Indian *Selaginella* species. *Selaginella ciliaris* (Retz.) Spring, *Selaginella crassipes*, and the other five species *Selaginella chrysocaulos* (Hook. & Grev.) in spring *Selaginella tenera* (Hook. & Grev.) Spring, *Selaginella ganguliana* R.D. Dixit, and Spring are chosen. They are mainly found to be growing in moist, shady and humid areas that are typically free from human intervention, invasive weeds and disruptive natural forces because of their high degree of habitat selection. Particularly lycophytes are a more fragile kind of primitive plants than ferns, requiring more care to grow than ferns do. Additionally, included are efficient methods of replicating these lycophytes, such as spore culture and vegetative procedures using the right substrates.

## Materials and methods

### Collection of plant materials

The five *Selaginella* species that were chosen were collected from different locations from south India. The standard authentic literature was used to identify the collected specimens. These resources included Ferns and Fern allies of Kerala by Madhusoodhanan (2015), Ferns and Lycophytes of Peechi-Vazhani Wildlife Sanctuary, Kerala, India by Sreenivas (2021), and Pteridophyte flora of the Western Ghats, South India by Manickam and Irudayaraj (1992). Whole specimens of the plant components, including strobili, were gathered. Along with collecting the plants, photo documentation and herbarium preparation were also completed.



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**Spore micromorphology using SEM**

For micro-morphological analysis, SEM was utilized to evaluate the features of the species' spores. Spores were collected from both the sporophylls - the micro and megasporophylls. Spores were air-dried, distributed, and then mounted onto aluminum stubs of scanning electron microscopy to study precise spore morphologies. Next, a sputter coater was used to apply a three-minute gold coating on the stubs. The samples were visualized using SEM and an accelerating voltage of 20 kV was used. The proximal and distal views were examined and recorded for each sample.

**Conservation**

In an effort to successfully cultivate appropriate species in the Pteridophyte conservatory maintained by the Department of Botany, Government Victoria College, Palakkad, Kerala, a variety of experimental setups, including combinations of various pots and potting material, were tried. Earthen pots, plastic pots, coir pots and coconut husks were the pots utilized in the testing. The substrates and potting material that were employed were bricks, laterite stones, sand, dirt, leaf litter, coir pith and perlite. After gathering the plants, several methods were explored to cultivate them in the aforementioned containers with different mixes of potting medium.

**Results and Discussion**

**Taxonomy and Morphological analysis**

Five species of *Selaginella viz*. *Selaginella ciliaris* (Retz.) Spring, *Selaginella crassipes* Spring, *Selaginella chrysorrhizos* Spring, *Selaginella ganguliana* R.D.Dixit and *Selaginella tenera* (Hook. & Grev.) Spring was selected for morphological analysis (Figure 1).

***Selaginella ciliaris*** (Retz.) Spring, Bulletin de L'Acadmie Royale des Sciences et Belles-Lettres de Bruxelles 10(1) (1843).

**Synonyms:** *Lycopodium ciliare* Retz. in Observ. Bot. 5: 32 (1789); *Lycopodioides ciliaris* (Retz.) Kuntze in Revis. Gen. Pl. 2: 826 (1891); *Stachygynandrum ciliare* (Retz.) P.Beauv. in Prodr. Aethéogam.: 110 (1805)

**Distribution:** CHINA (Guangdong, Guangxi, Hainan, Taiwan, Yunnan), INDIA (Andaman and Nicobar Islands, Andhra Pradesh, Assam, Bihar, Chhattisgarh, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Odisha, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttarakhand, Uttar Pradesh, West Bengal), Myanmar, Srilanka, Bangladesh, Indonesia, Philippines, Thailand, Vietnam, New Guinea, Australia.

**Description:** Prostrate, 0.8–5 cm tall stems that branch at the base. Rhizophores are narrow and limited to the basal region. Bright green, membrane-covered leaves; oblique, ovate-



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oblong, acute, with cilia at the base on the lateral leaves; ovate, acute, and distantly denticulate on the central leaves. Strobili abundant, solitary or occasionally double at the tip of the stem branch. Smaller sporophylls ascending, ovate, cordate, sharp tip; larger sporophylls dimorphic, ciliate, ovate, resupinate, inner half portion dentate.

***Selaginella crassipes*** Spring, Mém. Acad. Roy. Sci. Belgique 24: 243, no. 181 (1850).

**Synonyms:** *Lycopodioides crassipes* (Spring) Kuntze in Revis. Gen. Pl. 2: 826 (1891)

**Distribution:** India, Sri Lanka

**Description:** Stem up to 10 cm in length, erect; rhizophores limited to base, seldom above. Lateral leaves: oblong, oblique, cordate and ciliate at the base, with a serrated tip on one side and a ciliate edge on the other. Leaf medians are oblong, with a serrated border, aristate at the tip, and a very oblique base that is cordate. Axillary leaves are oval in shape, with an obtuse base, an acute tip, and ciliate margins at base. Strobili up to 5mm long, double/ single at the end of branches, dimorphic sporophylls.


**Figure 1:** Selected *Selaginella* species. **a.** *Selaginella ciliaris* (Retz.) Spring; **b.** *Selaginella crassipes* Spring; **c.** *Selaginella chrysorrhizos* Spring; **d.** *Selaginella ganguliana* R.D.Dixit; **e.** *Selaginella tenera* (Hook. & Grev.) Spring.



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***Selaginella chrysorrhizos*** Spring, Mém. Acad. Roy. Sci. Belgique 24 (2): 251 (1850).

**Synonyms:** *Lycopodioides chrysorrhizos* (Spring) Kuntze in Revis. Gen. Pl. 2: 826 (1891)

**Distribution:** Assam, Bangladesh, East Himalaya, India, Laos, Myanmar, Nepal, Thailand, Vietnam

**Description:** Stems suberect, up to 10cm, rhizophores limited to base,. stem smooth, pinnately branching, often producing stolons for propagation. Axillary leaves: oblong, denticulate on the border, blunt at the tip. The median leaves are oblong-oblong, imbricate, distantly growing, with an entire, basiscopic base and an obtuse apex. Lateral leaves: oval, border denticulate, apex cuspidate. solitary, terminal strobili, dimorphic sporophylls.

***Selaginella ganguliana*** R.D.Dixit, Bull. Bot. Surv. India 26(1-2): 104 (1985).

**Synonyms:** Nil

**Distribution:** India

**Description:** Sub-erect, up to 6 cm long stem with many branching branches at base that give the illusion of being spread out, and many rhizophores tufted towards the base. middle leaves: oval, aristate (long enough, curved), denticulate; lateral leaves: membranous, ovate, acute, edge serrate, sparse towards apex; axillary leaves: Oblique, ovate-lanceolate, acute, margin dentate towards apex. Strobili isomorphic, sessile, terminal sporophylls.

***Selaginella tenera*** (Hook. & Grev.) Spring, Bull. Acad. Roy. Sci. Bruxelles 10: 232 (1843).

**Synonyms:** *Lycopodium tenerum* Hook. & Grev. in Bot. Misc. 2: 400 (1831); *Lycopodioides tenera* (Hook. & Grev.) Kuntze in Revis. Gen. Pl. 2: 827 (1891)

**Distribution:** India, Bangladesh

**Description:** Rhizophores thin to thick, stiff, and red towards the basal third of the prostrate stems, up to 12 cm long, red in colour and branching throughout. The median leaves are oval with a cordate base that is acute to acuminate and denticulate, while the lateral leaves are oblique, ovate-oblong, with an acute tip, ciliate at the base and the remainder whole. Strobili at the tip of branchlets are sometimes solitary or multiple. Dimorphic, membrane-bound, and ciliated sporophores.

**Micromorphological analysis**

Both micro- and megaspores of *Selaginella ciliaris* (Retz.) Spring, *Selaginella crassipes* Spring, *Selaginella chrysorrhizos* Spring, *Selaginella ganguliana* R.D.Dixit and *Selaginella tenera* (Hook. & Grev.) Spring, were subjected to SEM for analyzing micromorphology.



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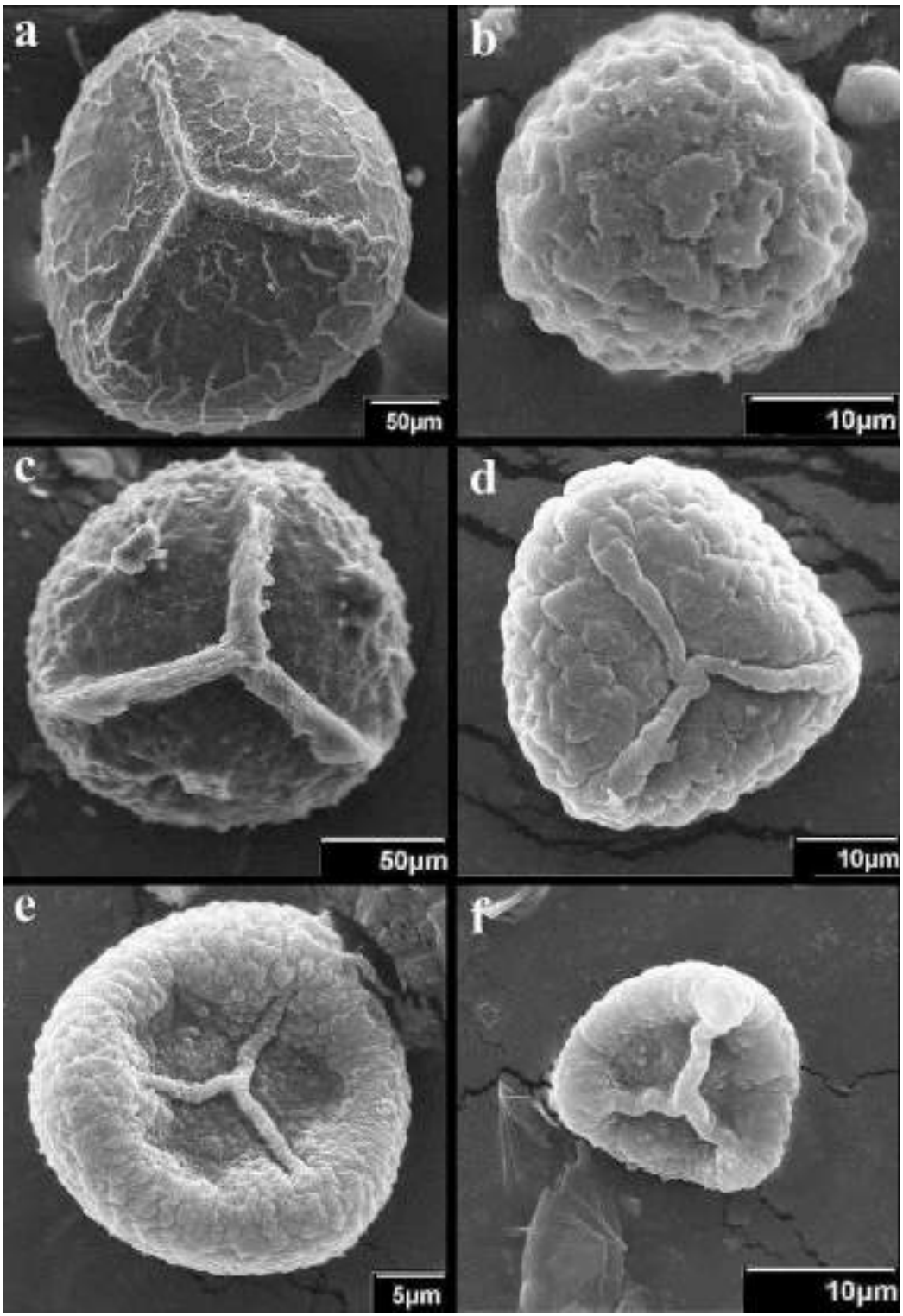


**Figure 2.** Megaspore and microspore micromorphology. **a,b:** *Selaginella ciliaris* (Retz.) Spring; **c,d:** *Selaginella crassipes* Spring; **e,f:** *Selaginella chrysorrhizos* Spring. (**a,c,e:** Megaspore; **b,d,f:** Microspore)



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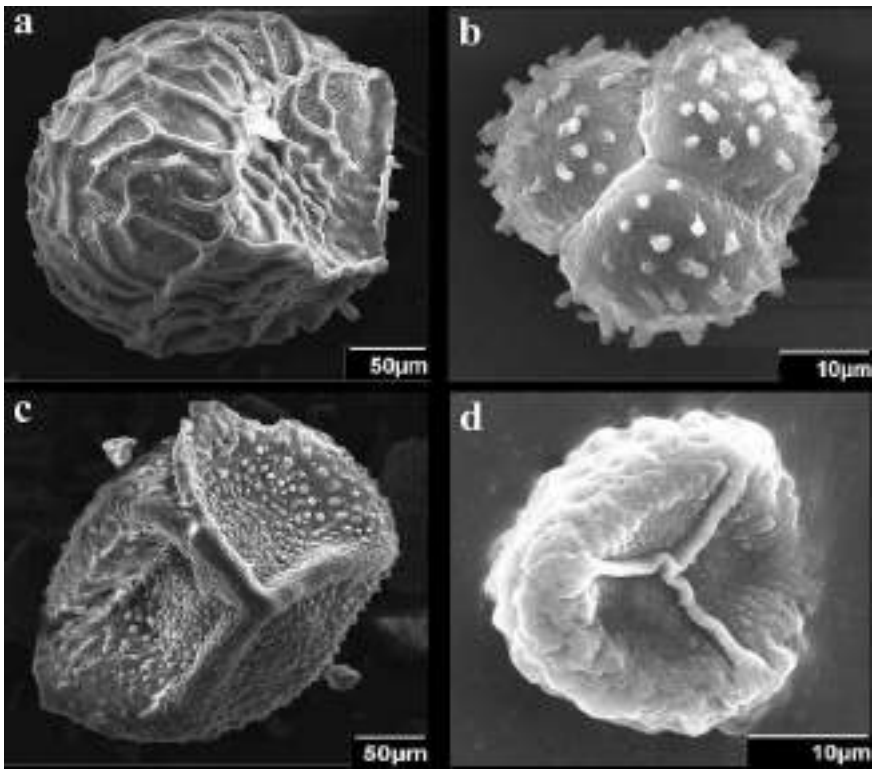


**Figure 3.** Megaspore and microspore micromorphology. **a,b:** *Selaginella ganguliana* R.D.Dixit; **c,d:** *Selaginella tenera* (Hook. & Grev.) Spring (**a,c:** Megaspore; **b,d:** Microspore)

***Selaginella ciliaris*** (Retz.) Spring.

Megaspore: Equatorial axis diameter: 170–250 µm Trilete, triangular amb present; laesurae coated with wrinkles, surface ornamentation cristate. Micro sculpture with areolae. Microspores: Diameter (equatorial axis): 22-36 µm. Trilete, rounded amb present; laesurae covered with spines. echinate ornamentation. Microsculpture echinate (Figure 2).

***Selaginella crassipes*** Spring.

Megaspore: Equatorial axis diameter: 155–200 µm. Trilete, sub-triangular amb present. Narrowing laesurae till the equator. Granulated ornamentation. Granulate microsculpturing. Microspore: Equatorial axis diameter: 29–52 µm Triangle, triangle amb present; extends to the center. Verrucate ornamentation little sculpture made of verrucate (Figure 2).

***Selaginella chrysorrhizos*** Spring.

Megaspore: Diameter (equatorial axis): 150–200 µm. Trilete, rounded amb present. Narrow laesurae extending almost till equator Ornamentation verrucate. Micro-sculpture with spinules. Microspore: Diameter (equatorial axis): 25-30 mm. Trilete, sub-triangular amb present. laesurae narrow. Ornamentation verrucate. Micro-sculpture with verrucae (Figure 2).



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***Selaginella ganguliana*** R.D.Dixit

Megaspore: Diameter (equatorial axis): 100–260 μm. Trilete, amb rounded and in place. Irregular laesurae. The ornaments are reticulated. The lumina floor and the muri's sides meet at almost a straight angle. Microsculpture consists of spinulose. Microspore: Diameter (equatorial axis): 17-28 mm. Trilete, sub-triangular amb present. wide laesurae up to the equator. There is baculate ornamentation on the distal surface and smooth ornamentation on the proximal surface. Micro-sculpture is echinate (Figure 3).

***Selaginella tenera*** (Hook. & Grev.) Spring

Megaspore: Diameter (equatorial axis):100–245 μm . Trilete, spherical and in good condition. broad laesurae Proximal surface with irregular verrucae. Distal surface with rugae. microsculpture on both sides with spinules or spines. Microspore: Diameter (equatorial axis): 30-35 mm. Trilete, sub-triangular amb present. laesurae narrow. Ornamentation verrucate. Micro-sculpture with verrucae (Figure 3).

**Conservation efforts**

**Propagation:** The species that were gathered from Kerala were examined for potential dissemination strategies. The three main techniques for propagation are sexual, asexual and vegetative. Plant divisions, cuttings, stoloniferous branches and gemmae are the vegetative ways. Microspores and megaspores are produced as part of asexual reproduction techniques. Male and female gametophytes that are endosporic are responsible for sexual reproduction. Vegetative reproduction techniques are best for propagation attempts.

**Establishment trials:** The five species of *Selaginella* were subjected to various combinations of pots and potting media. The results obtained are summarized in Table 1.

**Table 1.** Establishment trials of selected *Selaginella* species

| Sl. No. | Name | Wild/Cultivated | Medium | Propagation |
|---|---|---|---|---|
| 1 | *S. ciliaris* | W | S+LL | Spores |
| 2 | *S. crassipes* | W | Lat. Rocks | Spores |
| 3 | *S. chrysorrhizos* | W | S+LL | Spores, stolon |
| 4 | *S. ganguliana* | W | S+LL | Spores |
| 5 | *S. tenera* | W | S+LL | Gemmae |

W- wild, S+LL - Soil + Leaf litter



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## Conclusion

Morphological examination has been performed on five species that were selected from different regions of South India: *Selaginella ciliaris* (Retz.) Spring, *Selaginella crassipes* Spring, *Selaginella chrysorrhizos* Spring, *Selaginella ganguliana* R.D.Dixit, and *Selaginella tenera* (Hook. & Grev.) Spring. Features including the rhizophore structure, branching pattern, size of the stem morphology, axillary, lateral, and median leaves, as well as the strobili, were observed. Micromorphology adds extra information to the field of taxonomy, which is mostly based on morphology. SEM analysis was done to determine the equatorial size, shape, laesurae character, surface ornamentation, and micro-sculpture of megaspores and microspores. Additionally, included are efficient methods of propagating these lycophytes, such as spore culture and vegetative procedures using the right substrates. The present work is hence an attempt at the taxonomical and conservation approaches on the genus *Selaginella*.

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# NANOMATERIAL-BASED BIOSENSORS IN FORENSIC SCIENCE: INNOVATIONS AND APPLICATIONS

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**Abstract-** Biosensors are compact devices capable of translating biological interactions into readable signals, offering portability and user-friendliness. They can be scaled down and integrated into handheld or wearable gadgets for on-the-spot testing or continual monitoring. Conventional forensic detection methods are time-consuming, expensive, and demand expertise. Nanomaterial-based biosensors facilitate swift, sensitive screening of samples for trace compounds, yielding valuable forensic evidence. They provide cost-effective and sensitive material analysis without necessitating elaborate lab setups or time-intensive processes.

Nanobiosensors pledge faster, more sensitive, and practical investigations, potentially expediting case resolutions. Overall, biosensors, particularly nanobiosensors, offer promising solutions for contemporary challenges and are poised for further innovative applications as technology advances. Creating nano-biosensors for forensic use is a complex undertaking demanding thorough research and development. A key challenge is designing and producing sensors capable of identifying minute quantities of biological substances, like DNA or proteins, within intricate matrices. Another hurdle involves incorporating these sensors into portable devices suitable for field use by law enforcement agencies.

In the realm of forensic analytical fields, detecting analytes holds significant importance. Biosensors have emerged as promising tools for rapid, reliable, and cost-effective analysis. They demonstrate versatility in examining various analytes and sample types, showcasing their practical implementation and resulting outcomes. Several compelling biosensing designs have been developed, as evidenced by selected examples. This review highlights the evolution of nanomaterial-based biosensors and recent progress in forensic analysis, encompassing alcohol, drug, and explosive detection.

**Keywords:** Crimescene, investigation, biosensor, nanomaterial



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**Introduction**

One of the recent developments in sensing technology is the widespread use of biosensors, small devices capable of detecting substances even in small quantities. Biosensors have gained importance in medicine, environmental monitoring, and food safety due to their ability to provide real-time, highly sensitive, and specific measurements. They are valuable for diagnosing diseases, monitoring drug levels, detecting pollutants, and ensuring food quality. The application of nanotechnology to biosensors has enhanced their capabilities and addressed challenges associated with traditional devices.

In this article, we aim to explore traditional biosensors, the types of nanomaterials used, and recent advancements in nano biosensors for detecting analytes of forensic significance. We also discuss the challenges involved in developing such specific nano biosensors.

The term "biosensor" refers to an analytical tool that converts biorecognition events into quantitative signals. Typically, biosensors consist of a receptor (e.g., enzyme, antibody, DNA) that recognizes the analyte, a transducer that converts the binding interaction into a measurable signal, and a detector that displays the results. Biosensor technologies find applications in diagnostics, forensics, environmental monitoring, food science, and health sciences. Sensitivity and selectivity are crucial for biosensor applications, especially in clinical and Point of Care (POC) settings.

The quantity of analyte-receptor interactions directly influences the signal conversion processes. Transducer signals, often electrical, are quantified by a detector. Biosensors may include display units like LEDs, LCDs, computers, or printers for visual representation of the monitored signals.

Key characteristics of biosensors include reproducibility, selectivity, stability, sensitivity, linearity, and response time. Reproducibility ensures consistent results, while selectivity allows for specific target identification. Stability is important for continuous monitoring, and sensitivity is crucial for detecting low analyte concentrations. Linearity ensures accurate measurements, and response time indicates the speed of detection. Overall, biosensors play a critical role in various fields, offering real-time, precise, and specific detection capabilities, with ongoing advancements in nanotechnology further enhancing their potential.

Forensic science plays a crucial role in the criminal justice system by providing scientific evidence to aid in the investigation and resolution of crimes. Traditional forensic techniques often rely on time-consuming processes and may have limitations in terms of sensitivity and specificity. The emergence of nanotechnology has revolutionized the field of forensic science by offering new tools and methods for analysis. Nanomaterial-based biosensors, in particular, have shown great promise in enhancing the capabilities of forensic analysis.



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**Principles of Biosensors**

Biosensors are analytical devices that combine a biological recognition element with a transducer to convert a biological response into a measurable signal. The biological recognition element, often an enzyme, antibody, or nucleic acid, interacts with the target analyte, leading to a measurable signal that is proportional to the analyte concentration. The transducer then converts this signal into a quantifiable output, which can be interpreted to determine the presence and concentration of the analyte.

**Role of Nanomaterials in Biosensors**

Nanomaterials, due to their unique properties such as high surface area-to-volume ratio, tunable surface chemistry, and excellent electrical and optical properties, have been extensively used to enhance the performance of biosensors. Nanomaterials can serve as platforms for immobilizing biological recognition elements, increasing the surface area available for analyte binding, and improving the sensitivity and specificity of biosensors. Additionally, nanomaterials can be engineered to exhibit specific properties tailored for forensic applications, such as enhanced stability and selectivity.

**Applications of Nanomaterial-Based Biosensors in Forensic Science**

Nanomaterial-based biosensors have found diverse applications in forensic science, including the detection of drugs, explosives, toxins, and biological agents. These biosensors offer rapid, sensitive, and specific detection capabilities, making them well-suited for forensic analysis. For example, in drug detection, nanomaterial-based biosensors have been used to detect trace amounts of illicit drugs in biological samples with high accuracy and speed. Similarly, in the detection of explosives, nanomaterial-based biosensors have shown potential for detecting explosive residues in various matrices with high sensitivity, enabling the identification of explosive-related crimes.

**Challenges and Future Prospects**

Despite their significant potential, nanomaterial-based biosensors for forensic applications face several challenges, including standardization, validation, and integration into existing forensic protocols. Additionally, the cost-effectiveness and scalability of these biosensors need to be addressed to enable their widespread adoption in forensic laboratories. However, ongoing research and development efforts are focused on overcoming these challenges, with the aim of realizing the full potential of nanomaterial-based biosensors in forensic science. Future prospects include the development of multiplexed biosensors capable of detecting multiple analytes simultaneously, as well as the integration of biosensors into portable devices for on-site forensic analysis.



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## Conclusion

Nanomaterial-based biosensors hold great promise for enhancing the capabilities of forensic science by offering rapid, sensitive, and specific detection of forensic analytes. The development of these biosensors represents a significant advancement in the field of forensic science, with the potential to revolutionize forensic analysis. However, further research and development efforts are needed to address the challenges associated with the adoption of these biosensors in forensic laboratories. With continued progress in nanotechnology and biosensor development, nanomaterial-based biosensors are expected to play a crucial role in the future of forensic science.

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# MONSOON AND MARITIME MALABAR: IMPACT OF MONSOON WINDS ON THE EARLY HISTORIC INDIAN OCEAN TRADE

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**Abstract**

Monsoon played a predominant role in the ancient maritime contacts between India and the Mediterranean world. Monsoon winds controlled the voyages of traders from the Egyptian coast to India and their return journey to the Red Sea region. The proper use of monsoon winds shortened the distance between India and the Mediterranean world. Prior to the use of monsoon winds, traders heading towards India had to travel along the coasts, the knowledge of monsoon wind patterns put an end to the tedious, coast-hugging journey. *Periplus of the Erythrean Sea*, a mariner's account composed in the first century CE, gives the credit for discovering monsoon winds to Hippalus. However recent studies discard the Hippalus story and suggest that ancient mariners of Indian Ocean littorals were aware of monsoon winds long before the arrival of Greeco Roman travelers in the Indian Ocean. This article examines the intricate relationship between monsoon winds and early historic Indian Ocean trade, unravelling the impact of monsoon winds on the Malabar region. Focusing on ancient maritime voyages backed by Southwest and North-East monsoons, the study explores how these winds connected diverse regions of Indian Ocean littorals. The article also sheds light on how monsoons created a favourable environment for the growth of spices and forest products in ancient Malabar.

**Keywords**: Monsoon winds - Indian Ocean Trade - Hippalus - Malabar coast

## Introduction

The period of Indo-Mediterranean maritime trade is a significant phase in the history of the Indian Ocean. Mediterranean countries had contact with India long before the turn of the common era. The monsoon winds played a vital role in regulating early voyages across the Indian Ocean. The proper use of the monsoon winds accelerated maritime contacts in the early centuries of the common era. Prior to the understanding of monsoon winds maritime journeys from the Red Sea coast to India were along the coastline. The knowledge of seasonal wind patterns helped the traders to cross the Indian Ocean and make direct voyages across the Indian Ocean to India. This study examines the impact of monsoon wind on ancient Indian Ocean trade between India and the Mediterranean world with special reference to the Malabar coast.



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**Monsoon**

Monsoon is "the seasonal reversal of steady and sustained surface winds, which blow from the northeast during winter and from the southwest during summer."[1]The term monsoon originated from the Arabic word Mausim, "which refers to anything that appears once a year."[2] The temperature difference between the land and the ocean and the rotation of the earth is the primary cause of monsoon winds.[3] The southwest monsoon and northeast monsoon are the two forms of the Indian monsoon. The southwest monsoon blows eastward from the west coast of Africa from March and reaches the southwest coast of India by the end of May or the beginning of June. Generally, the period from June to September is considered the southwest monsoon period in India. This moisture-bearing wind brings heavy rain to India. The northeast monsoon blows from northeast to southwest in winter. It is less powerful than the southwest monsoon.

**Discovery of monsoon**

There are numerous stories regarding the discovery of monsoon wind in early Greeco-Roman accounts. Strabo in his *Geography* speaks about the journey of Eudoxus of Cyzicus, a Geek mariner, to India across the open sea.[4] It has been said that the discoverer of monsoon was the steer man of Eudoxus. In the words of Strabo during the reign of Ptolemy VIII an Indian sailor, who had survived a shipwreck, was brought to the court of Ptolemy. After learning Greek the sailor informed the king about his willingness to provide information regarding the sea route to India to those who return with him. Eudoxus, an able explorer from Cyzicus, had been selected to help the Indian sailor to reach his homeland. With the help of the Indian sailor Eudoxus is believed to have led the fleet to India.[5] Casson says "It must have been he (Eudoxus of Cyzicus) who brought back to the Greek the secret of Monsoons, but later generations gave the credit to a pilot named Hippalus. Nothing else is known about this figure. It's a shrewd guess but only a guess that he was Eudoxus' navigator."[6]

Until recently, it was commonly held the view that Hippalus, a Greek Navigator, had discovered the southwest monsoon wind and the direct sea route from the Red Sea to India by crossing the Indian Ocean. The Hippalus' story gained currency since the reference to it in *Periplus of The Erythrean Sea*.[7]It notes:

> Hippalus was the pilot who by observing the location of the ports and the condition of sea first discovered how to lay his course strait across the ocean. For at the same time when with us the etesian winds are blowing, on the shores of India the wind set in from the ocean, and this Southwest wind is called Hippalus, from the name of him who first discovered the passage across.[8]

Modern scholars spoke about it with suspicion and later they succeeded in uncovering the truth behind the Hippalus' story. Curtin discards the much-vaunted discovery of monsoon by Hippalus



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as 'Roman ethnocentric nonsense.'[9] Tcherniya rightly points out that "it was not the Romans who indulged in such ethnocentric nonsense but modern commentators."[10] Prior to the supposed discovery of monsoon winds Indians and Arabs definitely have experienced it and made use of it.

**Indo Mediterranean contacts**

Mediterranean countries had maritime contacts with India from the second half of the first millennium BCE. Scylax of Caryanda, a Greek mariner, is considered as the earliest person from the Mediterranean world to travel in the Indian Ocean.[11] Scylax, on the command of Darius, sailed from the mouth of Indus to Suez.[12] In 325 BCE Nearchus, Alexander's admiral, Voyaged from Indus to the Persian Gulf. Strabo in the 1st century BCE notes that "as many as 120 ships were sailing from Mayos Hormos to India annually."[13] His number may not be correct but it indicates that there was maritime connection between India and Egypt in his time. The Roman annexation of Egypt gave new dimensions to Indo-Mediterranean trade, it made Alexandria part of the Roman Empire and helped Romans to enter the Indian Ocean through the Red Sea.

**Trade Routes**

Voyages from the Red Sea to India were heavily depended on the monsoon wind system that prevailed in the Indian Ocean.[14]In order to get the advantage of South West monsoon the journey from the Red Sea to India was generally commenced in July.[15] According to the information provided by Pliny, ships that depart from Berenice take about 30 days to arrive at Ocelis, the first port on the entrance of the Red Sea, or Cane.[16] Ships usually sail along the coast from Ocelis as far as Cane. The author of *Periplus* notes that Vessels departing from Cane went either to the North West coast of India[17] or to the Malabar Coast.[18] From Ocelis a few ships opt to sail southward to the Cape Guardafui, the horn of Africa. Ships bound for South India from the horn of Africa took a direct voyage across the Indian Ocean, the Southwest monsoon led the vessel to the Malabar Coast.[19]

Both Pliny and the author of *Periplus* make no reference to the return journey from south India.[20] Because of the seasonal nature of monsoon Traders had to stay at the Malabar Coast until the commencement of north east Monsoon. Western traders left the Malabar Coast in December to get the benefit of the northeast monsoon which pushed them back to Red Sea ports. Goods brought from India were delivered at Egyptian ports and from there to the Nile city of Coptos. Red Sea ports were the main trade centers of Romans' maritime trade with the East. Berenice and Mayos Hormos were the prominent ports on the western coast of the Red Sea. There were desert roads across eastern Egypt to Coptos. Cargos from the East were unloaded at Coptos and transported to Alexandria through the Nile River. Eventually, Mediterranean ships conveyed commodities brought from the east to Rome.[21] The proper use of wind made the mid-ocean crossing faster and cheaper but it involved many dangers.



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Pirates and shipwrecks were the common dangers faced by early traders traveling from the Red Sea to India.[22]

**Malabar coast**

The Malabar coast was an important part of the early historic Indian Ocean trade. The peculiar geographical position and the availability of rare spices and precious stones made the Malabar Coast of South India an ideal place for Western traders. Greco-Roman texts like *Periplus maris Erythaei*, Pliny's *Natural History,* and Ptolemy's *Geography* speak of the Maritime trade contacts of South India with the West. References in Sangam literature regarding maritime trade and the discovery of Roman coin hoards from different parts of South India underpin the descriptions of Greco-Roman accounts. In addition, archaeological discoveries from Pattanam provide further clarifications to the role of the Malabar coast in the early historic transoceanic trade contact between India and Mediterranean countries.

Among the products exported from south India pepper was of prime value. Pepper was highly valued by the Romans, thus it was known by the name *Yavanapriya* (dear to foreigners). It was used as an ingredient of food and also as medicine.[23] Pepper was produced in the western part of Tamilakam under the influence of Cheras.[24] Both the author of *Periplus* and Pliny indicates that the area from which pepper was brought to the port town was Cottonora.[25]There were three varieties of pepper- black pepper, long pepper, and white pepper. Cultivation of white pepper was restricted to North India. South India was known for its black pepper.[26] There are numerous references to the production of pepper in the Sangam anthologies. Poems indicate that it was cultivated in the *kurinji* tracts.[27]

Monsoon played a crucial role in creating a favourable environment for the growth of spices in Malabar. The region's peculiar climate and rich soil are the result of monsoon.[28] The Malabar region, which corresponds to modern Kerala, is a land mass bordered to the east by the Western Ghats and to the west by the Arabian Sea.[29]In India, the southern end of the Malabar coast is the first region hit by Soth west monsoon wind. which brings heavy rains to this region. The monsoon rains are largely responsible for raising the water levels of the rivers and improving soil fertility in this region.

**Conclusion**

Ancient Maritime contact between India and Mediterranean countries is a significant part of the history of the Indian Ocean. Monsoon winds were the determinant factor that destined the course of the premodern Indian Ocean trade. The use of monsoon winds gave a new dimension to Indo-Mediterranean trade. The voyages driven by monsoon winds helped Egyptian traders to cross the Arabian Sea and find out direct sea route to India. The availability of rare spices attracted traders to



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the Malabar coast. Early Greco-Roman accounts considered the marts of this region as the leading trade centers of India. Among the articles exported from Malabar pepper had considerable demand in Mediterranean countries. The role of monsoon in creating a favorable environment for the production of pepper in the Malabar region is indispensable.

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# AN INTEGRATIVE ANALYSIS OF HEAVY METAL-INDUCED ANATOMICAL CHANGES IN *CALOTROPIS GIGANTEA* (L.) W.T.AITON UNDER LEAD AND CADMIUM STRESS

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**Abstract-** This study assesses the phytotoxic effects of cadmium and lead on Calotropis gigantea, with a focus on industrial areas in Kanjikode, Kerala. The objectives involve estimating heavy metal concentrations in soil samples, determining the accumulation of cadmium and lead in plant tissues, and analyzing the effects of varying metal concentrations on seed germination and seedling growth. Additionally, the research explores anatomical changes in plants exposed to heavy metal contamination. The soil analysis revealed elevated levels of lead and cadmium in Kanjikode, surpassing permissible limits. Calotropis gigantea from the polluted area exhibited lead accumulation in both shoot and root, while cadmium was detected below measurable levels. Although seed germination remained unaffected by lead and cadmium exposure, increasing metal concentrations adversely impacted seedling growth, with a more pronounced effect on root length. Anatomical analysis identified reduced metaxylem and parenchyma width in plant stems from polluted areas. In summary, the findings suggest Calotropis gigantea's potential for lead accumulation and remediation from soil, highlighting its tolerance to heavy metals, particularly cadmium and lead. The study contributes valuable insights for future research, emphasizing the need for further exploration of the plant's tolerance and phytoremediation capabilities, especially concerning other heavy metals.

**Keywords---** *Calotropis gigantea*, Heavy metal-induced anatomical changes, Lead and Cadmium stress, Phytotoxic effects and soil analysis.

## 1. Introduction

The universal threat posed by heavy metal contamination to both human health and the environment is a consequence of increased industrialization and the expanding global population. The resultant disturbance of natural ecosystems has led to the accumulation of substantial quantities of heavy metals in the soil, primarily driven by human activities such as the use of metal-laden



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agricultural inputs and industrial effluents. Beyond anthropogenic contributions, natural events like volcanic eruptions also contribute to the environmental burden of heavy metals [1]. The non-biodegradable nature of these pollutants accentuates their persistence in the environment, with diverse levels of toxicity and potential for biomagnification, highlighting the urgent need for effective mitigation strategies [2].

Phytoremediation emerges as a promising solution, leveraging the inherent capabilities of plants to absorb and translocate metal contaminants. This eco-friendly approach involves the use of hyper-accumulators, plants proficient in accumulating substantial metal quantities, to enhance remediation processes [3,4,5]. However, heavy metal accumulation in plants triggers phytotoxic effects, inducing morphological, anatomical, and biochemical changes [6,7]. Certain metals, like Cadmium (Cd), adversely impact processes such as photosynthesis and root proliferation, while Lead (Pb) disrupts hormonal status and membrane structure. The complex interplay between heavy metals and seed germination further emphasizes the broader ecological implications of metal toxicity on plant life [8].

Amidst this complex ecological backdrop, our study directs its focus toward *Calotropis gigantea*, renowned for its pharmacological properties and traditional medicinal use. Thriving in polluted environments, *C. gigantea*'s unique ability to accumulate heavy metals positions it as a potential asset in ecological restoration efforts. This study seeks to unravel the details of heavy metal accumulation and tolerance mechanisms within *Calotropis gigantea*, contributing valuable insights to the fields of environmental science and traditional medicine.

## 2. Experimental/Methods

### a. Soil characterization

Soil samples were collected from the industrial areas of Kanjikode, Kerala. The study area was divided into 6 subsites, and soil samples were gathered randomly from each of these 6 subsites. The top layer of soil (approximately 1-2 inches) was removed, and a v-shaped cut was made to collect soil from a depth of 20 cm. These soil samples were mixed to form composite samples. Any clumps of soil were broken down, and the final sample was collected in clean polythene bags. The soil samples were air dried and analyzed for the total concentration of heavy metals, such as cadmium (Cd), lead (Pb), nickel (Ni), and chromium (Cr), using an atomic absorption spectrophotometer.

### b. Heavy Metal Analysis of Plant Material

*Calotropis gigantea* plants, prevalent in the study area, were collected for the analysis of heavy metal accumulation. The plant samples were air dried in an oven at 60°C until it reached a constant weight. 60shoot and root tissues from various plants were dried in an oven at 60°C until a



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constant weight was achieved. The accumulation of cadmium (Cd) and lead (Pb) in both the root and shoot tissues was analyzed using the ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry) method. The Bioconcentration Factor (BCF) was determined to assess the heavy metal absorption capacity of the plant, using the formula given by Pachura et al., (2016) [5]. The Translocation Factor (T.F) was calculated to determine the phytoextraction capacity of the plant, using the formula given by Barman *et al*., 2000 [9].

$$Bioconcentration\ Factor\ (BCF) = Heavy\ metal\ concentration\ in\ plant\ tissue\ /\ Heavy\ metal\ concentration\ in\ soil$$

$$Translocation\ Factor = Heavy\ metal\ concentration\ in\ the\ shoot\ /\ Heavy\ metal\ concentration\ in\ the\ root$$

**c. Anatomical Studies**

Hand sections of stems and leaves from *Calotropis gigantea* plants collected from heavy metal-polluted and unpolluted areas as control were taken. Thin hand sections from the third internodal area and leaves of the third node were analysed and compared for anatomical parameters, such as the metaxylem width and parenchyma width.

**d. Seed Germination Studies**

Seeds of *Calotropis gigantea* were collected from an unpolluted area. The seeds were sterilized using sodium hypochlorite and then washed with distilled water. To break seed dormancy, they were soaked in distilled water for 12 hours. Seeds were germinated under different concentrations of heavy metals (5, 10, 15, 20, and 25 mg/L of cadmium, and 100, 200, 300, 400, and 500 mg/L of lead). The seed germination percentage was calculated using the formula given by Al-Mudaris (1998) [10] to determine the germination ability of seeds under heavy metal exposure. The germination index, which indicates the speed of seed germination, was calculated using the formula by Ranal et al. (2009) [11].

$$Seed\ Germination\ Percentage = (Number\ of\ seeds\ germinated\ /\ Total\ number\ of\ seeds) \times 100\%$$

$$Germination\ Index = (5 \times n1) + (4 \times n2) + (3 \times n3) + (2 \times n4) + (1 \times n5)$$[1]

**e. Seedling Growth Parameters**

The seedling growth were monitored for 16 days and the percentage of phytotoxicity was estimated using the formula given by Chou and Linn (1976) [12]. The Tolerance Index percentage was calculated according to the formula given by Iqbal and Rahmati (1992) [13].

[1] Where n1, n2, n3, n4, and n5 are the number of seeds germinated on the 1st, 2nd, 3rd, 4th, and 5th day, respectively.



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$$Percentage\ Phytotoxicity\ of\ Root = ((Root\ length\ of\ control - Root\ length\ of\ treatment) / Root\ length\ of\ control) \times 100\%$$

$$Tolerance\ Index = (Root\ length\ of\ the\ seedling\ under\ heavy\ metal\ stress / Root\ length\ of\ seedling\ grown\ in\ controlled\ condition) \times 100\%$$

## 3. Results and Discussion

### a. Heavy metal analysis in soil

According to the pollution control board of India, the permissible and safe limits of heavy metals that can be present in soil for Cadmium: 3 mg/l, Chromium: 50 mg/l, Lead: 100 mg/l, and Nickel: 100 mg/l. Based on the analysis, (Table: 1) it is evident that the area is polluted with cadmium and lead.

Table.1: Heavy metal concentration analysis of soil composite collected from Kanjikode.

| Sample no. | Lead (mg/l) | Nickel (mg/l) | Chromium(mg/l) | Cadmium(mg/l) |
|---|---|---|---|---|
| 1 | 30.8 | BDL | 8.05 | 3.71 |
| 2 | 41.5 | 18.39 | 9.45 | 4.54 |
| 3 | 54.0 | 3.06 | 8.64 | 5.26 |
| 4 | 1407.5 | 5.06 | 10.79 | 8.63 |
| 5 | 7.2 | BDL | 11.36 | 2.34 |
| 6 | 2010 | BDL | 8.99 | 6.17 |

Note: BDL - Below detectable limit

### b. Heavy metal accumulation and phytotoxicity analysis

*Calotropis gigantea* grown in the study area showed significant Pb accumulation in both the roots and shoots, but Cd concentration remained below the detectable level (Table: 2). Bioconcentration factor (BCF- 0.08) and translocation factor (TCF- 1.5) analysis discloses, *C. gigantea* as a low accumulator of Pb and demonstrated its high ability to translocate Pb from roots to shoots. Similar results were observed in other plants, such as Moringa oleifera Lam., which showed higher accumulation of Pb in roots compared to Cd. Moreover, *Calotropis procera* was identified as a potential heavy metal remediator [14,15].



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Table.2: Heavy metal accumulated in C. gigantea collected from polluted area.

| Plant part | Cd (mg/l) | Pb (mg/l) |
|---|---|---|
| **Root** | BDL | 34 |
| **Shoot** | BDL | 51 |

Note: BDL - Below detectable level

**c. Anatomical adaptations**

The anatomical variations in the stem and leaf of *C. gigantea* from polluted and unpolluted sites showed a reduction in the width of metaxylem and parenchyma but an increase in the number of metaxylem compared to the control (Table: 3). This could be an adaptive response to cope with pollution as the similar findings were reported in studies involving *Euphorbia hirta* exposed to coal-smoke pollutants, *Sida spinosa*, and *Psoralea coryfolia* [16,17].

Table.3: Comparative anatomy of metaxylem and parenchyma width of C. gigantea stem from polluted and unpolluted areas

| TISSUES | POLLUTED | UNPOLLUTED |
|---|---|---|
| **Metaxylem width (µm)** | 77.66 ± 7.11 | 122.71 ± 18.83 |
| **Parenchyma width (µm)** | 82.32 ± 7.11 | 100.96 ± 11.72 |

Note: Values are mean ± S.E.

Contrastingly, Ahmad et al. (2005) [18] observed a decline in the number of xylem tissues in *Trigonella foenum-graecum* L. subjected to Pb and Cd stress. But *Dalbergia sissoo* trees grown in polluted areas exhibited a large number of xylem vessels with decreased lumen diameter [19]. Anatomical variation in *Cajanus cajan* (Linn) exposed to cadmium stress was decrease in xylem width and density [20].

Furthermore, red coloured depositions were detected in the cortical cells of the stem sections from polluted areas, possibly indicating heavy metal deposition within the cells (Figure: 1). Similar observations were made in *Thalassia hemprichii*, where red depositions were observed on roots, rhizomes, and leaves due to lead deposition [21]. In addition, phenolic compounds were seen as black deposits on the leaf surfaces of various plant species due to exposure to air pollution [22]. There was no observable change in metaxylem width of the leaf in polluted and unpolluted areas.



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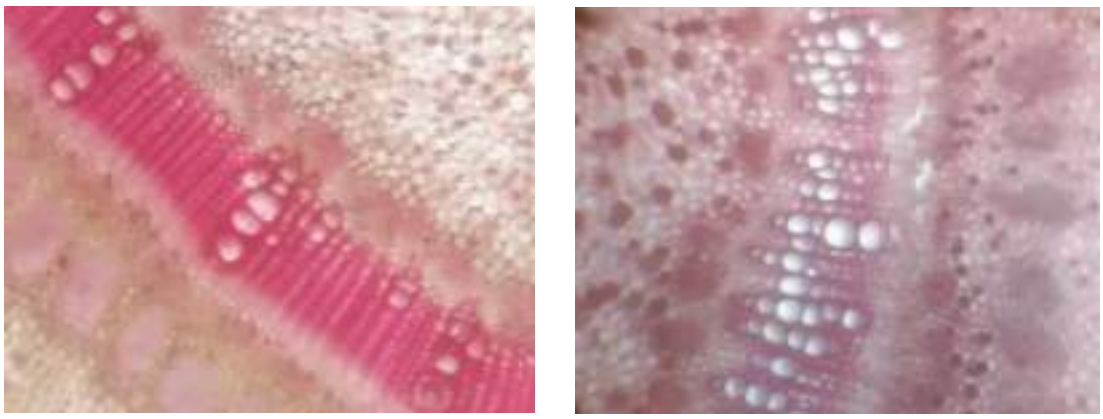

**Control** **Polluted**

Figure 1: Stem sections of *C. gigantea* showing red spots in the samples collected from polluted sites compared with control.

### d. Seed germination and Seedling growth analysis

In this study, seeds of *Calotropis gigantea* germinated in varying concentrations of Cd and Pb, did not cause any inhibitory effect on seed germination of *C. gigantea*. Unlike the experimental studies by Yang et al., 2022,[23] the germination percentage and germination index remained unaffected even with increased heavy metal concentrations. Similar results have revealed by Farooqi et al. (2009) [24] that increasing concentrations of Cd and Pb led to reduced germination in *Albizia lebbeck*. Similarly, Heidari and Sarani (2011) [25] observed that Cd and Pb nitrate negatively affected the seed germination of *Sinapsis arvensis*. The germination index of *C. gigantea* was found to be higher in the controlled condition than in the treated condition. However, the heavy metal concentration did not significantly influence the germination index (Table.4).

Table.4: Effect of varying concentrations of Cd and Pb on germination index of *C. gigantea*

| Cadmium concentrations (mg/L) | Germination index | Lead concentrations (mg/L) | Germination index |
|---|---|---|---|
| 0 (Control) | 59 | 0 (Control) | 59 |
| 5 | 48 | 100 | 55 |
| 10 | 55 | 200 | 57 |
| 15 | 57 | 300 | 55 |
| 20 | 56 | 400 | 55 |
| 25 | 52 | 500 | 49 |

The tolerance index of the seedling registered a significant reduction with an increase in the concentration of both lead and cadmium (Figure 2). The result also shows that the seedling of *Calotropis gigantea* is more tolerant to cadmium than lead. There was a rapid decrease in the tolerance index at 500 mg/L of lead.



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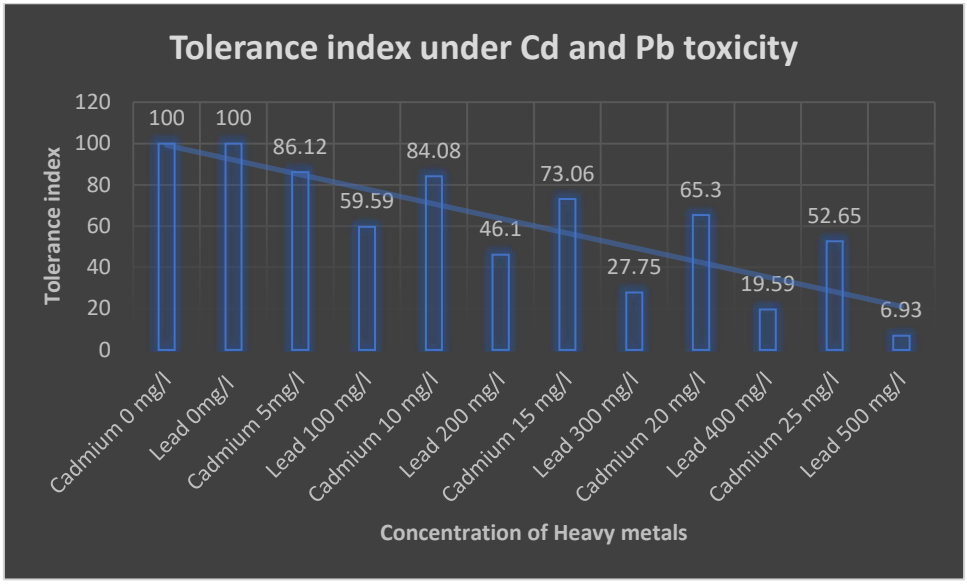


Figure 2: Tolerance index of *C. gigantea* seedlings under cadmium and lead toxicity

The effects of Cd and Pb stress on seedling growth of *Calotropis gigantea* showed reduced growth, with both root and shoot length, although roots were more sensitive than shoots (Figure 3 & Figure 4). These findings align with the study conducted by He et al. (2008) [26], which observed that high concentrations of Cd inhibited radicle growth more than plumule growth in Oryza sativa. Moreover, the accumulation of lead in Triticum sativum and Lens esculenta led to a reduction in root growth compared to shoot growth [27].

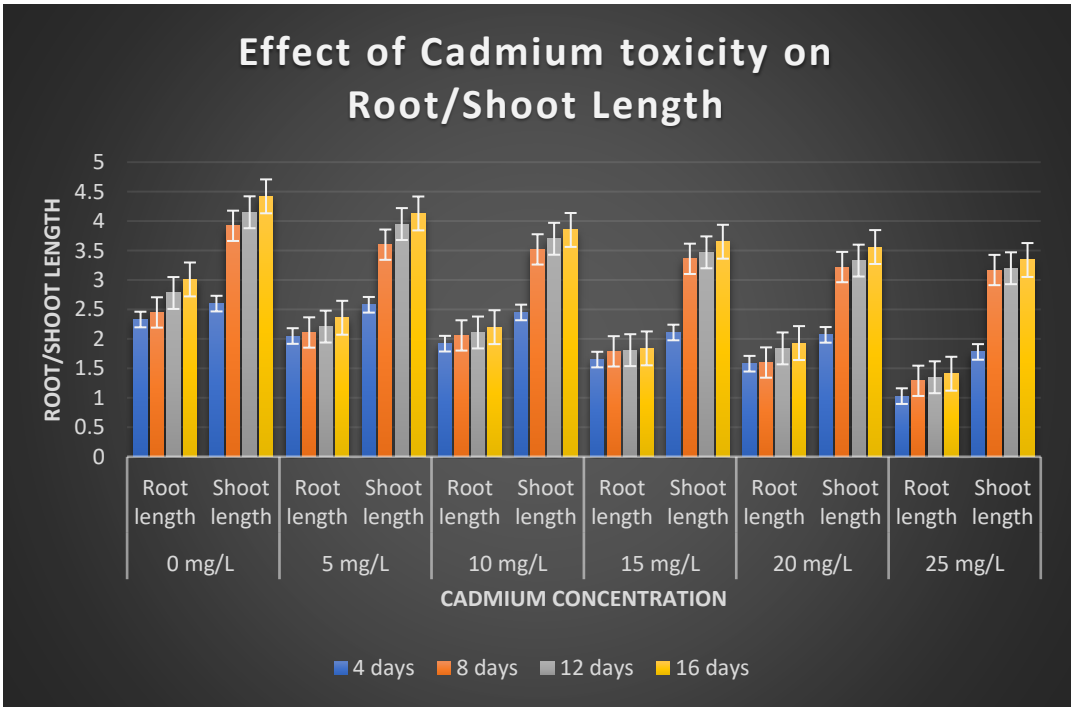


Figure 3: Root/Shoot length of *C. gigantea* seedlings under cadmium toxicity



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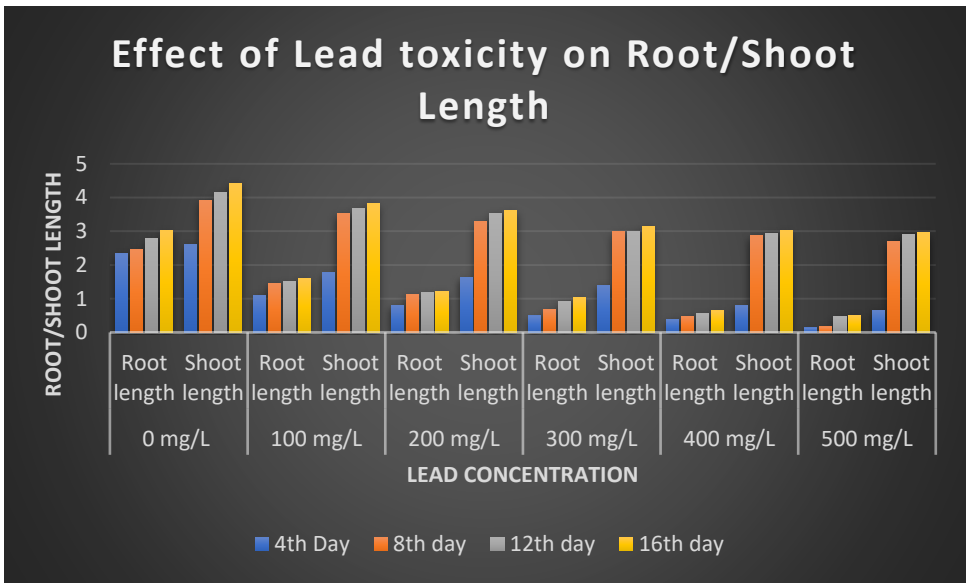


Figure 4: Root/Shoot length of *C. gigantea* seedlings under lead toxicity

In this study, *C. gigantea* showed higher tolerance to Cd than Pb. The phytotoxic effect of both metals increased with concentration, with roots being more affected than shoots. Lead induced more phytotoxicity than Cd, which contrasts with a study by de Souza Costa et al. (2012) [28], where castor beans grown in Cd showed more phytotoxic effects than those grown in Pb.

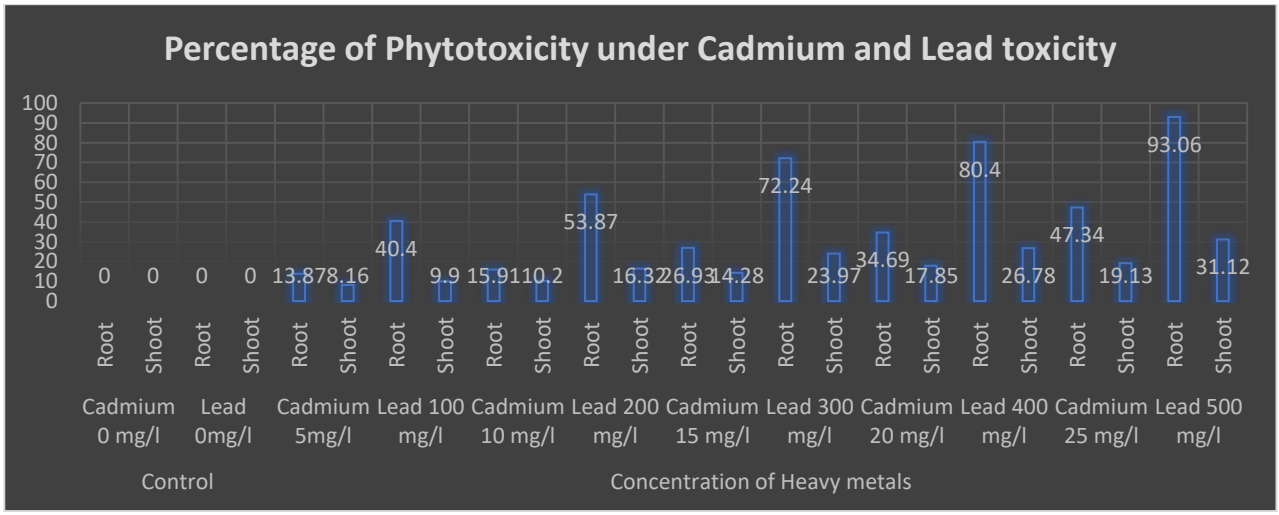


Figure 5: Percentage of phytotoxicity on seedling growth of *C. gigantea* under cadmium and lead toxicity

## Conclusions

This study comprehensively explores *Calotropis gigantea*'s capacity to absorb heavy metals in an industrially polluted environment, revealing elevated Cd and Pb levels in the soil surpassing permissible limits. From the heavy metal concentrations of Cd and Pb in shoot and root tissues, it highlights the plant's efficient accumulation of lead, though cadmium was below detectable levels.



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Confirmation of phytoaccumulation was established through bioconcentration factor (BCF) and translocation factor (TF) calculations, demonstrating the effective translocation of Pb from roots to shoots. Seed exposure to Cd and Pb showcased unaffected germination but inhibited seedling growth, with *C. gigantea* displaying higher tolerance to Cd than Pb. Anatomical comparisons between polluted and unpolluted plants indicated stem adaptations in response to pollution, underscoring the plant's resilience. In summary, *C. gigantea* exhibits significant potential for heavy metal phytoremediation, offering insights into its adaptive mechanisms. While this study contributes substantially to understanding its capabilities, further research is needed to explore tolerance and phytoremediation for other heavy metals, providing a foundation for sustainable solutions in mitigating heavy metal pollution.

**Acknowledgements**

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# IMPACT OF ENVIRONMENTAL POLLUTION ON LIFE STYLE DISEASES

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**Abstract**

Environmental pollution can significantly impact lifestyle diseases by contributing to factors such as air and water pollution. Poor air quality often caused by pollutants like particulate matter and chemicals can lead to respiratory issues and cardiovascular diseases. Contaminated water sources may contribute to waterborne diseases affecting overall health. Additionally, exposure to environmental toxins can increase the risk of developing conditions like cancer and neurological disorders, influencing life style choices and overall well-being. Efforts to reduce pollution can play a crucial role in preventing and managing lifestyle related diseases. This research aims to elucidate the mechanisms linking environmental exposures to life style disease outcomes. This study shows the urgent need for holistic interventions, policy measures, and life style modifications to mitigate the detrimental impact of environmental pollution on public health. Both Primary data and Secondary data were used for this study

**Keywords**: life style disease, Public health, environmental pollution,

## Introduction

In the 21st century, though the world countries attained an optimum progress in different aspects they are facing many challenges in the case of health and environmental issues. Environmental Pollution refers to the introduction of harmful substances or contaminants into the natural surroundings, causing adverse effects on eco systems, human health and the overall environment It can result from various activities such as industrial processes, transportation and improper waste disposal. Life style diseases, also known as non-communicable diseases are health conditions primarily caused by unhealthy habits and behaviors such as poor diet, lack of physical activity, excessive alcohol consumption and smoking. The long-term impact of air pollution on health are chronic asthma, cardiovascular diseases, Pulmonary Insufficiency. Anthropogenic air pollution is one of the health hazard that kills around 9 million people around the world every year. Small air pollutant is related to COPD (Chronic Pulmonary Disease). Multiple human activities adversely affect environment. The environmental impacts leads to pollution of water we drink, air we breath and soil in which our food grow. Two third of diseases is attributed to environmental issues. Vulnerability and exposure of environmental issue is mainly hit children and elderly. According to WHO 2022, 25-33 % of diseases are attributable to environment. Many pollutants that



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are major factor in many diseases like respiratory problem, cardiovascular diseases, cancer, reproductive dysfunction etc. Increasing atmospheric pollution and resultant climate change will lead to increasing geographical redistribution of infectious diseases.

**Statement of problem**

In this study relationship of environment pollution and life style diseases are analyzed .Since earth is under a condition of pollution of environment in different aspect, this study is the need of hour. By studying this relationship and proposing sustainability different stake holders can prevent to some extent the impact of environmental pollution on lifestyle disease.

**Methodology**

Both primary data and secondary data was used for this study. Primary data was collected from Ponnani Municipality. Ponnani Municipality consist of 51 wards .Out of this 2 wards were randomly selected.30 individuals were selected as samples by using simple random sampling methods. Secondary data was collected from internet , WHO data, etc

**Objective**

1. To find the level of life style diseases in Ponnani Municipalities.
2. To find the relationship between life style disease and environmental pollution
3. To find status of awareness of life style disease in Ponnani Municipality

**Limitations**

1. Limited Time
2. Lack of data for health impact assessment of environmental pollution.

**Review of literature**

1. Environment and human health, Europe's environment: third assessment: points out that outdoor air pollution leads to persistent allergy and asthma among children and elderly. European Union Research Agenda shows that some diseases are of concern by giving example cancer, heart disease and obesity associated with risk correlated to environment, Neurotoxin effect of environmental contaminants, the environmental factors affect onset of puberty, food and fertility.

2. Ewa Konduracka, A link between environmental pollution and civilization disorders :a mini review, May 2019 quoted WHO's estimate that every year 12.6 million death by different environmental cause .This study shows that one of the main cause of civilization disorder attributes to environmental pollution .This article data was based on EBSCO, Pubmed .This article concludes



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that multidisciplinary research team had moral obligation to raise awareness of public and decision makers and develop methods for reducing pollutant emission.

3. International Journal of environmental research and public health, Green Space Exposure Association with Type 2 Diabetic Mellitus, Physical Activity and Obesity: A systematic Review by Felipe De la Fuente et al shows a positive impact of green exposure and type 2 Diabetics.

**Overview**

Environmental pollution has positive correlation with lifestyle diseases. Non-communicable diseases (NCDs) are diseases, generally of long duration, that cannot be spread directly from one person to another. However, some NCDs are caused by infections, including cervix cancer (caused by human papillomavirus) and liver cirrhosis (caused by hepatitis B or C infection). Many NCDs share behavioral risk factors, including tobacco smoking and insufficient physical activity. Metabolic risk factors, such as high blood pressure, also increase the risk of non-communicable diseases. Among the NCDs, cardiovascular diseases and cancers are the most common causes of death. Globally Austria was selected for showing the relationship between environment pollution and life style diseases in this study.

**Deaths Due To Non Communicable Diseases**

| Year | Male | Female |
|---|---|---|
| 2021 | 46 010 | 45 952 |
| 2020 | 45 372 | 46 227 |
| 2019 | 40 774 | 42 612 |
| 2018 | 40 851 | 43 124 |

Source:WHOdata

**Deaths Due To Cardiovascular Diseases**

| Year | Male | Female |
|---|---|---|
| 2021 | 14 175 | 17 124 |
| 2020 | 14 708 | 17 836 |
| 2019 | 14 335 | 17 813 |
| 2018 | 14 392 | 18 292 |

Source:WHO data

As per the data the deaths due to cardiovascular disease is higher in female.

**Respiratory Diseases**



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| Year | Male | Female |
|---|---|---|
| 2021 | 1 761 | 1 521 |
| 2020 | 1 987 | 1 620 |
| 2019 | 2 011 | 1 774 |
| 2018 | 2 058 | 1 668 |

Source:

WHO data

As per the data deaths due to respiratory diseases are higher in male.

**Diabetes Mellitus And Endocrine Disorders**

| Year | Male | Female |
|---|---|---|
| 2021 | 2 354 | 2 363 |
| 2020 | 1 948 | 1 981 |
| 2019 | 1 760 | 1 907 |
| 2018 | 1 965 | 2 152 |

Source: WHO data

As per the table deaths due to Diabetes mellitus and endocrine disorders are higher in female.

The relationship between environment pollution and life style disease is clear from some key points.

1.Air pollution and respiratory diseases

2. Water pollution and waterborne diseases

3. Pesticides and agriculture run off

4. Noise pollution and stress related disease

5. Chemical exposure and cancer

6. Urbanization and sedentary life style

7 Climate change and health impact

8 Cumulative impact and vulnerable population



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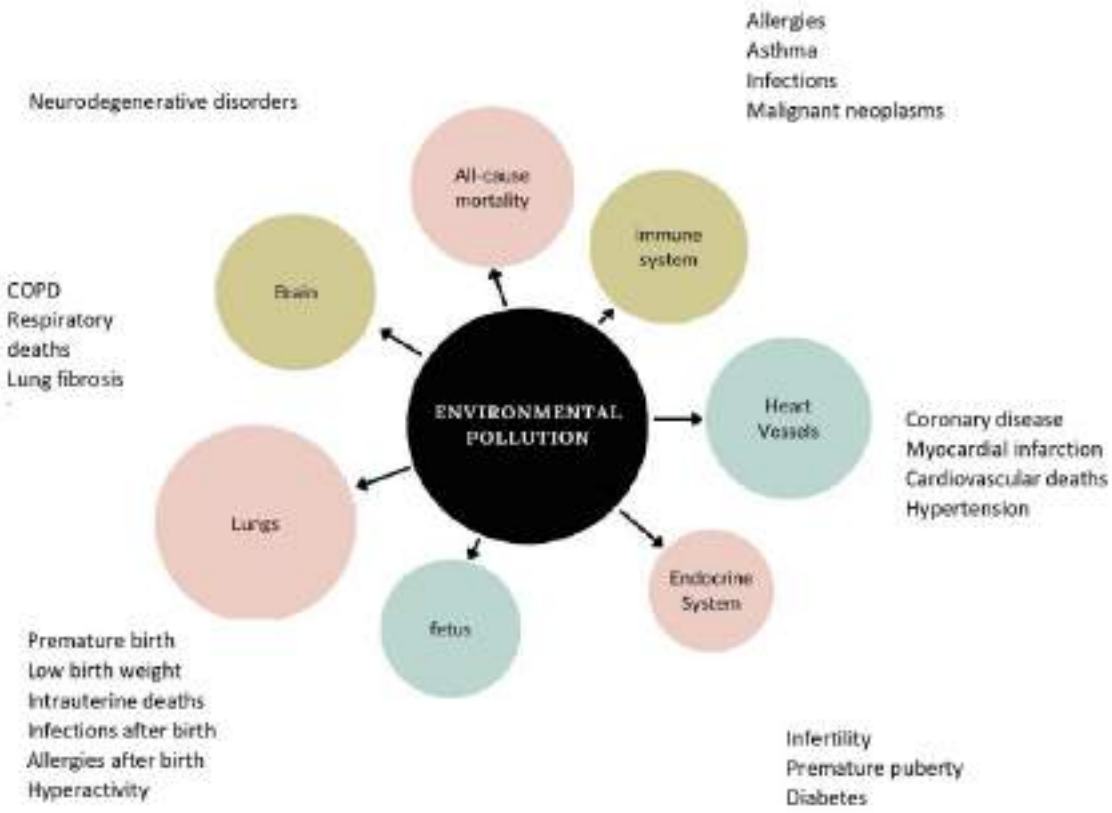
Air pollution is not an exemption to India for factors contributing to ill health as it contribute top rank in diseases. As per Global Burden of Disease comparative risk assessment for 2015 air pollution exposure contribute approximately 1.8 million pre mature deaths and 49 million disability adjusted life years (DALYs)lost ranking it top risk factors contributing to ill health in India. A standing committee on air pollution proposed to be chaired by health and environment secretaries is under consideration at ministerial level. National Green Tribunal and Supreme Court actively driven action for controlling air pollution. In India household air pollution is mainly contributed by cooking, heating, smoking tobacco, air condition. refrigerator etc. National Air Quality Monitoring Programmers for nationwide launched by Central Pollution Control Board for controlling Primary pollutants in urban and semi urban areas. Among the metro cities Delhi, Mumbai, Kolkata and Hyderabad have highest PM2 5 level (40-81 $mg/m^3$) which exceed the permissible standards (40 $mg/m^3$).

**Data Analysis**

**Civilization disorders and environmental pollution**




Source: Ewa Konduracka, A link between environmental pollution and civilization disorders:a mini review,May 2019

This figure shows a relationship between environment pollution and lifestyle diseases.



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In Kerala, the latest global Burden of Disease (GBD) estimation, the major Chronic respiratory diseases in the state are Chronic Obstructive Pulmonary Diseases and Bronchial Asthma. The GBD has estimated a prevalence of 4250-4749/100000 population for COPD and >3750/100,000 population for Asthma in the state. Climate change negatively affect health in the state as everywhere. The health mission aims to reduce climate sensitive illnesses through integration with other missions under National Action Plan for Climate Change (NAPCC) as well as through programmes run by various ministries.

**Gender wise classification of sample**

| Category | Frequency | Percentage |
|---|---|---|
| Female | 19 | 63.3 |
| Male | 11 | 37.7 |
| Total | 30 | 100 |

Source:primary data

63.3 Per cent of sample was male and 37.7 per cent was female

**Awareness about lifestyle Diseases**

| Category | Frequency | Percentage |
|---|---|---|
| Yes | 28 | 93.3 |
| No | 2 | 6.66 |
| Total | 30 | 100 |

Source:primary data

93.3 % of sample have awareness about lifestyle diseases and only 6.66 per cent of sample have no awareness about life style diseases

**Family history status of lifestyle disease**

| Category | Frequency | Percentage |
|---|---|---|
| Yes | 21 | 70 |
| No | 9 | 30 |
| Total | 30 | 100 |

Source:primary data

70 per cent of respondents have family history status of life style disease and 30 per cent have no family history status of life style disease.



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**Findings**

1. 63.3 Per cent of sample was male
2. 70 Per cent of respondents have family history status of lifestyle diseases
3. 93.3 per cent of respondents have awareness about life style diseases
4. All types of environmental pollution leads to health hazards
5 WHO data show a close relationship between environment pollution and life style diseases

**Suggestions**

1. Public awareness for reducing environment pollution
2. Multidisciplinary approach by scientific experts to prevent environmental impact on life style disease
3. Protect environment by focusing on sustainable development.
4. Research
5. Set environmental exposure standard for children
6. Follow the policy of reduce, reuse and recycle
7.Control environmental pollution
8. promote policies helpful for reducing environmental pollution like car pooling etc
9. Reduce emission
10. Reduce exposure
11. National and international organizations must address this threat and stand for sustainability.

**Conclusion:**

Fully integrated approach for reducing environmental health risk has to follow by all stakeholders. Since it is a transnational issue, cooperation of world nations is essential for preventing health impact of environment. All nations must propose sustainable policy and follow it. For preventing the environmental impact on health to some extent national and international co-operation and public and private cooperation is essential. Research has to be done in ecology, biology and toxicology to identify various poisonous elements having environmental negative impact. It's a good study having scope for future research.

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# APPLICATION OF RU(II)NHC COMPLEXES FOR ELECTROCHEMICAL SENSING OF CLUB DRUG: Γ–BUTYROLACTONE

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**Abstract:** Over the last twenty years, the landscape of drug abuse has undergone a significant transformation, leading to the emergence and utilisation of a novel class of substances driven by the underlying motivations and intentions behind their consumption, γ–butyrolactone acts as a synthon for the synthesis of γ–hydroxybutyric acid by paraoxonase enzymes, which acts as a central nervous system depressant, while its excess dose can cause amnesia, coma and death. γ–Butyrolactone has been used as a party– or club–drug in small doses and lasts for 4 hours of effect as it can serve as a euphoria agent, hence used for abusive purposes. Traditional drug testing techniques, such as HPLC, gas chromatography, missile chromatography, and mass spectrometry, have limitations in detecting γ–butyrolactone due to its short half-life. To address this issue, electrochemical sensing using molecular electrocatalysts, specifically Ru(II)-NHC complexes with pyridine wingtip substitution, is being explored. These complexes provide structural and chemical stability and will be assessed for their electrocatalytic sensing of γ–butyrolactone via square wave voltammetry, resulting in an LOD of 2.393 nM. Additionally, the modified electrodes have shown excellent selectivity, sensitivity, and reproducibility, along with an interference study involving spiking samples containing target molecules in the presence of interfering molecules like uric acid, ascorbic acid, dopamine, glucose, etc.

**Keywords:** Electrochemical sensing; γ–butyrolactone; N-heterocyclic Carbene; Square wave voltammetry; Electrocatalyst.

## Introduction

Substances commonly referred to as "date rape drugs," also known as "club drugs" or "rape drugs," are frequently employed to facilitate sexual assault or rape. These substances are typically odorless, tasteless, and colorless liquids, making them challenging to identify when introduced into beverages or food[1]. In many instances, these drugs are administered without the victim's knowledge



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or consent, rendering them susceptible to sexual assault or other criminal activitie[2,3]. The effects of date rape drugs can vary based on the specific substance, dosage, and individual tolerance and metabolism. Nevertheless, common effects may include drowsiness, confusion, loss of coordination, memory impairment, and difficulty speaking or moving.

It is crucial to detect date rape drugs and analgesics on-site at a crime scene to understand the nature of drug-facilitated sexual assault, especially when these substances are commonly administered with alcoholic beverages. Date rape drugs have high lipophilicity and undergo rapid metabolism in the body, leading to the formation of short-lived metabolites that are quickly absorbed, digested, and eliminated. Unfortunately, detecting these drugs or their metabolites becomes increasingly challenging due to the presence of naturally occurring trace amounts in the body, making it difficult to identify elevated levels[4]. Therefore, a versatile sensor designed to detect these chemicals should demonstrate improved performance in terms of sensing mechanism, reduced sample size, high speed, heightened sensitivity and selectivity, while maintaining accuracy, precision, and other essential characteristics.

The current methods utilized for detecting date rape drugs and their metabolites are time-consuming, underscoring the necessity for robust and swift on-site monitoring facilitated by appropriate [5–7] There is a notable increase in demand for such sensors due to their capacity to offer efficient and timely detection in real-time scenarios[8]. The progression of non-enzymatic, environmentally friendly, and economically viable sensors designed for on-site applications carries significant importance from a forensic standpoint. These sensors are specifically crafted for the discerning and quantitative detection of date rape drugs, which unfortunately are misused for abusive purposes. The development of these sensors addresses an urgent requirement and furnishes valuable tools for forensic investigations.

The versatility and significance of ruthenium(II) NHC complexes are derived from their outstanding stability, robust sigma-donor capabilities, weak pi-acceptor characteristics, and inherent adjustability. These complexes exhibit diverse structures and stand out as pioneering molecular electrocatalysts, particularly in the highly selective and ultra-sensitive detection of predatory drugs such as xylazine, γ-butyrolactone etc[9] . The incorporation of additional donors like pyridine has generated substantial interest, primarily due to the improved stability resulting from chelation in the metal-NHCs. This progress contributes to the growing importance and exploration of these compounds.

In alignment with this perspective, we present a compilation of ruthenium(II) complexes formed by bidentate NHC ligands, showcasing their structural diversity and exceptional potential as pioneering molecular electrocatalysts[10]. These complexes excel in the highly selective and ultra-



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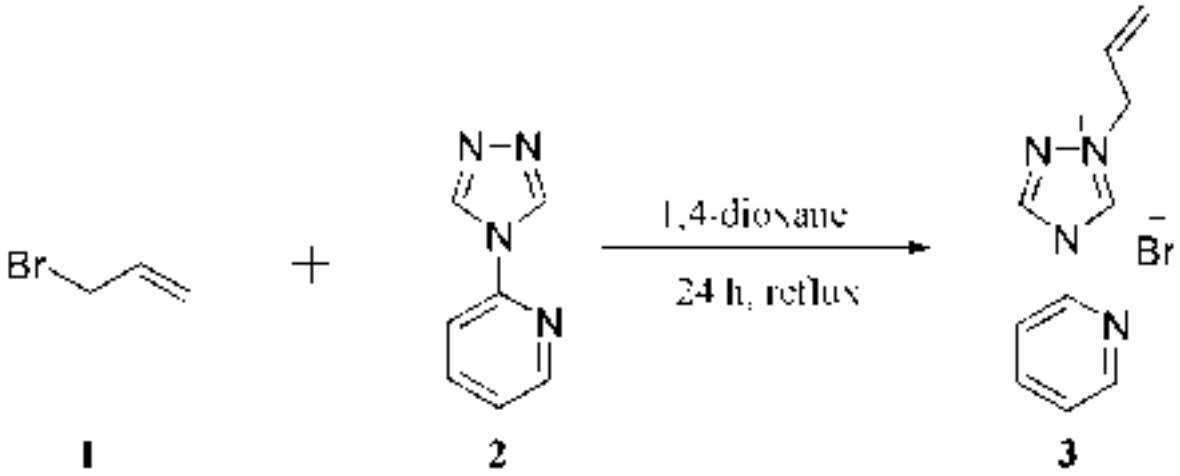
sensitive detection of predatory drugs, including ketamine hydrochloride, γ-butyrolactone, and scopolamine. Additionally, the utilization of a carbon nanotube composite incorporating the ruthenium(II)-NHC complex has been demonstrated to significantly enhance the sensitivity of the modified electrode by multiple folds.

## Experimental/Methods

**Materials and method---** All experiments were carried out under aerobic conditions using glassware that had been oven-dried. Commercially sourced chemicals and solvents were employed without any further purification or recrystallization. The advancement of the reactions was tracked using thin-layer chromatography (TLC) conducted on 0.25 mm Merck TLC silica gel plates, with UV light employed as the visualizing agent. The electrodes were procured from ALS Co., Ltd.

**Electrode preparation---** The working glassy carbon electrode, with a 3 mm diameter, underwent three rounds of polishing using 1.0, 0.3, and 0.05 μM alumina paste to achieve a glossy, mirror-like finish on the surface. The electrode was then thoroughly rinsed with distilled water multiple times. Following that, it underwent approximately 5 minutes of sonication in a 1:1 water-ethanol mixture to ensure thorough cleaning. In the standard electrode preparation procedure, a 5 mM concentration solution of the Ru(II)NHC complex was dissolved in dichloromethane. The drop-casting method was employed to deposit thin films onto the GCE uniformly. A total of 10μL of the stock suspension was gradually adsorbed onto the GCE in two sets of 5 μL aliquots. Subsequently, the modified GCEs were left to dry overnight at 40°C to ensure proper film formation.




**Scheme 1**. Synthesis of pyridine and coumarin substituted 1,2,4–triazolium bromide salts (**3**) from 2–(4H–1,2,4–triazol–4–yl) pyridine (**2**) and propargyl bromide (**1**).



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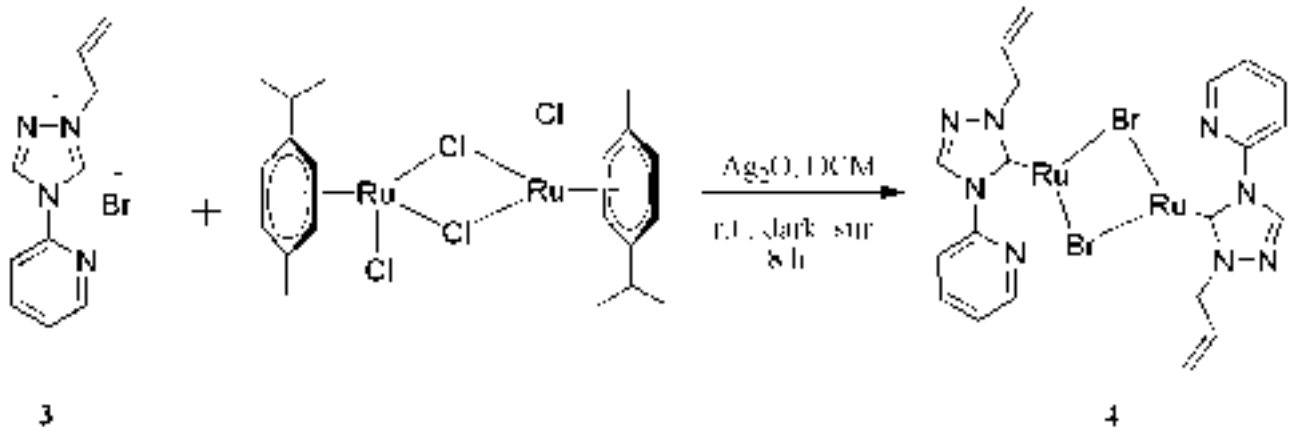


**Scheme 2**. Synthesis bis–NHC coordinated ruthenium(II) complexes (**4**) from triazolium bromide salts (**3**).

**Synthesis of Ru (II)-NHC complex---** A solution of 2-(4H-1,2,4-triazol-4-yl)pyridine **2** in 1,4-dioxane was added to a stirring solution of propargyl bromide **1**, also in 1,4-dioxane. The resultant mixture was stirred under reflux conditions for 48 hours[11]. The precipitated bromide salt **3** formed was then filtered under suction, washed with fresh 1,4-dioxane, and air-dried at room temperature before storage. The resulting bromide salt **3**, precipitated in this manner, underwent suction filtration, followed by washing with fresh 1,4-dioxane and subsequent air-drying at room temperature before storage, illustrated in scheme 1.

A dichloromethane (DCM) solution of silver oxide was introduced to compound **3** in a round-bottom flask. The reaction proceeded in darkness, with continuous stirring at room temperature. As illustrated in scheme 2, the solution's color transitioned to ash black within the initial hour of reflux. After the 4-hour mark, ruthenium paracymene was added to the solution under the same reaction conditions[12]. Following an additional 4 hours, the reaction mixture underwent filtration through a celite bed, followed by reducing the volume by half using a rotary evaporator. The subsequent work-up involved adding small amounts of dichloromethane (DCM), followed by washing with diethyl ether and then cold hexane. The resulting residue of complex **4**, a bright yellow solid, was dried and stored.



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**Results and Discussion**

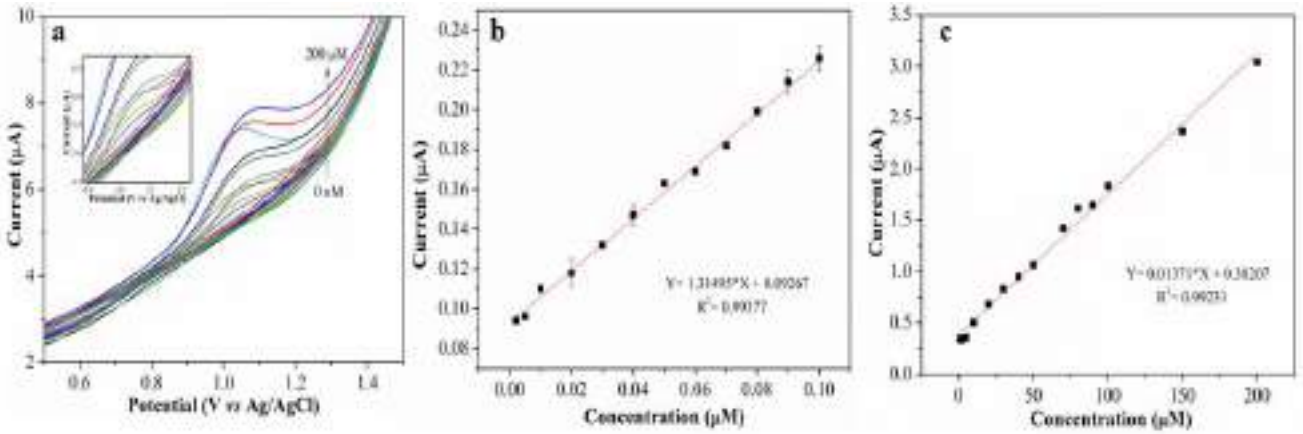


**Figure 1.** SWV **c**oncentration study with complex **4** for γ–butyrolactone **(a)** in the linear range from 0 nM – 100 μM. Calibration curve in the range of (**b**)2–100 nM and (**c**)1-200 μM.

The electrochemical performance of the modified glassy carbon electrodes (GCEs) in detecting DRD was evaluated through square wave voltammetry (SWV) analysis, with complex 4 serving as the standard representative electrocatalyst for subsequent investigations. Utilizing the optimized conditions outlined in Figure 1 for γ–butyrolactone, which included the use of Britton–Robinson Buffer at pH 7, an accumulation time of 0 seconds, and an accumulation potential of 0 V, SWV analysis was conducted.

γ–Butyrolactone was initially introduced at a concentration of 2 nM, resulting in a current response of 0.094 μA, and progressively increased up to 200 μM, leading to a current of 3.041 μA. As the concentration continued to rise, a saturation of the current was observed. It is evident that with an increasing concentration of γ–butyrolactone within the reaction cell, the current response at +1.075 V also shows a corresponding increase, as depicted in Figure 1a.

A concentration versus current calibration curve was constructed for γ–butyrolactone, clearly indicating an increase in current response corresponding to the concentration. The calibration curve for γ–butyrolactone revealed two linear concentration ranges of 2–100 nM and 1–200 μM at +1.075 V as the potential peak. The lower concentration calibration curve is depicted in Figure 1b and 1c. The limit of detection (LOD) was determined to be 2.393 nM, the limit of quantification (LOQ) was found to be 7.976 nM, with an electrode sensitivity of 17.302 μA $\mu M^{-1}$ $cm^{-2}$.



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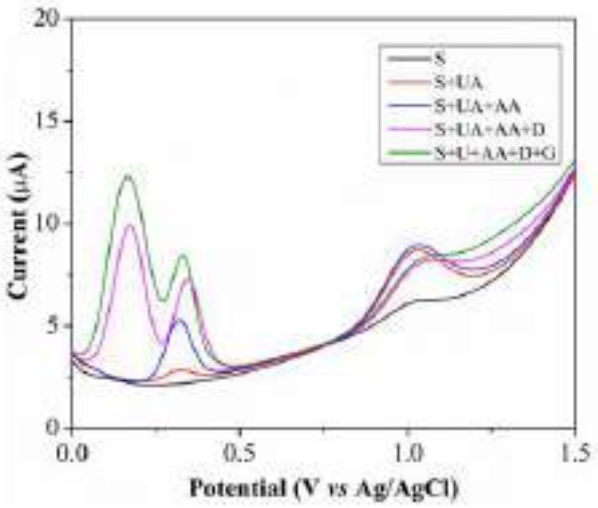


**Figure 2.** Interference study with uric acid (UA), ascorbic acid (AA), Dopamine (D) and glucose (G) γ–butyrolactone 40μM (S).

The interference study is essential for evaluating the selectivity of the modified electrode in real-time. An interference experiment was carried out to assess the response of the electrocatalyst as a representative sensor to various species present in the blood. The results of this experiment are depicted in Figure 2. The experimental procedure involved the sequential addition of different substances. Initially, DRDs were added, followed by the addition of 0.1 μM each of uric acid (UA), ascorbic acid (AA), dopamine (D), and 2.5 μM glucose (G), replicating the composition of human blood in each run of SWV analysis.

Although current responses were observed from the interfering components, they were significantly located at different peak potentials than those of bare DRDs in the electrochemical cell. In Figure 2, the introduction of γ–butyrolactone resulted in a single peak. However, upon adding uric acid, an additional peak was observed at 0.32 V, corresponding to the oxidation peak of uric acid, with no interference in the current response for γ–butyrolactone. The subsequent addition of ascorbic acid led to an increase in the peak corresponding to uric acid, with no significant change in the peak height of γ–butyrolactone. Further addition of dopamine resulted in a dopamine peak at 0.2 V, and the uric acid peak shifted, but there was no significant change in the γ–butyrolactone peak. The addition of glucose caused a slight decrease in the peak height of both dopamine and γ–butyrolactone, with minimal shifts in peak position.



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**Conclusions**

We successfully synthesized four Ru(II) NHC complexes, meticulously characterized them, and employed them as electrocatalysts for detecting DRD. Among these complexes, complex 4 displayed promising performance and was selected as the representative electrocatalyst for γ–butyrolactone detection. A concentration study of γ–butyrolactone using square wave voltammetry (SWV) was conducted within linear ranges of 2–100 nM and 1–100 µM, resulting in a low limit of detection (LOD) of 2.393 nM. Notably, the detection of DRDs was achieved even in the presence of various interfering chemicals such as uric acid, ascorbic acid, dopamine, glucose, etc. Over the course of one month, the electrocatalyst's repeatability exhibited only a marginal reduction of 7–8%, demonstrating its resilience to fluctuations in humidity and temperature, ensuring efficiency and reliability.

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# SUSTAINABLE DEVELOPMENT IN TOURISM: BALANCING GROWTH AND ENVIRONMENTAL RESPONSIBILITY – AN OVERVIEW

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**ABSTARCT:**

The global tourism industry has experienced exponential growth in recent decades, presenting both opportunities and challenges for sustainable development. It explores, the complex relationship between tourism and sustainable practices, emphasizing the need for a balanced approach to ensure the longevity of both industry growth and environmental preservation. Tourism, a vital economic contributor for many nations, often faces scrutiny due to its environmental impacts, including resource depletion, pollution and disruption of local eco systems. The pursuit of sustainable development within this industry requires a multidimensional approach, encompassing environmental, social and economic considerations.

Efforts to mitigate environmental degradation caused by tourism have gained traction through various means, including the promotion of eco-friendly accommodations, implementation of responsible tourism practices, and conservation initiatives in popular destinations. Additionally, community engagement and empowerment play pivotal roles in fostering sustainable tourism by preserving local cultures, supporting socio-economic development, and minimizing negative impacts on indigenous communities

This paper underscores the importance of adopting a holistic and long tern perspective in the tourism industry, where sustainable practices are integrated into a core of business models and decision-making processes. By embracing sustainability as a fundamental principle, the tourism sector can achieve a harmonious balance between growth and environmental responsibility, ensuring that future generations can continue to enjoy the cultural, natural and economic benefits of travel.

**Keywords:** Sustainable development, tourism industry, environmental responsibility, community engagement, sustainable practices.



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**Introduction**

Sustainable development in tourism refers to the responsible and balanced growth of the tourism industry that minimizes its negative impacts on the environment, local communities, and cultural heritage while maximizing the positive contributions to economic development and social well-being. It is a holistic approach that seeks to meet the needs of present tourists and host regions while safeguarding and enhancing opportunities for future generations. In an era where travel and tourism play a pivotal role in global economies, the pursuit of sustainable development has emerged as a crucial imperative. The dynamic growth of the tourism industry brings with it both economic opportunities and environmental challenges. As destinations strive to attract visitors and boost their economies, there is an increasing awareness of the need to strike a delicate balance between fostering growth and ensuring environmental responsibility. As the global tourism sector continues to expand, it is imperative to explore strategies that ensure the long-term viability of destinations while minimizing negative impacts on the environment.

The tourism industry has witnessed unprecedented growth in recent decades, contributing significantly to economic development in various regions. However, this expansion has brought about environmental degradation, cultural disruptions, and social inequalities. Striking a balance between tourism growth and environmental responsibility is crucial to ensure the industry's sustainability. The tourism industry, a significant driver of global economic growth, is at a crossroads. Rapid expansion has brought unprecedented challenges, necessitating a critical examination of practices to ensure long-term sustainability. This article delves into the nuanced relationship between tourism growth and environmental responsibility, aiming to identify key challenges, explore current trends, and propose sustainable solution

While the industry contributes significantly to economic development, job creation, and cross-cultural exchange, its unbridled expansion poses threats to natural ecosystems, wildlife habitats, and the delicate balance of local communities. The need for a paradigm shifts towards sustainable tourism practices is not just a moral imperative; it is an essential strategy for ensuring the longevity and resilience of both the industry and the destinations it serves. Sustainable development in tourism is not merely an option but a necessity, requiring the collaboration of governments, businesses, local communities, and travelers themselves. By understanding and embracing the principles of sustainability, we can pave the way for a tourism industry that not only thrives economically but also becomes a beacon of environmental responsibility and cultural preservation.

**Objectives of the study**

- To analyse the impact of tourism growth on the environment and local communities.
- To evaluate environmental initiatives within the tourism sector



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- To analyse the role of policies and regulations in promoting sustainable tourism.

**Scope of the study**

The study encompasses a broad and multidimensional exploration of the interactions, challenges, and opportunities associated with achieving sustainability in the tourism industry. The study aims to cover various key aspects within the overarching theme of balancing growth and environmental responsibility. The study examines both natural and cultural aspects affected by tourism growth. While recognizing the overarching importance of sustainable practices, specific attention is paid to the role of policies, community engagement, and emerging trends shaping the industry.

**Methodology**

The study is based on secondary sources which incudes academic articles, Reports from environmental organizations and government publications. It emphasizes a multi-disciplinary approach to provide a holistic view of sustainable tourism. Econometric models can be employed to explore the relationships between various factors affecting sustainable tourism.

Simple econometric model where Sustainable Development in Tourism (SDT) is influenced by economic growth (EG) and environmental responsibility (ER):

$SDT=\beta0+\beta1\cdot EG+\beta2\cdot ER+ \varepsilon$

- SDT is the dependent variable representing the level of sustainable development in tourism.
- EG is the independent variable representing economic growth.
- ER is the independent variable representing environmental responsibility.
- $\beta0$ is the intercept term
- $\beta0$ & $\beta1$ are the coefficients of the respective independent variables.
- $\varepsilon$ is the error term, representing unobserved factors.

**Model Interpretation**

- $\beta0$ Represents the level of sustainable development in tourism when both economic growth and environmental responsibility are zero.
- $\beta1$indicates the change in sustainable development in tourism for a one-unit change in economic growth, holding other variables constant.
- $\beta2$ indicates the change in sustainable development in tourism for a one-unit change in environmental responsibility, holding other variables constant.



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β1is positive and statistically significant, it implies that an increase in economic growth is associated with a positive change in sustainable development in tourism.

β2 is positive and statistically significant, it implies that an increase in environmental responsibility is associated with a positive change in sustainable development in tourism.

**Findings**

- Environmental Impact: Tourism growth often leads to environmental degradation, affecting ecosystems, biodiversity, and natural resources.
- Sustainable tourism principles, including the triple bottom line approach (economic, social, environmental), are crucial for achieving a balance between growth and responsibility.
- Environmental Initiatives: Green infrastructure and conservation partnerships are effective tools in mitigating the negative environmental impacts of tourism.
- Policy and Regulation: Strong government interventions and certification programs play a pivotal role in guiding the industry towards sustainable practices.
- Community Involvement: Community-based tourism and stakeholder engagement are instrumental in ensuring that local communities benefit from tourism and have a say in its development.

**Environmental Impact**

**Resource Depletion**

Tourism often puts pressure on local resources such as water, energy, and land. Overuse or mismanagement of these resources can lead to depletion and environmental degradation.

**Pollution**

Tourism activities can contribute to pollution, including air and water pollution. Increased traffic, waste generation, and improper disposal of pollutants can harm ecosystems and wildlife.

**Habitat Destruction**

The development of tourism infrastructure, such as hotels and resorts, may lead to habitat destruction and fragmentation. This can threaten local biodiversity and disrupt ecosystems.

**Climate Change:**

Transportation, particularly air travel, is a major contributor to greenhouse gas emissions. Tourism-related transportation can contribute to climate change, affecting weather patterns and ecosystems.



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**Land Use Change**

Rapid tourism development can lead to changes in land use, such as the conversion of natural landscapes into urbanized areas. This alters the visual appeal and natural beauty of destinations.

**Cultural Heritage Impact**

Uncontrolled tourism growth can lead to the degradation of cultural and historical sites, impacting the authenticity and integrity of these locations.

**Impact on Local Communities:**

**Economic Opportunities**

Tourism growth can provide economic opportunities for local communities by creating jobs, generating income, and fostering entrepreneurship. However, the benefits are not always distributed evenly, and there may be issues of income inequality.

**Cultural Impacts**

Increased tourism can lead to changes in local cultures and traditions. This may include the commodification of cultural practices for tourist consumption, potentially diluting the authenticity of local traditions.

**Social and Behavioral Changes**

The influx of tourists can sometimes lead to social and behavioral changes within local communities. This may include shifts in values, lifestyles, and social dynamics.

**Infrastructure Strain**

Tourism growth can strain local infrastructure, including transportation, sanitation, and healthcare. Local residents may experience increased congestion and pressure on public services.

**Gentrification**

In some cases, tourism growth can lead to gentrification, where rising property values and rents displace local residents. This can alter the social fabric of communities and lead to the loss of cultural diversity.

**Land Disputes and Displacement**:

The development of tourism infrastructure may result in land disputes and displacement of local communities. This is particularly true when projects involve the construction of hotels or resorts on traditionally owned lands.



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**Crisis Vulnerability:**

Dependency on tourism as a primary source of income can make communities vulnerable to economic downturns, natural disasters, or global crises, as witnessed during events like the COVID-19 pandemic.

Environmental initiatives within the tourism sector are actions and programs aimed at minimizing the negative environmental impacts of tourism activities while promoting conservation and sustainable practices. These initiatives are crucial for preserving natural resources, protecting ecosystems, and mitigating climate change. Policies and regulations play a crucial role in promoting sustainable tourism by providing a framework for managing the environmental, social, and economic impacts of tourism activities The effective policies and regulations create a legal and regulatory framework that guides the tourism industry toward sustainability, balancing economic benefits with environmental and social responsibility. Implementation, enforcement, and periodic evaluation are essential to ensure the ongoing effectiveness of these policies in promoting sustainable tourism.

To address these challenges and promote sustainable tourism, it is essential to implement responsible tourism practices, engage local communities in decision-making processes, and establish effective policies and regulations. Sustainable tourism seeks to balance the economic benefits of tourism with the preservation of cultural heritage and environmental integrity, ensuring that tourism contributes positively to both the destination and the local communities.

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# ANTI- BRITISH STRUGGLES IN THE NORTHERN PARTS OF VALLUVANAD TALUK DURING 1921 - 22: STUDY OF A FEW CASES

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**ABSTRACT**

The period from 1836 to 1922 Malabar witnessed to unprecedented resistance and struggles against the British colonial State and their Jenmi Raj supporters - The chief organisers of these struggles and confrontations were mainly the Muslims of Malabar, better known as Mappilas - These struggles and confrontations were come to be known as 'Malabar Rebellions' or in the British records as the 'Mappila Outbreaks' or 'outrages' and 'atrocities' of the Moplah/Mappila fanatics or 'jungle Moplahs'. All the studies and writings were mainly focussed on the socio-religious and political reasons and course of the Rebellions. - there are only a few studies about the leaders who actively organised these struggles at the local. - There is no major micro level study on the uprisings and confrontations in the northern parts of erstwhile Valluvanad Taluk also. - the present paper makes an attempt to trace and explain the history of the local level anti-British struggles in the localities like Pandikkad, Melattur and Vettathur of the erstwhile Valluvanad Taluk.

KEY WORDS: British Colonialism, Mappilas, National Movement, Khilafat Movement, Malabar Rebellion, Pandikkad War etc.

"It was largely Mappilas who carried on the fight against the Portuguese, Dutch and British, and the history of Malayali Muslims from the second decade of the sixteenth century is largely a history of that indigenous Muslim community".[1]

## Introduction

During the British Colonial rule in India, Malabar - situated in the northern part of modern Kerala - had witnessed and showed unprecedented resistance and struggles against the British colonial State and their *Jenmi* Raj supporters from 1836 to 1922. The chief organisers of these struggles and confrontations were mainly the Muslims of Malabar, better known as Mappilas,[2] and therefore these struggles and confrontations were come to be known as 'Malabar Rebellions' or in the British records as the 'Mappila Outbreaks' or 'outrages' and 'atrocities' of the Moplah/Mappila fanatics or 'jungle Moplahs'.[3] These resistances had been a topic of lively interest as well as of bitter controversy even since its outbreaks. But from the beginning every attempt to examine and explain these had to face the fact that it was an extremely complex episode, which could not be



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viewed from a single viewpoint, but have to be analysed in detail. Moreover, when a number of contradictory reports, statements and declarations came out, it became more inextricable and intricate one. Even though, a lot of studies, reports and writings on these struggles were made by scholars like D. N Dhanagare, Saumyendranath Tagore, A. R Desai, K.N. Panikkar, M. Gangadhara Menon, K. Madhavan Nair, C. Gopalan Nair and so on. While the British colonial officials and writers like, William Logan, Conrad Wood, Robert L. Hardgrave, Stephen F. Dale, and the like have also expressed their divergent views and opinions regarding its cause, nature and course.

Indeed, all these studies and writings were mainly focussed on the socio-religious and political reasons and course of the confrontations and struggles. Unfortunately, there are only a few studies about the leaders who actively organised these struggles at the local level. For instance, the two studies of K. K.M Abdul Karim *1921le Khilaphat Lahalayum Ali Musliyarum* (Malayalam) and *Variankunnath Kunhahamed Haji: Malabar Kalapam 1921- Smaranakalum Padanangalum* (Malayalam). Likewise, there is no major micro level studies on the uprisings and confrontations in and around of Pandikkad, Melattur and Vettathur[4], also. In this backdrop the present paper makes an attempt to trace and explain the history of the local level anti-British struggles in and around of Pandikkad, Melattur and Vettathur region of Northern Valluvanad in the South Malabar under the leadership of local leaders like Chembrasseri Thangal, Karadan Musliyar and so on. But at the same time, historians indicate that the leadership and participation of Hindu sects was active in these struggles. According to historian K.N Panikkar, there were such continuous struggles and uprisings in Malabar from 1836 to 1921. Due to the constant occurrence of such fighting in Malabar, the British records show Eranad, Valluvanad region as the centre of religious fanaticism and the 'Ireland' of the Madras province.[5]

It is very clear that the struggles of 1921-22 in and around Eranad, Valluvanad and Ponnani taluks were not mere riots by the Mappila Muslims of these taluks as claimed by the British, Fascists and some narrow-minded historians.[6] Instead, these were heroic resistances and struggles of the tenants and agricultural Muslim and lower-class Hindu labourers of Eranad, Valluvanad, Kozhikode, Ponnani Taluks, Kurubranad of Wayanad in the Malabar district, and Gudalur of Nilgiris district. This reality accurately indicates the individuality and breadth of the struggles of 1921-22.[7] The success of any people's struggle is defined and determined by the unity and resistance at the local level. Therefore, the history of the anti-British, and freedom struggles in Malabar in 1921-22 was also the history of each locality and its leaders, which participated in the struggle.



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**What Happened at Pandikkad in 1921 – 22?**

In 1921 Pandikkad was one of the famous markets (*Chanda*) in the border of Valluvanad and Ernad taluks. It was an *Amsam* and around 18 KM away from the capital of Valluvanad Angadipuram. Very after the Tirurangadi developments of 20th August 1921, at Pandikkad, in the early morning of August 21 a rumour spread that the Mambram Mosque was demolished by the British military troops and in the subsequent fighting between the Muslims and the military several officers were killed, including the District Magistrate, District Superintendent of Police and Deputy Superintendent of Police, Amu Sahib.[8] Then the Muslims were found together in small groups discussing this matter. In the afternoon the arms and ammunitions at Pandikkad Police Station were sent to Manjeri under the orders from the Circle Inspector of Manjeri. These were sent in a cart in charge of a Police Head-Constable and seven Constables. But within a short distance from Pandikkad this party was attacked by a gang of Muslims numbering about fifty, led by Variankunnath Kunhahamed Haji and some others. The gang overpowered the Constables and carried away the entire arms and ammunitions. Shortly afterwards the Muslims numbering about a hundred attacked the Pandikkad Police Station.[9] With this, troubles broke out at Pandikkad and surrounding areas.

The rebels rose up in Rebellion in Pandikkad under Chembrasseri Thangal. They set fire to the Police Station, Travellers Bungalow, '*Amsakkacheri*' and Post Office and demolished other Government buildings. M. Gangadhara Menon writes that the rebels looted the Police Station and Police lines and all records were destroyed. The Mappilas of Pandikkad bazaar joined together in looting and chanting '*Thakbir*'. Then all of them proceeded to Valluvangad and demolished the bridge there on the road to the west. Later, looting of Hindu lords' houses by the gangs of Mappilas started in and around Pandikkad *Amsam*. At about 8.00 PM on the day about 3000 Mappilas gathered in a Juma Mosque at Pandikkad under Variankunnath Kunhammed Haji and Chembrasseri Thangal. At this stage the *Adhikari* of Pandikkad named Kodalayil Moosa Haji joined the rebels along with four Police Constables, all were Eranad Mappilas.[10]

The British Civil Servant and Superintendent of Malabar Special Police (MSP), Hitchcock notes about this development that the meeting of Mappilas on the night of 21st August 1921was held in the Pandikkad Mosque, which was attended by Variankunnath Kunhahamed Haji and Chembrasseri Thangal. The meeting took some crucial decisions to organise the struggle. It also appointed Chembrasseri Thangal as the ruler of Chembrasseri, Karuvarakund, Melattur and Kalikavu. Variankunnath Kunhahamed Haji to govern the areas of Nellikuth and Valluvangad. Kodalayil Moosa Haji, the *Adhikari* of Pandikkad who had just joined the rebels, was to be the ruler of Pandikkad itself.[11] Very after the Pandikkad events, the struggle spread to the other areas. Tottenham reported that on 22nd August 1921 Chembrasseri Tangal started rebellion in



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Mannarkkad; the Elaya Nayar and other Hindus certainly took some part in the outbreak. A week late Chembrasseri Tangal made a second visit to Mannarkkad and appointed Sithi Koya Thangal as the leader of Mannarkkad.[12] The Police Station at Melattur was attacked and the Muslim Sub-Inspector there was caught and cut with a sword by the rebels. But his life was spared due to the intervention of a local leader among the mob. Later even the persons who gave shelter to the Sub-Inspector were threatened by the rebels and had to escape to Shornur.[13] Thus the struggle further spread to more and more places under the leadership of Chembrasseri Thangal.

When situation became very critical and out of control, the British authority decided to bring in more troops to deal with the rebels. However, the arrivals of Battalions of Gurkhas Add Chin and Kachin (Burmese) accustomed to jungle warfare did not immediately lead to any remarkable success against the rebels. Two companies of Gurkhas and one company of Seffolks, stationed at Perithalmanna and Mannarkkad respectively, were given the definite objective of 'crushing the rebels under the Thangal'. But they failed to bring about any big engagement. Chembrasseri Thangal and his men successfully avoided any direct engagements with the troops. It was only when more reinforcements in the form of another battalion of Gurkhas and a battalion of Gurwalis arrived in the first week of November, and started action along with the only newly raised Special Armed police, that the policy of keeping the rebels to the hills and making it difficulty for them to get food, began to yield results. It was at this stage that these were persistent rumours of rebel concentration in the Chembrasseri areas and of rebel intentions to make a big attack on one or other of the military posts[14].

These developments culminated in the attack on the 2/8 Ghurkha Camp at Pandikkad on 14th November 1921. On the day morning at 5.00 AM a body of Muslims 2000in number under the leadership of Variankunnath Kunhahamed Haji and Chembrasseri Thangal took the Gurkhas by surprise and attacked the camp by pushing down the walls of the shanty. The rebels penetrated into the camp and all of them were killed in hand fight and the rest were beaten back with the loss of 230 lives and many being wounded.[15] The leaders escaped. These encounters were watching by the rebel leaders Variankunnath Kunhahamed Haji and Chembrasseri Thangal from a distance. According to the records these inspired the rebels with false confident to the effect that the guns of the military would not effective on attack because of the presents and blessings of the Thangals. With this belief the rebels attacked the military. In the midst of the attack the Post Master of Pandikkad was hacked to pieces and Sub-Inspector Ahammedkkuty s/o late Inspector Khan Bahadur Chekkutty was seriously wounded. Among the Gurkhas, one officer and thirty-four other ranks were wounded. Subsequently the officer and three of the men expired.[16]

After this there was a gap for attacks and encounters between the rebels and the British forces. However, on 1st December 1921 the Gurkhas unit at Melattur received a letter purporting to



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come from Chembrasseri Thangal. It is said that the rebels were forced to fight in the face of insult to their religion and race, and enumerated eight different charges against the British authorities including killing of women and children. It also said that the fighting shall be stopped the troops were withdrawn and Gandhi and Muhammed Ali brought in for arbitration. To the regret of the higher officers, the Commander of the Gurkhas unit at Melattur sent an argumentative replay to this letter. In which the Government insisted that the rebels should be unconditionally surrendered.[17]

Thus, in the first week of December 1921, a large number of rebels were surrendered. M. Gangadhara Menon writes that perhaps this was the result of the failure of the venture to visit the Mambram shrine and to take the final stand. Early in December the British authorities got the information that Chembrasseri Thangal was sounding 'the Malappuram Thangal (who remained loyal to the British) to find out what will be done with him if he surrenders'.[18] On 07th December 1921 Kumaramputhur Seethikoya Thangal sent a letter to the Gurkhas camp at Mannarkkad expressing repentance and readiness to surrender with all his men and arms if the Government would promise them a free pardon. From such feelers it was evident that at least some of the rebels, including Chembrasseri Thangal, were willing to surrender in case they were given some assurance that their life would be spared. It would appear that this tendency on the part of the rebel leaders was cleverly worked up by some Police officers though some of the rebels who surrendered, and through the relatives of the leaders, even using for this purpose some influential members of the Mappila Community. Most probably such tactics made Amakundan Alias, Kozhisseri Muhammed, the right-hand man of Chembrasseri Thangal, to appear before a Police Sub-Inspector attached to the Gurkhas Camp at Melattur on 17 December 1921.

The continuous pressure exerted by the military troops and the authorities compelled Chembrasseri Thangal, Seethikoya Thangal and followers to withdraw into the mountains. But there they were blocked by the 2/8th and 2/9th Rifles. As a result, Chembrasseri Thangal surrendered to the 2/8th Gurkhas Rifles on 19th December and Seethikoya Thangal to the 2/9th Rifles on December 20, 1921[19]. Both of them and others were taken to the Gurkhas camp at Melattur. Finally on 9th January 1922 Chembrasseri Thangal and Amakundan Muhammed, the close follower and right hand of Chembrasseri Thangal, were tried by court martial. According to the Crime Records at Pandikkad Police Station Chembrasseri Thangal was shot by the British judiciary[20]. Thus, the British took the full control of Pandikkad.

**Melattur In 1921-22**

In 1921, Melattur was the eleventh sub-division, twentieth *Amsam* and 116th *Desam* of Valluvanad, the biggest taluk of Malabar district. It was a small market, situated at 11.068381 Latitude, 76.268188 Longitude and 19 km north from Angadipuram, the capital of



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Valluvanad taluk.[21] R. H. Hitchcock describes Melattur as a region in the heartland of the insurgency comprising eastern Eranad and north-eastern Valluvanad.[22] Geographically Melattur is located on the north and right above side of river Velliyaar. The official web portal of Melattur Village Office is also showing similar kind of story.[23]

With the developments of August 20, 1921 in Tirurangadi, which started at a rapid pace, the struggle soon reflected in Melattur also. Hitchcock notes that on the night of August 21, 1921 a meeting was held in the Juma Masjid in Pandikkad, in which the Muslims of Melattur also participated. In the said meeting, Chembrasseri Thangal was elected as the leader of the areas like Melattur, Tuvvur, Pandikkad, etc.[24] Thus, Melattur became part of the anti-British struggles. From August 21onwards to at least mid-of October, Valluvanad western areas from Mannarkkad to Melattur were completely under the control of Chembrasseri Thangal. During the period, Pulvetta a nearby place to Melattur was the headquarters for fighting in the outlying areas. Thus, in this land, more than five thousand warriors fought vigorously against the British. Consequently, the British established a military centre or Gurkha camp at Melattur for the purpose of waging war against the fighters.[25] As a result, the anti-British struggles cantered in Melattur became a bloodbath. Madhavan Nair wrote that the Police Station at Melattur was attacked and the Muslim Sub-Inspector there was caught and cut with a sword by the rebels. But his life was spared due to the intervention of a local leader among the mob. Later even the persons who gave shelter to the Sub-Inspector were threatened by the rebels and had to escape to Shornur.[26]

Historian M Gangadharan writes by quoting GRF Tottenham that On August 28, 1921, the Melattur rioters along with the rebels of Karuvarakund moved towards Angadipuram, and demanded that the arms seized on August 22 from Perinthalmanna be handed over to them, but they were not given. As a result, they looted the shops of the *Bajar* (Bazar) and set fire to the taluk office.[27] Subsequently, in the beginning of September 1921, one pf the local leaders of Melattur named Manu Haji murdered Chaliyathodi Unnian Kutty, who was a loyal Mappila and had helped the Melattur Sub-Inspector against the rebels. Then on 15th September E. V Amu sahib sent two Nair spies to Melattur for verifying the developments of the locality. But they were returned with severe injuries because, according to Hitchcock, they walked unexpectedly into a mob over 100 strong at Chemmaniyode, and they were beaten with the butts of guns.[28]

After this, on the basis of the news of rebel attacks on refugees, on 26th September Amu Sahib went out with troops to Melattur, but saw no rebels, though a bomb and some implements used for breaking the culvert were picked up.[29] The on September 28, the leaders like Chembrasseri Thangal and Kumaramputhur Seethikoya Thangal gathered at Melattur and discussed the further strategies of the struggle. In the meeting, leadership of the struggle in Mannarkkad area was given to Seethikoya Thangal.[30] The presence of Chembrasseri Thangal in and around Melattur, and the



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constant passing of Variankunnath Kunhammed haji's force through the locality gave a fighting spirit to the fighters of Melattur. Their local leader was Ambalavan Mammad, who kept the momentum of the fights. These developments were noted by Hitchcock in his report.[31] In the meantime, on October 16, 1921, a fierce encounter took place between the militants and the British forces at the Perinthalmanna Melattur Road. In which 14 Muslims were killed by the British force. Another big incident that happened at Melattur after this was that on October 26, about fifteen Hindus, who were working for the army, were killed by the fighters.[32] This argument of GRF Tottenham is also supported by A. P Ibrahim Kunju in his writing on the Muslims of Kerala.[33]

When the reports from Melattur became a serious headache, the authorities deployed the 2/8$^{Th}$ Regiment of Gurkhas to Melattur. Accordingly on 25$^{th}$ October 1921 the Gurkhas marched Melattur and stationed there. In the meantime, the army found that 11 Hindus, including one Nair woman rendering help to the rebels. Hitchcock believed that it was because of the fact that the only way by which they could remain there.[34] Here one fact is clear that, Hitchcock deliberately neglected and belittled the anti-British stand and support to Non-Cooperation and Khilafat movement by the Hindus of Melattur. Instead, he tried to see and report things as Muslim fanatism. Two days after this on 27$^{th}$ October Muslim women folk of Melattur left to Velliyancheri to take advice from Chembrasseri Thangal, but not finding him returned to their homes. The next big incident related to Melattur is said to have happened on 14 November 1921. On the day, Hitchcock notes that fighters from Melattur also took part in the2/8th Gurkha camp attack in Pandikkad.[35]

By the month of December, the fighting started to cool down in Melattur. The main reason for that was the strong retaliation and brutalities unleashed by the British forces. At the beginning of December 1921 fighting in and around Melattur began to fade. C. Gopalan Nair reports that the surrender of the fighters took place at the beginning of December 1921. On 3, 5, 6, 7 and 9 December mass surrender took place in Melattur. Thus, by December 10, 3777 fighters, 10 guns, 1505 swords, and innumerable number of knives were surrendered.[36] According to Hitchcock, in the first half of December, 5028 Mappilas came in and produced 36 guns and 2352 war knives and choppers. The surrendered rebels were sent to bring others.[37]

Meanwhile on December 19 Chembrasseri Thangal was arrested from Vettathur and brought him to the Melattur Gurkha camp. After a mockery trial, on 9$^{th}$ January 1922 he was court martialled by the British authorities in the camp.[38] While M. Ishaq writes that on 20$^{th}$ December 1921 Chembrasseri Thangal was arrested at Velliyancheri by the Melattur Sub Inspector of Police P Ramanadha Ayyer by giving a cheating offer of deporting him to Mecca. After the namesake trial at the Gurkha camp in Melattur Chembrasseri Thangal was taken to Malappuram Kottakkunnu, and on 20$^{th}$ January 1922 he was Court martialled by the British.[39] Since then, there was no serious encounter in Melattur. Gradually, the British brought Melattur under their full control.



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**Vettathur During 1921 - 22**

Vettathur was 122nd Desam of Valluvanad Taluk, and it was 15 KM away from the Valluvanad capital Angadipuram. Very after the outbreak of Malabar struggle with the Tirurangadi incidents of 20th August 1921 Saturday, a meeting of more than 1000 people was held in the Pandikkad Mosque on the night of 21st August 1921. Karadan Muhammed Musliyar, highly influential local leader of Vettathur region, too participated in the meeting. The British Civil Servant and Superintendent of Malabar Special Police (MSP), Hitchcock notes that the meeting of Mappilas on the night of 21st August 1921was held in the Pandikkad Mosque attended by Variankunnath Kunhahamed Haji and Chembrasseri Thangal. The meeting took some crucial decisions to organise the struggle. It also appointed Chembrasseri Thangal as the ruler of Chembrasseri, Karuvarakund, Melattur and Kalikavu. Variankunnath Kunhahamed Haji to govern the areas of Nellikuth and Valluvangad. Kodalayil Moosa Haji, the *Adhikari* of Pandikkad who had just joined the rebels, was to be the ruler of Pandikkad itself.[40] Within days after the Pandikkad events, the struggle spread to the other areas including Vettathur- Kappu. People in and around Melattur gathered and attacked the Police Station at Melattur and the Muslim Sub-Inspector there was caught and cut with a sword by the rebels. But his life was spared due to the intervention of a local leader among the mob.[41]

When the struggle became stronger and wider in and around Vettathur – Kappu area, the British authorities and their supporters of the area began to take actions, including physical assaults and arrests. They even conspired with pro-British supporters, and used the anti-social elements to destruct the struggles. These anti-social elements entered into the groups of the fighters and committed robberies, attacks, molestations, atrocities etc… and tried their level best to create division between the Hindus and Muslims of the area.[42] These atrocities were ascribed on the fighters and gave information about the movements and plan of the freedom fighters. These developments created much predicaments and headache to Karadan Musliyar and sometime he even lost the control over the fighters.[43] At the same time, the British authorities and their local supporters, including elites of the area unleashed terror upon the family members of the fighters. They molested women folk of the fighters, set flame to homes, confiscated properties etc. Local people became frightened and infuriated.

In this critical juncture, like the other leaders of the anti-British struggle in Malabar, Karadan Musliyar and his gang adopted guerilla war strategy by withdrawing to the mountains and forests like Vettathur Thekkanmala and Amminikkadan Mala. They continued the fight from their hiding spots, which created much panic and lose to the British and their supporters.[44] The then Under Secretary, G. R. F Tottenham recognised it when he reported that 'the rebels soon split up into different gangs and adopted guerilla method of warfare, and, helped as they were by their



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superior mobility and the enclosed nature of the country presented a military problem and difficulty'.[45] Though, with the entry of 2/8th and 2/9th Battalions of the Gurkha Rifles situation began to change, and it became more hard and tough to the fighters. As a result, Karadan Musliyar and his companions compelled to escape from the locality. Karadan Musliyar and a few could escape from Malabar to other places. Most of the rest were arrested and deported to Andaman, after a mock trial. A few were sent to Bellari Jail for life time imprisonment. Karadan Musliyar and a few members of his band escaped incognito through the forest, first to Thuvaranguruchi in Tamil Nadu. With this anti-British struggle in and around Vettathur came to an end and the British brought it under their tight grip.

**Conclusion**

It is very vivid that, in the midst of the anti-British and freedom struggle in the South Malabar region in 1921 – 22 local level struggles had great impacts. The struggles in Pandikkad, Melattur and Vettathur were also the heroic and adventurous chapters of resistances and confrontations against the British imperialist State and the Lords in Eranad and Valluvanad taluks. With the arrest, execution and escape of leaders the heroic and adventurous chapters of struggle against the British Raj and the Lords came to an end. In short, the history of the anti-British, and freedom struggle in Malabar in 1921-22 was also the history of each locality and its leaders.

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# PHYTOCHEMICAL SCREENING AND ANTIDIABETIC ACTIVITY OF METHANOLIC LEAF EXTRACT FROM *Kigelia africana* (Lam.) Benth.

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## ABSTRACT

Diabetes mellitus represents a complex array of disorders that disrupt the metabolism of carbohydrates, fats, and proteins, posing significant health challenges. In the pursuit of alternative treatments, plant-based medicaments have gained prominence for addressing various human ailments. This study centred on *Kigelia africana*, a plant from the Bignoniaceae family and collected from the Calicut University Botanical Garden with official approval. The main objective of the present investigation included uncover the phytochemical composition of *Kigelia africana* leaves and evaluate their potential antidiabetic properties. Utilizing methanol as the primary solvent for cold extraction, the preliminary analysis revealed the presence of essential metabolites such as carbohydrates, proteins, and amino acids, with the absence of sterols. Alkaloids, flavonoids, steroids, terpenoids, saponins, phenols, cardiac glycosides, and tannins were shown to be secondary metabolites. An alpha-amylase inhibition experiment was used to assess the anti-diabetic qualities at three different concentrations. The most striking result was a 23.3% inhibition at 200 ml. This result point to a potential function for *Kigelia africana* in the treatment of diabetes.

**Keywords**- *Kigelia Africana,* Phytochemical analysis, Methanol, Cold extraction process, Anti-diabetic properties

## Introduction:

Diabetic mellitus is a complex and a diverse group of disorders that disturbs the metabolism of carbohydrates, fat and protein.[1] The use of herbal medicines for the treatment of diabetes mellitus has gained importance throughout the world and there is an increased demand to use natural products with anti-diabetic activity due to the side effects associated with the use of insulin and oral hypoglycemic agents. [2]



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*Kigelia* is a genus of flowering plants in the family Bignoniaceae. The genus comprises only one species, *Kigelia africana*, which occurs throughout tropical Africa from Eritrea and Chad south to northern South Africa, and west to Senegal and Namibia. The genus name comes from the Mozambican Bantu name, kigeli-keia, while the common name Sausage Tree refers to the long, sausage-like fruit. Its name in Afrikaans Worsboom also means Sausage Tree, and its Arabic name means "the father of kit bags".[3] The *K. africana* plant has many medicinal properties due to the presence of numerous secondary metabolites. So, the current investigation has been focused on preliminary analysis and anti-diabetic property from methanolic leaf extract of *Kigelia africana.*

**Material and Methods: Plant collection:**

The leaves were collected from the Calicut university botanical garden with special permission. The authenticity of the plant was carried out by Dr. Asma V.M, Associate Professor, Research & P G Department of Botany, MES Asmabi College, P. Vemballur, Kodungallur, Thrissur (Plate 1).

Plate 1: Morphology of the Plant- *Kigelia Africana*

**Extraction procedure:** The leaves were shade dried and grinded in homogenizer in to coarse powder. The samples were extracted using the solvent methanol. For the preparation of extract the 20 g of plant powder were dissolved in 200 ml of methanolic solvent. Then it was kept in shaker for 48 hrs to shake well for uniform mixing. The content of flask were filtered through four layers of muslin cloth. The extract obtained was stored under refrigerator and used for further analysis.

**Preliminary phytochemical analysis:** The leaf extract of the plant Kigelia Africana underwent analysis to detect a range of components, including flavonoids, steroids, cardiac glycosides, alkaloids, phenols, proteins, carbohydrates, amino acids, saponins, sterols, and tannins. This assessment was conducted using established and standardized procedures to identify and quantify the diverse constituents present in the plant.[4]

**Carbohydrates:** About 0.5 ml of the filtrate was taken to which 0.5 ml of Benedict's reagent is added. This mixture was heated for about 2 minutes in a boiling water bath. The appearance of red precipitate indicates the presence of sugars.



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**Proteins:** Add 4% NaOH and few drops of 1% CuSO4 solution to 3 ml of the extract. Formation of violet or pink colour indicates the presence of proteins.

**Aminoacids:** To the extract add 0.25% Ninhydrin reagent and boil for a few minutes. Formation of blue colour indicates the presence of aminoacid.

**Alkaloids:** Methanolic extract was warmed with 2% H2SO4 for 2 minuts . It is filtered and a few drops of dragendroff's reagent were added and the red precipitate indicates the presence of alkaloids.

**Flavonoids:** A portion of crude powder was heated with 10 ml of ethyl acetate over a steam bath for 3 minutes. The mixture was filtered and 4 ml of the filtrate was shaken with 1 ml of dilute ammonia solution. The presence of flavonoid is indicated by a yellow colouration.

**Steroids:** 0.5 g of crude powder was dissolved in 5 ml of methanol. 1 ml of the extract was treated with 0.5 ml of acetic acid anhydride and cooled in ice . This was mixed with 0.5 ml of chloroform and 1 ml of concentrated sulphuric acid was then added carefully by means of a pipette. At the separate level of the two liquids, a reddish- brown ring was formed as an indication of the presence of steroids.

**Sterols:** The extract was mixed with 2 ml of chloroform and concentrated $H_2SO_4$ (3 ml) is carefully added to form a layer.Shake well and allow to stand for some times . Red colour appears in lower layer as the indication of the presence of sterol but if it not there indicated absence of sterol.

**Terpenoids:** The extract was mixed with 2 ml of chloroform and concentrated $H_2SO_4$ (3 ml) is carefully added to form a layer. A reddish-brown coloration of the interface is formed indicate the presence of terpenoids.

**Saponins:** 0.5 mg of extract was vigorously shaken with few ml of distilled water. The formation of frothing is positive for saponins.

**Phenols:** Add 2 ml of test solution in alcohol is added with 1 drop of neutral ferric chloride (5%) solution . Formation of an intense blue color indicates the presence of phenols.

**Cardiac glycosides:** 5 ml of each methanolic extract was mixed with 2 ml of glacial acetic acid containing one drop of ferric chloride solution (FeCl3) followed by the addition of 1 ml concentrated sulfuric acid.Brown ring was formed at the interface which indicate the presence of deoxysugar of cardenolides. A violet ring may appear beneath the brown ring . While in the acetic acid layer, a greenish ring may also form just gradually through out the layer, indicate the presence of cardiac glycosides.

**Tannins:** About 0.5g of the extract was boiled in 10 ml of water in a test tube and then filtered. A few drops of 0.1% ferric chloride was added and observed for brownish green or blue-black colouration indicates positive test for tannins.



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**Enzyme inhibitory effects of *Kigelia africana* extract.**

**Alpha-amylase inhibition assay:** The investigation into α-amylase inhibitors in *Kigelia africana* adhered to the specified research protocols.5 1000µL of starch solution was mixed with 1000 µL of α-amylase enzyme (purchased from Hi Media) in 5 test tubes. 10, 20, 50 and 100µL of extract were added to 4 test tubes (Test samples) and one without extract was kept as control. All the test tubes were incubated for 3 minutes. After incubation 500µL of 96mM DNS reagent (0.438g in 20mL distilled water) was added to all the test tubes and kept in incubation for 15minutes. Then solutions in each test tube were made up to 6ml with distilled water.Optical density of these samples was measured at 540nm. Then a set of another 4 test tubes were prepared with 4 different concentrations of the sample (10, 20, 50 and 100µL). All test tubes were made up to 8mL with distilled water and labeled as extract control. Blank was prepared with 1000µL starch and 500µL DNS reagent. These samples are also made up to 6ml with distilled water. Optical density of the samples was measured at 540nm.

Inhibition of enzyme activity was calculated as;

**Inhibition of enzyme activity(%)** = AC 540 – AT 54 x 100

where , AC= Absorbance of control

AT= Final absorbance of Test sample

AT= Absorbance of test sample – Absorbance of extract control

**Results: Preliminary phytochemical screening:** The analysis of methanol leaf extract from *Kigelia africana* unveiled the presence of a variety of significant phytochemicals, including alkaloids, tannins, glycosides, phenolic compounds, and others. The detailed findings are presented in Table 1.

**Inhibitory activities of *Kigelia africana* leaf extract on α-amylase:** The results of the alpha-amylase inhibition assay for methanolic extracts of *Kigelia africana* leaves are presented in Table No.2 & Fig.1. At a concentration of 50 ml, the alpha-amylase inhibition percentage is recorded at 6.66%, which increases to 13.33% at 100 ml, and significantly rises to 23.33% at 200 ml of the sample. This indicates a notable increase in alpha-amylase inhibition with higher concentrations of the solution. Additionally, the optical density of the sample solution shows a decreasing trend from 0.028 at a low concentration (50 ml) to 0.023 at a high concentration (200 ml). The data suggests a correlation between concentration and both alpha-amylase inhibition percentage and optical density, emphasizing the potential effectiveness of *Kigelia africana* leaf extracts in inhibiting alpha-amylase activity.



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Table: 1. Preliminary phytochemical analysis from methanolic leaf extract of *Kigelia africana*

| SL.NO. | TEST | RESULT |
|---|---|---|
| 1 | Carbohydrates | + |
| 2 | Proteins | + |
| 3 | Amino acids | + |
| 4 | Alkaloids | + |
| 5 | Flavonoids | + |
| 6 | Sterols | - |
| 7 | Steroids | + |
| 8 | Terpenoids | + |
| 9 | Saponin | + |
| 10 | Phenol | + |
| 11 | Cardiac glycosides | + |
| 12 | Tannins | + |

+ indicates the presence of the compound, -indicates the absence of the compound

**Table: 2. Inhibitory effect of α- amylase by *Kigelia africana* leaf extract at various concentrations**

| Concentration(µl) | OD of Test | OD of control | % of Inhibition |
|---|---|---|---|
| **50** | 0.028 | 0.03 | 6.66 |
| **100** | 0.026 | 0.03 | 13.33 |
| **200** | 0.023 | 0.03 | 23.33 |



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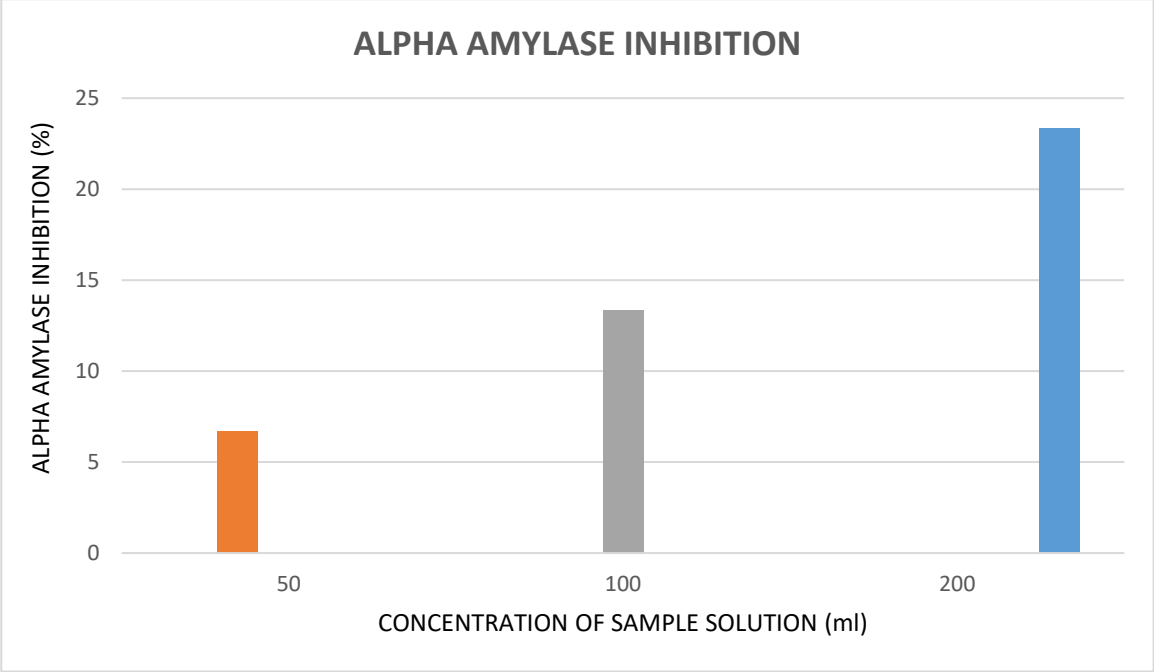


**Fig: 1 Inhibitory effect of α- amylase by *Kigelia africana* leaf extract at various concentrations**

**Discussion:**

The results obtained in this study suggest that the leaf extract of *Kigelia africana* harbor a diverse array of phytochemicals, playing a role, either directly or indirectly, in influencing the biological activity of the extracts. Preliminary phytochemical analysis involved the application of various tests to examine the composition of the leaf extract of *Kigelia africana*. The screening revealed the presence of both primary and secondary metabolites. Primary metabolites, essential for cellular growth and function maintenance, encompass carbohydrates, proteins, and amino acids. These metabolites typically carry out vital physiological functions in organisms. On the other hand, secondary metabolites, which act as defence chemicals in plants, do not adversely impact plant health when absent. The study identified carbohydrate, protein, and amino acids as the primary metabolites. Interestingly, sterol was the sole secondary metabolite absent in the *Kigelia africana* leaf extract. Conversely, alkaloids, flavonoids, steroids, terpenoids, saponins, phenols, cardiac glycosides, and tannins were among the secondary metabolites identified in the extract.

The methanolic extract of *Kigelia africana* leaves showed a trend in alpha-amylase inhibition percentages across concentrations (6.66% at 50 ml, 13.33% at 100 ml, and 23.33% at 200 ml) that indicates a positive correlation between sample solution concentration and alpha-amylase inhibitory activity. The inhibitory action on alpha-amylase increases with concentration, suggesting a possible dose-dependent connection. Furthermore, the measurements of optical density offer significant understanding of the behaviour of the sample solutions. The optical density is 0.028 at a low concentration (50 ml) and drops to 0.023 at a greater concentration (200 ml). The inverse relationship



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between concentration and optical density suggests that the optical density falls with increasing sample solution concentration.

Despite the availability of anti-diabetic medications on the market, medicinal herbs are often effective in the treatment of diabetes.[7] Herbal treatments and plant components with low toxicity and no side effects are notable treatment options for diabetes around the world. Nowadays, medicinal plants are used to treat diseases such as diabetes because they include phytoconstituents such as flavonoids, terpenoids, saponins, carotenoids, alkaloids, and glycosides, which may have anti-diabetic properties. Furthermore, the combined action of biologically active compounds (e.g., polyphenols, carotenoids, lignans, coumarins, glucosinolates, etc.) leads to the potential beneficial properties of each plant matrix, which can serve as a starting point for understanding their biological actions and beneficial activities.[6] pancreatic α-amylases hydrolyze the internal 1,4-glycosidic bond of starch to produce maltose and glucose.[8 &9].The World Health Organization (WHO) has substantiated the utilization of herbal remedies for the management of diabetes.[10]

The comprehensive analysis of *Kigelia africana* reveals the presence of all metabolites, excluding sterol. This observation suggests substantial anti-diabetic potential in the plant, indicating promising prospects for future diabetes treatments. Furthermore, the observed escalation in the plant's anti-diabetic efficacy with higher sample concentrations, as evidenced by the alpha-amylase assay, emphasizes the substantial promise of *Kigelia africana* in the domain of anti-diabetic therapies.

**Conclusions:**

The findings derived from the present study reveal a promising correlation between the methanolic leaf extract of *Kigelia africana* and its potential anti-diabetic properties. This suggests that the leaf extract from the *Kigelia africana* plant may serve as an effective treatment for certain manifestations of diabetic mellitus. The study's results emphasize the significant therapeutic potential embedded in the natural components of this plant, highlighting its role as a valuable resource in the development of alternative approaches for managing diabetes. Further research and exploration into the specific mechanisms underlying these anti-diabetic effects could provide deeper insights and contribute to the advancement of novel therapeutic interventions for diabetes.

**Acknowledgments:**

We extend our heartfelt appreciation to the Department of Botany at Calicut University for facilitating the collection of the plant, a crucial aspect of our research. Special gratitude is extended to Dr. Asma V M, Associate professor Research & PG Department of Botany at MES Asmabi College, P. Vemballur, Kodungallur, for her invaluable contribution in authenticating the plant, a



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pivotal step in ensuring the accuracy and reliability of our study. Additionally, we express our sincere thanks to UniBiosys Biotech Research Lab, Kochi, for their support and assistance in completing this work. Their expertise and collaboration have played a vital role in the successful execution of our research endeavors.

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# ELECTRICAL CHARACTERIZATION OF $MnSeO_4.2H_2O$ SINGLE CRYSTAL USING COMPLEX IMPEDANCE ANALYSIS

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**Abstract**

Single crystals of $MnSeO_4.2H_2O$ are grown by the method of slow evaporation at constant temperature. Light pink coloured crystals of $MnSeO_4.2H_2O$ having dimensions 40mm x 25mm x 10mm are grown with duration around 60 days. The electrical characterization of $MnSeO_4.2H_2O$ single crystal has been carried out with the help of complex impedance analysis. The semicircles observed in the Cole-Cole plots indicate a single relaxation process and can be modelled by an equivalent parallel RC circuit. The peaks of the semicircles are used for determining the relaxation times ($\tau$). The values of Cole-Cole parameters namely $R_b$, $C_b$ and $\tau$ are calculated and the presence of an ionic contribution to the electrical conductivity has been observed

**Keywords**: Complex Impedance Analysis, Single Crystal, Manganese Selenate

## Introduction

The dielectric properties of solids across the radio frequency range have long been attributed to the contributions of microscopic dipolar, or dipolar-like components to the total dielectric response. In the classical Debye model [1], the relaxation time $\tau$ arises from the retarding effect that the viscosity of a liquid has on the rotation of a floating dipole. A similar term is necessary to account for dipolar response in a solid where dipoles are taken to respond to an applied electric field by rotation between a series of allowed orientations that are separated by activation energy barriers. Dipolar rotation is considered to be a thermally activated process and dipole relaxation time is expected to vary with temperature as: $\tau = \tau_0 \exp(E_a/k_BT)$. In many physical systems, especially those possessing an appreciable amount of disorder, the experimental results for properties such as the mechanical or dielectric response and the ionic conductivity [2, 3] cannot be attributed to a single type of process with a given relaxation time$\tau$. Such a process would lead, for instance to the electric polarization P(t) on the removal of a steady field or the mechanical stress G(t) on the removal of a steady strain exhibiting a simple exponential decay with time. Instead the response of these two properties can often be described in the time domain by the Kohlrausch-Williams-Watts stretched



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exponential function, exp $[-(t/\tau)^{\beta}]$ [4, 5], or in the frequency domain by the Havriliak-Negami function $[1+(i\omega\tau)^{\alpha}]^{\gamma}$ [6]. Numerous explanations have been advanced for this type of response and also for the observed frequency dependence of the ionic conductivity, such as Nagai's coupling model [7] and Shlesinger's generalized trigger diffusion model [8]. One quite popular type of model attributes the experimental results to the existence of different particles, such as molecules or ions, relaxing in parallel with a distribution of relaxation times (DRT) that can be associated with a distribution of activation energies. This model has been used inter alia, to account for the dielectric response [9, 10] and the ionic conductivity [11-13] of different systems.

**Experimental**

Manganese Selenate Dihydrate ($MnSeO_4.2H_2O$) crystallizes in the orthorhombic system with lattice parameters: a = 10.421$A^0$; b = 10.516$A^0$; c = 9.232$A^0$, space group = $Pca2_1$. Single crystals of $MnSeO_4.2H_2O$ has been grown by slow evaporation methods from an aqueous solution of manganese carbonate ($MnCO_3$) and selenic acid ($H_2SeO_4$) in stoichiometric quantities at 303 K. Transparent crystals of light pink colour with good optical quality are obtained after a period of 60 days and the grown crystals are of size 40mm x 25mm x 10mm (Figure 1).

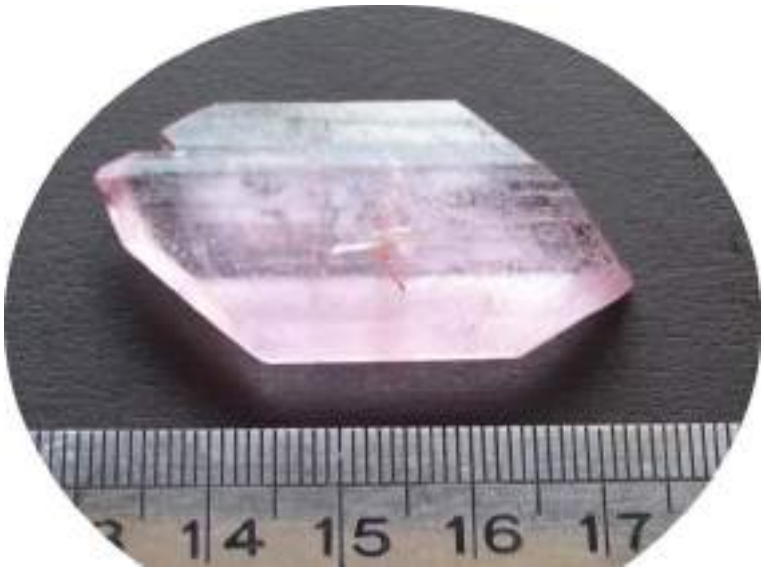


Figure 1. The photograph of the grown $MnSeO_4.2H_2O$ single crystal

After identifying the crystallographic axes using stereographic projection techniques, the crystal has been cut using slow speed diamond wheel saw (MTI Corp. USA, model 150). Crystals cut along different axes are polished well before taking measurements using a polishing unit which uses cerium oxide powder. The prepared sample is then placed in a conductivity cell having a sample holder where graphite electrodes are used for electrical contact. Complex Impedance measurements are carried out in $MnSeO_4.2H_2O$ single crystals with the help of Impedance Analyzer Hioki 3532. Julabo FP 50 is used as the temperature controller and refrigerated bath for the temperature variation



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measurements. Complex Impedance Analysis are carried out along all three crystallographic axes and figures 2, 3, & 4 show the Cole-Cole plots along a, b and c axes respectively.

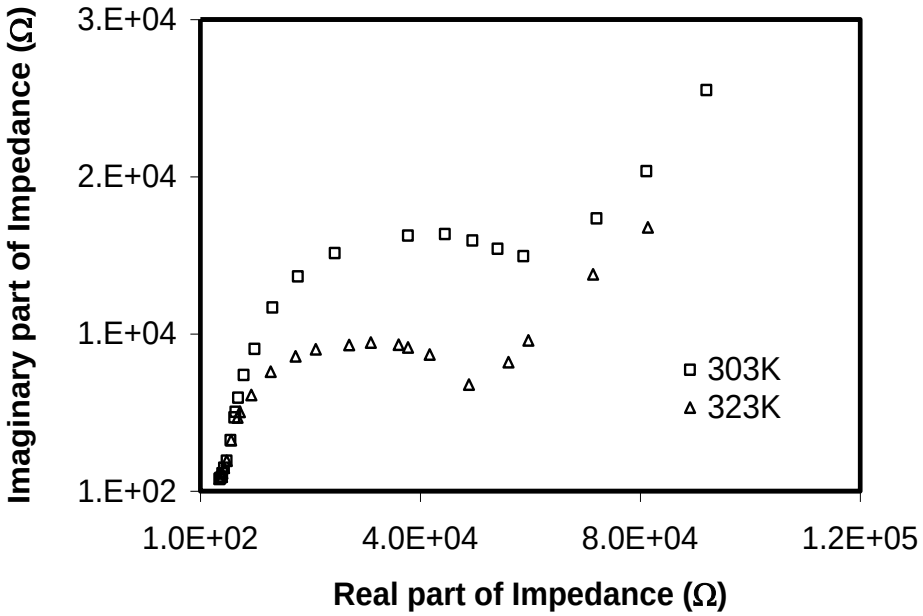


Figure 2. Complex impedance plots along a-axis

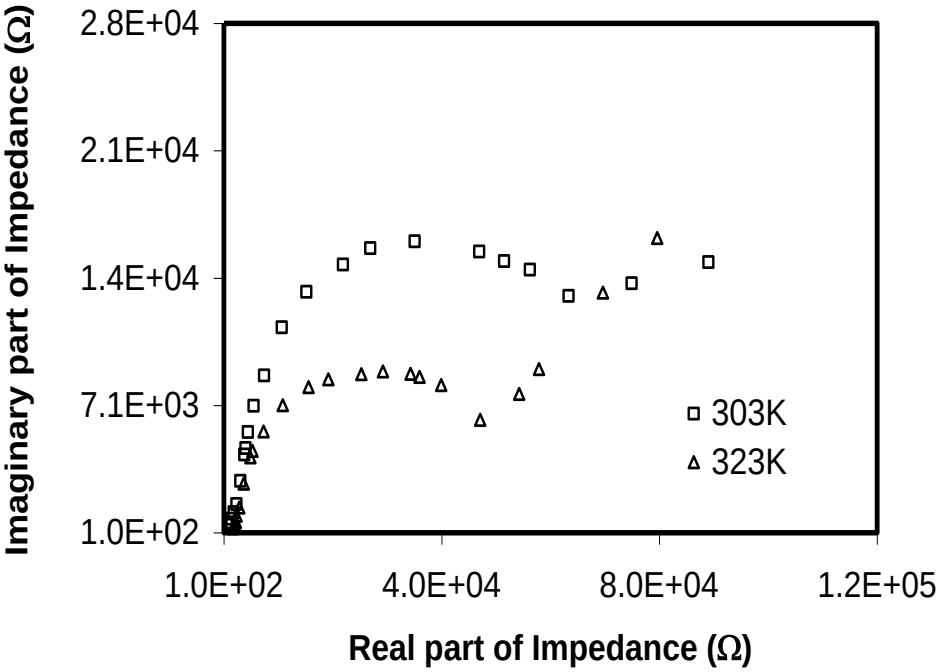


Figure 3. Complex impedance plots along b-axis



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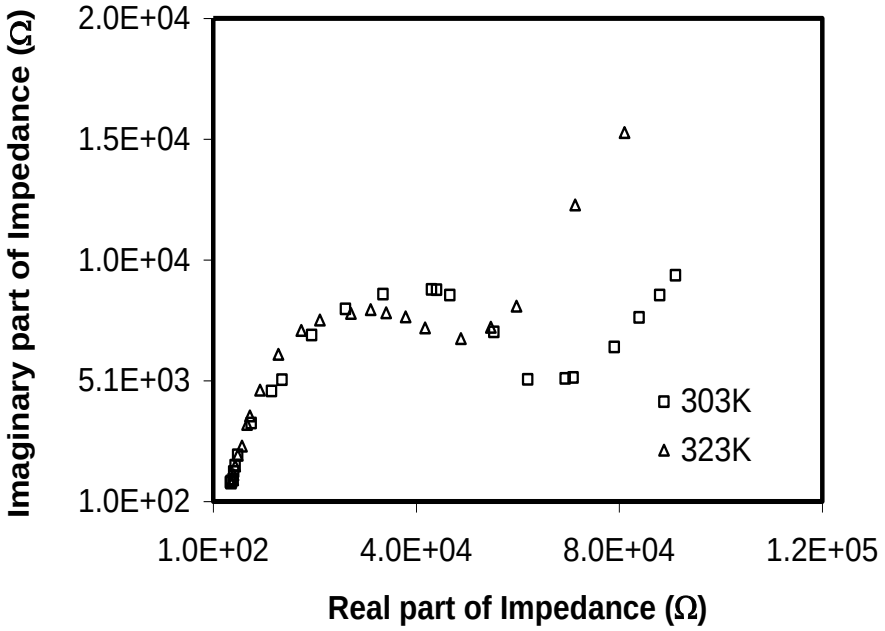


Figure 4. Complex impedance plots along c-axis

**Results & Discussion**

An equivalent circuit comprised of a parallel resistance and capacitance can model the impedance diagrams obtained along all three axes. The peaks of the semicircles are used to determine the relaxation times (τ). The low frequency intercept made by the semicircle on the real impedance axis can be used to determine the dc (frequency independent) resistance of the sample at that particular temperature. The values of $R_b$, $C_b$ and τ, known as Cole-Cole parameters are tabulated in table 1. It can be seen that $R_b$ decreases with increase in temperature whereas $C_b$ and τ increases.

| Axis | Temperature (K) | $R_b$ (ohm) | $C_b$ (pF) | τ (sec) |
|---|---|---|---|---|
| a | 303 | 7.9 E+04 | 22.39 | 1.77 E-06 |
| | 323 | 5.6 E+04 | 35.54 | 1.99 E-06 |
| b | 303 | 8.3 E+04 | 22.57 | 1.87 E-06 |
| | 323 | 5.7 E+04 | 39.9 | 2.27 E-06 |
| c | 303 | 6.9 E+04 | 23.07 | 1.59 E-06 |
| | 323 | 6.4 E+04 | 26.19 | 1.68 E-06 |

Table 1. Cole-Cole parameters of $MnSeO_4.2H_2O$ single crystal.

Conductivity studies carried out earlier in this crystal reports high conductivity values of $10^{-03}$ S/cm along all three crystallographic axes. These conductivity values are very much comparable with that of many well-known fast ionic conductors. Impedance spectroscopy is the most elegant and powerful technique for electrical characterization of solids in general and electrochemical devices including electrodes as well as electrolytes, in particular. The presence of the spike at low frequencies



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in the impedance plots obtained is typical of polarization effects at the electrodes and indicates the presence of an ionic contribution to the electrical conductivity.

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# REGIONAL REFORM MOVEMENTS IN THE MUSLIM COMMUNITY OF KERALA: A HISTORICAL REVIEW FROM 1900 TO 1950

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**Abstract:**

This research article explores the significant regional initiatives for reform within the Muslim community took place during the dynamic period from 1900 to 1950 in Kerala, South India. The study examines the socio-religious context, key reformist movements, and the influence of prominent figures who contributed to educational, social, and cultural advancements within the community in regional level. It sheds light on how these initiatives fostered a renaissance within the Muslim community, aligning with broader developments in India during the pre- and post-independence era.

**Key words**: *Reform Movements, Regional Initiatives, Kerala Muslims*

## Introduction:

The early 20th century witnessed a transformative phase in Kerala, where so many Muslim leaders actively engaged in reform movements that aimed to address various social, religious, and economic challenges. These regional initiatives, carried out within the context of broader socio-political changes in India, played a pivotal role in reshaping the Muslim community in Kerala.

## Historical Context:

The 20th century in Kerala was marked by British colonial rule, socio-religious movements, and the influence of the Indian independence struggle. The Muslim community in Kerala, like other communities, was confronted with various challenges, including economic disparities, educational backwardness, and issues related to superstitions in religious practices.

In these circumstances, several leaders took the initiative to independently engage in reform efforts across different regions of the state, with the objective of tackling diverse social, religious, and economic issues. They founded local associations to empower the community, and some of these organizations expanded throughout Kerala, playing a significant role in the renaissance of the Muslim community, such as the Kerala Muslim Aikya Sangham.



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**Key Reform Movements:**

**1. Nishpaksha Sangham, Eriyad:**

The Nishpaksha Sangham, founded in 1921 under the leadership of Sayyid Mayin Hamdani Thangal and eleven other members in Kodungallur, Kerala, was established with the primary goals of uniting the Muslims in Kodungallur and resolving inter-community issues. This movement marked a significant turning point, reflecting the culmination of the reformist efforts initiated by individual leaders. In 1922, the Nishpaksha Sangham held its annual meeting in Eriyad, Kodungallur, during which they decided to expand their influence across Kerala and broaden their scope of activities.[1] Consequently, the organization's name was changed to the Kerala Muslim Aikya Sangham.

**2. Kerala Muslim Aikya Sangam**

The Kerala Muslim Aikya Sangham, established in 1921 in Kodungallor of Cochin state by prominent leaders including Manappattu P. Kunhu Muhammed Haji, Kottappurathu Seethi Muhammed Sahib, K.M Seethe Sahib, K.M Moulavi, and E.K Moulavi, marked the earliest organized effort in Muslim socio-religious reform in Kerala. This organization united various Muslim sections and became the pioneering socio-religious organization in the state.[2]

The establishment of the Kerala Muslim Aikya Sangham marked a pivotal moment in the history of Kerala Muslims and served as the catalyst for the Kerala Muslim renaissance. Following the Mappila Rebellion in 1921, Kerala's Muslims were disheartened by their circumstances. The Kerala Muslim Aikya Sangham sparked a widespread awakening among Muslim communities in various aspects of life, particularly in modern and religious education. Under its leadership and inspiration, numerous primary schools, secondary schools, and Madrasas were founded. The organization's leaders played a significant role in the establishment of Farook College, the first Muslim college in Kerala. Many Muslim youths, inspired by its message, pursued higher education in colleges and universities, subsequently attaining prominent positions in society.[3]

The primary goals of the Kerala Muslim Aikya Sangham were to unite Kerala's Muslims under the banner of Islam, combat superstitions and un-Islamic practices and beliefs, steer them back to the original faith of Islam, and promote both religious and secular education. This organization set a precedent for subsequent groups across the state that aimed to enhance education and champion social reform within the Muslim community. The Kerala Muslim Aikya Sangham serves as a precursor to subsequent organizations that emerged across various regions of the state, all with the common goal of advancing education and championing social reform among the Muslim community.[4]



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Moreover, the Sangham played a pivotal role in promoting modern education and transforming society's perspective on women's education, which had long been neglected. Notable scholars who significantly influenced the Sangham included Sayyid Sanahulla Makhthi Thangal, Moulana Chalilakathu Kunhammed Haji, Sheikh Muhammed Mahin Hamdani Thangal, Vakkam Muhammed Abdul Qadir Moulavi, Kottapuarath Seethi Muhammed Sahib, K.M Seethi Sahib, K.M Moulavi, Muhammad Abdul Rahman Sahib, and E.K Moulavi.

The Kerala Muslims Aikya Sangham organized a series of annual conferences, with a total of twelve held at different locations in Kerala. These conferences had a significant impact on Kerala's Muslim invigorating the revivalist movement within the community. The *Kerala Jameeyathul Ulama*, the earliest scholars organization in Kerala was formed at the second annual conference of Kerala Muslim Aikya Sangham held in Aluway, in 1924.

**3. Muslim Majlis**

Muslim Majlis was the earliest socio-political organization among Muslims in Kerala, with a primary focus on safeguarding the socio-political interests of the Muslim community. The Kerala Muslim Aikya Sangham eventually merged with the Muslim Majlis.[5] Notably, the Muslim "Majlis" was possibly the first political organization formed exclusively by Malabar Muslims in 1931, six years prior to the establishment of the Muslim League in Kerala.

**4. South Indian Muhammedan Education Association:**

Established in 1901, the South Indian Muhammedan Education Association's primary objectives were to promote both religious and secular education, with a focus on fostering Western education among Muslims.[6] This association actively engaged with the Muslim communities in Malabar, Cochin, and Travancore, making recommendations to the government to enhance educational and cultural identity. They also founded numerous schools and educational institutions throughout Kerala.[7]

**5. Lajnat ul-Muhammadiya Association:**

The Lajnat ul-Muhammadiya Association in Alleppey, founded in 1914 and inspired by the efforts of the early reformer Vakkam Abdul Khadar Moulavi,[8] was the first socio-religious organization in Travancore. Led by N.A Muhammed Kunju Sahib, Ibrahim Rowther, and Bava Haji, its main goal was to promote education within the community and cater to the educational needs of Muslims. This association spawned a sub-organization called "Nusratul Islam," aiming to provide education to Muslim youths who had limited schooling.[9] They established School and educational institutions in Alappuzha



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**6. All Travancore Muslim Mahajana Sabha:**

Established by the renowned religious scholar Vakkam Muhammed Abdul Qadir Moulavi in Travancore state, the All Travancore Muslim Mahajana Sabha influenced the Travancore government to implement measures beneficial to the Muslim community. The organization's objective was to unite Travancore Muslims under a robust banner, with a focus on addressing the socio-religious conditions of Muslims in Kerala, particularly in the early period of Travancore state.[10] This Sabha worked to coordinate educational initiatives in the state, and their efforts were instrumental in persuading the government to introduce religious education in schools and appoint Arabic teachers.[11] Additionally, the organization played a significant role in the early development of the socio-religious and educational sectors during a relatively brief period.

**7. Malabar Muslim Educational Association:**

In 1911, the Malabar Muslim Educational Association was founded in Cochin, with prominent Muslim leaders taking the lead in its organization. The association subsequently established branches across the state, primarily dedicated to advancing educational initiatives and social welfare programs within the Cochin state.[12]

**8. Chirayinkeez Taluk Muslim Samajam:**

Chirayinkeez Taluk Muslim Samajam was another early Muslim organization in southern Kerala, spearheaded by the early reformer Vakkam Muhammed Abdul Qadir Moulavi.[13] This Samajam aimed to uplift the Muslim community, and it established a modern school to provide contemporary education to Muslims.

**9. Lajnathul Hamdaniya Azheecode:**

Lajnatul Hahadaniya, an organization established by Sayyid Muhammad Mahin Hamdani Thangal in Azheecode during the early years in Kerala, focused on social activities.[14] This organization initiated social reform movements and educational endeavors, led by early reformers like Sayyid Hamadani Thangal and Seethi Muhammad.

**10. Rouzathul Uloom Association:**

The Rouzathul Uloom Association, an early socio-educational institution in Malabar, was established in 1942. It served as the parent body for all educational and cultural institutions within the Farook College campus. The Rouzathul Uloom Association and its affiliated institutions represent a significant and successful effort by Kerala Muslims, particularly those from Malabar, in the realm of educational progress.[15]



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**11. Tirurangadi Muslim Orphanage Committee**

In 1943, the Tirurangadi Muslim Orphanage Committee was founded under the leadership of MK Hajee Sahib in Tirurangadi, Malappuram District. The primary goal of this committee was to nurture neglected orphans and elevate the Muslim community in various aspects, including religious, cultural, social, educational, and political domains.[16]

Having grown up as an orphan, he had firsthand knowledge of the struggles and difficulties faced by those without support. Notably, he displayed exceptional generosity by converting his own home into an orphanage in 1943, which later evolved into the Tirurangadi Muslim Orphanage. This noble cause was supported by a small group of individuals, including K.M Maulavi, E.K Maulavi, and KM Seethi Sahib etc. Initially, this institution was established to provide shelter for those affected by the cholera outbreak in Malabar in 1943. Subsequently, a series of educational and charitable institutions were established in Tirurangadi, with PSMO College, Oriental school and KMMO Arabic College being the prominent institutions affiliated with the Orphanage Committee.

**12. JDT Islam Sabha**

JDT (Jama` at- Da`wat-i-Tablige-i-Islam) Islam Sabha was founded in Calicut in 1921, primarily to care for the orphans of the "Malabar Rebellion" and provide them with education.[17] The main mission of JDT was to rescue destitute orphaned children of both genders from the harsh clutches of poverty, offering them quality education and the opportunity to become responsible citizens.[18] Since its inception, this Sabha has raised and nurtured over 10,000 children from various communities. JDT Islam manages numerous educational institutions and strives to uplift the Muslim community in the realms of religion, culture, health, society, politics, and education.

**13. Muslim Sevaka Sangam Punnol:**

The Muslim Sevaka Sangam Punnol, established in 1930 in Punnol, Kannur, is a renaissance initiative dedicated to the educational and social advancement of the Muslim community. This organization gave rise to important initiatives like the Punnol Mapila LP School and the Iqbal Library. KP Ahmed served as the founding president of the Sangham, and the group brought in KM Maulavi, who organized a series of informative speeches. The revival efforts of the Sangham thrived in the region until 1939.[19]

**14. Nusratul Islam Sangam Kadavathur:**

Nusratul Islam Sangam was established in 1946 and continues to operate as a registered organization. It has played a crucial role in elevating the Kadavathur region in the context of the broader Kerala revival. Kadavathur is the birthplace of renowned Islahi scholars, such as EK



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Maulavi, Edapara Kunjahammed Maulavi, and NK Ahmed Maulavi. To this day, Nusratul Islam Sangam remains responsible for numerous educational, religious, and social initiatives, including the Nusratul Islam Arabic College Kadavathur.[20]

**15. Taalimul Islam Sabha Mattul:**

Taalimul Islam Sabha of Mattul in Kannur District was one of the earliest revival initiatives, founded on December 6, 1931, with the purpose of promoting religious, educational, and social revival among the local Muslims. The first annual meeting took place on April 26, 1935, on the grounds of the North Mappila UP School (which still exists), presided over by Muhammad Abdurahman Sahib, an influential revivalist leader and editor of Al-Ameen newspaper. KM Maulvi delivered a lecture at this event. The second annual conference, held on June 25, 1937, had KM Maulavi as its presiding figure. VV Muhammad Maulavi served as the president of the Sabha for an extended period. PP Musa Kunji and Muthari Muhammad were his colleagues and early proponents of the revival movement. Among their notable contributions, they established the North Mapila School, and in 1954, the Muhammad Abdurrahman Reading Hall was inaugurated.[21]

**16. Other Regional Organisations:**

Some initiatives for reform which got inspiration from Kerala Muslim Aikya Sangam and Kerala Jamiyyathul Ulama functioned before 1950 such as: Jamiyathul Mujahideen Areekode and Karakkunnu, Jamiyathul Mujahideen- Nilampur, Nusrathul Islam Sangam-Kadavathur, Izzatul Islam Sangam-Tirurangadi, Ansarul Islam Sangam- Thalassery, Tanmiyathul Islam Association-Chaliyam, Anwarul Islam SangamMongam, Irashadul Muslimeen-Kallikandi, Namaul Islam Sangam-Elankode, Himayathul Islam Sangam-Kuniyil, Jamiyahtul Musliheen Sangam-Trippanachi, Lajnathul Islah-Edavanna, Nusrathul Islam-Tanalur, Jamiyathussalafiya-Paravanna, Munavvirul Islam Sangam-Varanakkara, Islahiyya Committee-Kumaranallur, Islahuddeen Asociation-Peringadi, Jamiyathu Himaythu Sunnah-Kannur, Jamiyathul Mujahideen-Madakkara, Himaythuddeen Sangam-Palath, Naseemul Islam Sangam Athooli, Munavvirul Islam Sangam-Palakkad, Nusrathul Islam Sangam-Tachampara, Hidayathul Muttaqeen-Edathanattukara, Muslim Yuva Jana Sangam-Palakkad, Nusrathul Islam-Mannarkkad, Nadvathul Islam Samajam-Arukkutti, Irshadul Muslimeen-Koyilandi, Jamathul Islam Committee-Pinangode, Jamiyathul Muslimeen Sangam-Othayi and Manarul Islam-Keezhur etc. Most of them merged in Kerala Nadwathul Mujahideen (Estd.1950)[22]. The activities of this initiatives were to found Schools, Madrassas, Masjids and higher education centers in their locality. Most of them were success and some of them existed as centre of learning in modern day.



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**Impact and Legacy:**

The regional initiatives for reform in Kerala between 1900 and 1950 had a profound impact on the Muslim community. These initiatives led to increased literacy, social mobility, and a more islamisation in religious beliefs and practices. They also contributed to greater community integration within Kerala and a sense of empowerment and participation in the wider socio-religious landscape.

**Conclusion:**

The regional initiatives for reform within the Muslim community in Kerala from 1900 to 1950 were a response to the challenges and opportunities of the era. These initiatives played a vital role in shaping the socio-cultural and educational landscape of the Muslim community in the region. The legacy of these reform movements endures in modern Kerala and provides valuable insights into the resilience and adaptability of the community during a critical period in Indian history.

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**BIO NOTE**

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# $TiO_2$-$ZrO_2$ NANOCOMPOSITE: A REVIEW

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**Abstract---** Metal oxide nanocomposites have gained great attention for both theoretical and experimental aspects of their upgradation because of their wide range of practical applications such as catalysts, sensors, hydrogen storages, and optoelectronics. Since $TiO_2$-$ZrO_2$ composite has superior optical and electronic properties and is effective at degrading organic pollutants, it is a material that is universally appealing to the study community. In this review, the $TiO_2$-$ZrO_2$ nanocomposite compounds are comprehensively reviewed based on scientific and patent literatures. The materials syntheses with different methods, including sol–gel, hydrothermal and coprecipitation methods are summarized. The structural, optical, magnetic, electrical, dielectric, and acid – base properties and the corresponding diagrams are discussed. Diverse applications, including catalysis, photocatalysis and sensors are present. To conclude, we summarize general results and highlight future prospects regarding the $TiO_2$-$ZrO_2$ nanocomposites.

**Keywords---** $TiO_2$-$ZrO_2$, synthesis, magnetic, structural, electrical, optical, application

## Introduction

Nanocomposites showing a variety of functional properties and applications have attracted much attention from scientists in the past few years,[1,2] including those working in physics, chemistry, and material science due to their various practical applications such as photocatalyst, microelectronic circuit fabrication, fuel cell and solar cell. In recent years, there has been a growing interest in the development and characterisation of nanocomposites, and numerous studies have been conducted to investigate their properties and potential applications. Among different types of nanocomposites, metal oxide nanocomposites have gained significant attention due to their unique physical and chemical properties, which make them highly desirable for a broad range of industrial and scientific applications.[1,3]

Titanium dioxide – Zirconium dioxide ($TiO_2$-$ZrO_2$) mixed oxides attracted enormous attention due to their potential applicability. The hydrophilic nature of this composite makes it useful for self-cleaning applications. Combination of dissimilar oxides results in creating surface acid sites



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that are not present in either the pure components, this enhance its potential applicability as catalyst. The literature has established that combining two dissimilar oxides adds a new parameter because they are likely to form new stable compounds with entirely different physiochemical properties and catalytic behaviour. Such titania-zirconia mixed oxide benefits both $TiO_2$ and $ZrO_2$ and broadens their application by producing new catalytic sites due to their powerful interaction.[4–6] This review provides an overview of current state of art in $TiO_2$-$ZrO_2$ nanocomposites, including their synthesis, characterization, and properties, as well as their applications in various fields.

**Synthesis**

Condensed matter science places great importance on the exploitation and synthesis of novel advanced materials with intriguing characteristics and potential macroscopic applications. The preparation technique and the synthesis circumstances significantly impact the degree of interaction, or, to put it another way, homogeneity or dispersion. The choice of synthesis method depends on the specific application requirements and desired properties of the $TiO_2$-$ZrO_2$ mixed oxide. The annealing temperature required to obtain a $TiO_2$-$ZrO_2$ nanocomposite depends on various factors such as the starting materials, the synthesis method, and the desired properties of the nanocomposite. However, typical annealing temperature range for $TiO_2$-$ZrO_2$ nanocomposites is 400°C to 800°C.[7–9]

**Sol-Gel method**

Sol-gel is one of the simple wet chemical techniques widely used for the preparation of nanocomposites (mostly oxides) and ceramics. The sol-gel process is a chemical transformation of a sol into gel (three-dimensional polymer) state and a subsequent transition into solid oxide material caused by suitable post treatment. This method is based on inorganic polymerization reaction including hydrolysis, polycondensation, gelation, aging, drying, and calcination or sintering (densification). Different researchers have prepared $TiO_2$-$ZrO_2$ nanocomposite by sol-gel technique using different precursors.[10–13]

An adequate synthesis method is a fundamental starting point for developing any material. Among various methods mentioned earlier, sol-gel is widely employed due to its ability to control morphology and other properties.[14–16] The domain formation due to the difference in hydrolysis and condensation rates of Ti- and Zr-alkoxides is the major problem in sol-gel route for the preparation of mixed oxides.[17] The synthesis of $TiO_2$-$ZrO_2$ nanocomposites by sol-gel method involves several steps, first the preparation of precursor solutions. Second step is to mix precursor solutions, the mixed precursor is then put into hydrolysis and condensation. The final product obtained is then dried and calcinated. The calcination temperature is in the range of 500 to 800°C, to remove any organic impurities and to convert the gel into a crystalline $TiO_2$-$ZrO_2$ nanocomposite material. The synthesis



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of titanium zirconate powder by a sol-gel route was reported by H Zou et al.[10] in which Titanium chloride ($TiCl_4$) and zirconium oxide chloride were used as precursor.

**Hydrothermal method**

Hydrothermal method is also widely employed; it uses a solution-reaction-based methodology. One advantage of the hydrothermal method is, nanomaterials can form at a wide range of temperatures, from very low to very high. Also, the morphology can be tuned by controlling the pressure.[18] Laxmi J. Tomar and coworkers synthesized the TiO2-ZrO2 nanocomposite successfully by hydrothermal route, they uses Titanium isopropoxide, Zirconium propoxide and isopropanol were used as starting chemicals[19]. Ti isopropoxide and Zr propoxide were diluted in isopropanol (ROH) to obtain oxides. A $H_2O$ + $HNO_3$ mixture was drop-wise added to the alkoxides solution kept under vigorous stirring at ~273 K (Ts). The ROH/alkoxide., $H_2O$/alkoxide., and $HNO_3$/alkoxide molar ratios used were 65, 20 and 0.05, respectively. After alkoxide hydrolysis the alcogel was obtained. The solids were obtained by transferring the alcogel to a stainless steel autoclave. The temperature was raised to 240℃ and the sample was maintained under autogenic pressure for 24 h. Then, the sample was oven- dried at 100℃ (2 h) and finally calcined at 450℃ for 4 hours under static air atmosphere. The calcination process was carried out to remove any organic residues and to improve the crystallinity of the sample. The resulting material was characterized by X-ray diffraction, scanning electron microscopy, and nitrogen adsorption-desorption isotherms. The nanocomposites obtained through hydrothermal method will be of high purity, crystallinity and surface area.

**Properties**

**Structural properties**

The literature detailed a variety of methods to characterize $TiO_2$-$ZrO_2$ and metal or metal oxide impregnated $TiO_2$-$ZrO_2$-mixed oxides.[26–31] One of the primary techniques used to characterize the structure of $TiO_2$-$ZrO_2$ nanocomposites is X-ray diffraction (XRD). The interpretation of XRD results for $TiO_2$-$ZrO_2$ nanocomposites can provide valuable information about the crystal structure and phase composition of the material, which can be used to optimize its performance in various applications. The XRD pattern typically shows peaks corresponding to the anatase phase of $TiO_2$ and the tetragonal phase of $ZrO_2$. The intensity ratio of the anatase to tetragonal peaks can be used to estimate the relative composition of the two materials in the nanocomposite. In addition to the anatase and tetragonal peaks, XRD analysis may also reveal peaks corresponding to other phases, such as the monoclinic phase of $ZrO_2$ or impurity phases. The presence of these secondary phases can have an impact on the properties and performance of the nanocomposite. Figure 1 shows the XRD pattern of $TiO_2$-$ZrO_2$ nanocomposite.



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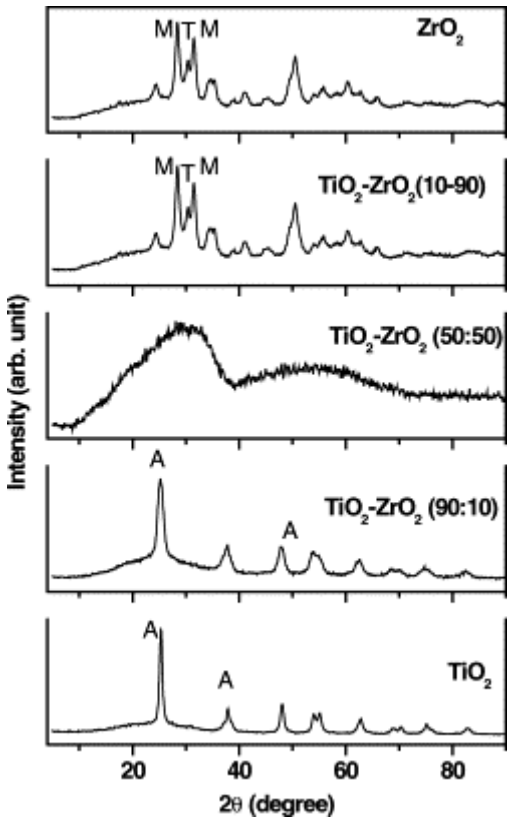


Fig. 1. XRD pattern of TiO2, ZrO2 and TiO2–ZrO2 mixed oxides annealed at 400 °C.[28]

According to the study by Manrquez et al, the mixed phase with equal composition (50:50) will be amorphous when annealed at 400°C, but an increase in the titania or zirconia content on the mixed $ZrO_2$-$TiO_2$ provides crystal structure at this temperature.[28] In another study carried out by R. Perez-Hernandez et al, where they annealed the samples at 500°C, the pure $ZrO_2$ sample's XRD pattern reveals a blend of two crystalline structures, with a significant predominance of the tetragonal phase and a negligible amount of the monoclinic phase.[32] The crystalline structure of the bare $TiO_2$ was compatible with the anatase phase in the XRD pattern. They also reported that, there is a loss in crystallinity with the addition of $TiO_2$ to $ZrO_2$, which inferred that addition of $TiO_2$ reduces the strength of the diffraction peaks. The binary $ZrO_2$-$TiO_2$ (50:50) (ZT50) oxide's XRD pattern matched with an amorphous substance even after the solid was calcined for 8 hours at 600°C. This result is in agreement with DSC results for this oxide, which did not show an exothermic peak related with the phase transformation from amorphous to crystalline material. Figure 2 shows the Differential scanning calorimetric curves of ZrO2–TiO2 xerogels. Each of them exhibits an endothermic peak between 30 and 250 °C, which is associated with the removal of physically adsorbed water and alcohol.[33,34] An amorphous material changing into crystalline tetragonal zirconia was the cause of the exothermic peak at 424 °C seen on the zirconia xerogel. This peak for the TiO2 xerogel was seen at 423 °C and is related to the anatase phase's crystallisation. The burning and decomposition of organic groups could be the cause of another peak seen at temperatures around 300 °C.[35–37] The increase in



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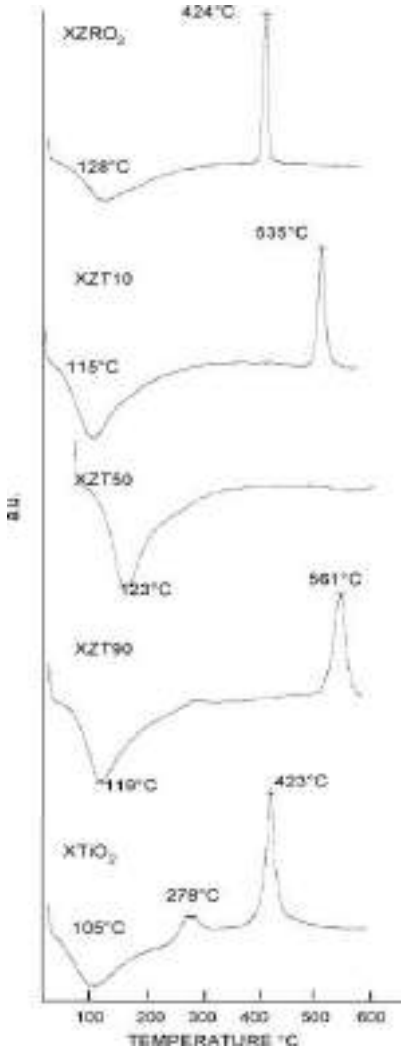
the titania or zirconia content on the mixed ZrO2–TiO2 xerogels, cause a shift on the exothermic peaks towards higher temperature compared to the single xerogels. These peaks are attributed to the crystallization of the amorphous material.[32] An amorphous material was reported[33,37] in the $ZrO_2$–$TiO_2$ samples with equal composition independently of the route of the synthesis. The amorphous ZT50 sample could be favoured by decreasing the particle size of the material.[33] However, crystallization of amorphous ZT50 oxide to ZrTiO4 phase is reported above 600 ◦C regardless the method of synthesis.[10,35,37,38]




A study by Pooja Kumari et al. (2023) reports the synthesis of $TiO_2$-$ZrO_2$ nanocomposite with high level of purity.[30] The Figure 2 indicates the XRD patterns of $TiO_2$, $ZrO_2$ and $TiO_2$-$ZrO_2$ with high level of purity.

Another technique used to characterize the structure of $TiO_2$-$ZrO_2$ nanocomposites is transmission electron microscopy (TEM). One of the key advantages of TEM is its ability to provide high-resolution images of nanoparticles, allowing researchers to observe their size, shape, and morphology. A study by Zheng et al. (2020) used TEM to analyse the structure of $TiO_2$-$ZrO_2$ nanocomposites synthesized by a hydrothermal method.[39] The TEM images revealed that the nanocomposite had a hierarchical structure, with $TiO_2$ nanorods embedded in a $ZrO_2$ matrix. The size



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of the nanorods was found to be around 10-20nm in diameter and 50-200 nm in length. The hierarchical structure of the nanocomposites was found to enhance their photocatalytic activity. Another study by Xiaofei Qu et al. (2014) used TEM to confirm $TiO_2$-$ZrO_2$ coaxial core–shell composite nanotubes with $TiO_2$ nanotubes is deposited on the inner surface of the $ZrO_2$.[40] Figure 4 represents the TEM image of $TiO_2$ nanotube, $ZrO_2$ nanotube and $TiO_2$-$ZrO_2$ nanocomposite nanotube. A study by Ramamoorthy et al. (2021) reports the formation of local heterogeneous clusters.

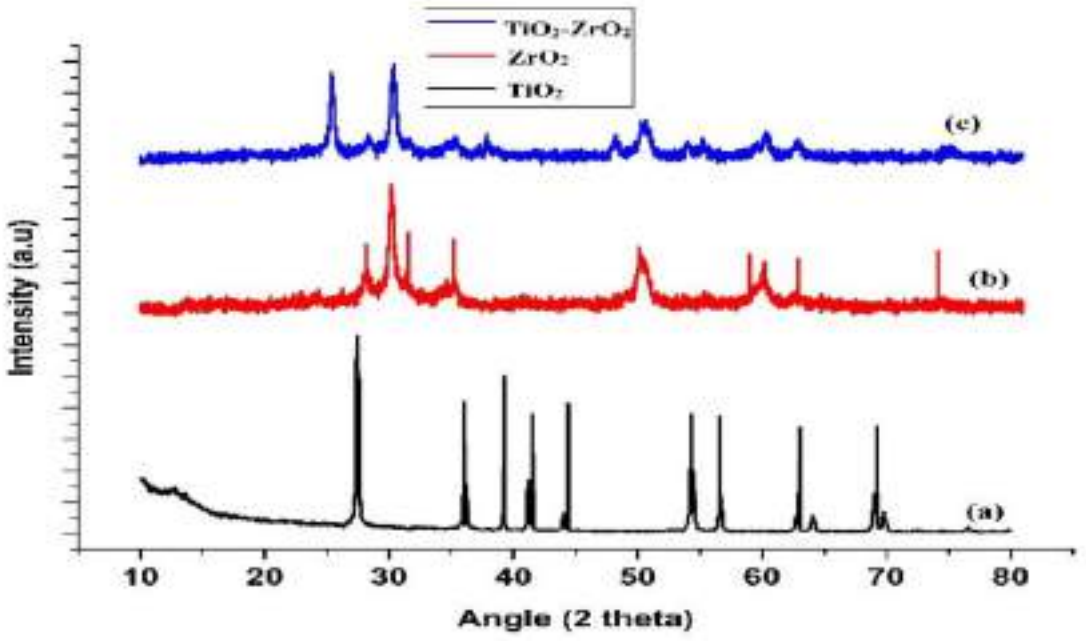


Fig. 2: XRD pattern of (a) $TiO_2$ (b) $ZrO_2$ (c) mixed phase $TiO_2$-$ZrO_2$ nanocomposite.[30]

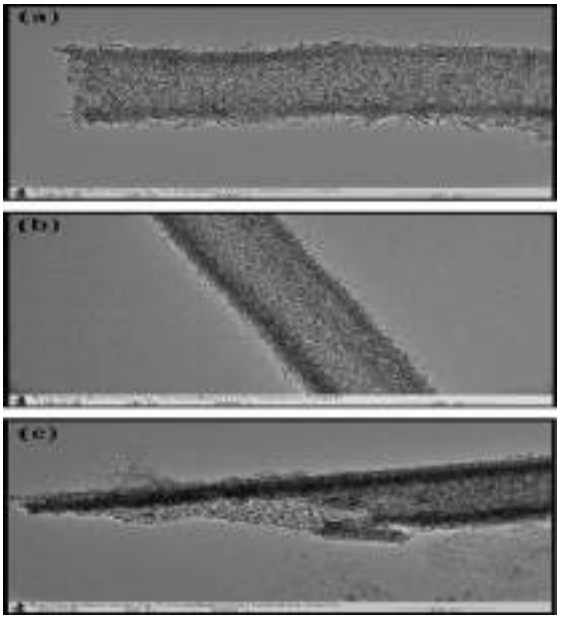


Fig. 4. TEM analyses of (a)$TiO_2$ nanotube, (b)$ZrO_2$ nanotube and (c)$TiO_2$/$ZrO_2$ composite nanotube.[40]



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**Optical properties**

Titanium dioxide ($TiO_2$) and zirconium dioxide ($ZrO_2$) are two commonly used materials in nanocomposites due to their unique optical properties[63]. When combined in nanocomposites, these materials can exhibit enhanced optical properties, such as improved light absorption, photoluminescence, and photocatalytic activity. These materials exhibit unique optical properties that make them attractive for applications in optics, photonics, and optoelectronics.

One of the most important optical properties of $TiO_2$-$ZrO_2$ nanocomposites is their high refractive index, which is a measure of how much a material can bend light. TiO2 and ZrO2 have high refractive indices of 2.5 and 2.2, respectively, which makes them ideal for use in lenses, mirrors, and other optical components. By combining these two materials in a nanocomposite, the resulting material can have an even higher refractive index than either material alone, making them useful for applications such as antireflection coatings.

Another important optical property of TiO2-ZrO2 nanocomposites is their ability to absorb and scatter light. This property is important for applications such as solar cells, where the material must efficiently capture sunlight and convert it into electricity. TiO2-ZrO2 nanocomposites can be tailored to absorb light across a wide range of wavelengths, including ultraviolet (UV) and visible light, making them useful for a range of applications. This is due to the bandgap structures of TiO2 and ZrO2, which enable absorption of light at different energy levels.

TiO2-ZrO2 nanocomposites also have good transparency in the visible and near-infrared regions of the electromagnetic spectrum, making them useful for optical coatings and filters. They can be used to create anti-reflective coatings for lenses and displays, or to block specific wavelengths of light in optical filters.

TiO2-ZrO2 nanocomposites can also exhibit photoluminescence, which is the emission of light in response to excitation by a light source. This property is useful for applications such as sensors and light-emitting devices.

TiO2-ZrO2 nanocomposites can exhibit fluorescence, which is the emission of light by a material after it has absorbed light. The fluorescence properties of these nanocomposites can be tuned by adjusting the composition and structure of the materials.

In addition, TiO2-ZrO2 nanocomposites have high photocatalytic activity, which means that they can use light energy to catalyse chemical reactions. When TiO2 is combined with ZrO2 in a nanocomposite, the photocatalytic activity can be enhanced due to the synergistic effect between the two materials. This property is useful in a variety of applications, including water purification, air pollution control, and self-cleaning surfaces.



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Overall, the optical properties of TiO2-ZrO2 nanocomposites make them promising materials for a wide range of applications, particularly in areas such as energy conversion and environmental remediation.

**Acid-Base properties**

The acid base properties are very important in catalytic applications. The selectivity, conversion and stability of a reaction not only depend on the nature of active sites, but also on their strength and number. Tanabe and colleagues examined several binary metal oxides' acid-base characteristics.[64–67] Their research aimed to create a theoretical foundation for the production of acidity in different binary oxides, which is absent in the individual component single oxides. The average electronegativities of metal ions in binary oxides were found to be remarkably correlated with the measured highest acid strengths. This correlation between electronegativities and acid strengths can be used to predict the acidity of other binary oxides, which can be useful in designing more efficient catalysts for various chemical reactions. The findings of this research could have significant implications for the development of new and improved industrial processes. The formation of new acid sites in different mixed oxides has also been predicted using a variety of models in the literature. However, Tanabe's and Kung's models have gotten much more notice in the literature due to their greater acceptability.[64–68] Tanabe's model is applicable to diluted mixed oxides in which cation substitution is used to incorporate a small quantity of a second oxide into the first oxide. According to this concept, an excess of negative or positive charge in a binary oxide structure leads to the formation of new acid sites. The model structure is as follows: (i) the oxygen ion in the binary oxide has the same coordination number as the major component oxide, and (ii) the coordination number of a cation of the component oxide is preserved in the binary oxide. Several binary oxides, including $TiO_2$-$ZrO_2$, have been studied using this approach. The binary oxide of $TiO_2$ and $ZrO_2$ has produced positive outcomes.[65]

Surface acidity is significantly increased as a consequence of the interaction between the two oxides compared to the individual oxides. That is, the mixed oxides have varying degrees of increased surface acidity, with the maximum occurring at about 50 weight percent, whereas the single oxides $TiO_2$ and $ZrO_2$ show less surface acidity, as measured by Hammett indicators.[69] These results align with the Tanabe model, which states that novel acid sites are connected to Ti-O-Zr linkages. It is also conceivable that as the transition metal oxide particle size diminishes, the quantity of surface oxygen anion vacancies rises, leading to the creation of new and more potent acid sites, with the smallest particles having the highest acidity.[69] The mixed oxides of $TiO_2$ and $ZrO_2$ can be conceptualised as a mixture of relatively tiny particles that contribute acidity from anion vacancies in addition to the surface acidity resulting from interactions proposed by Tanabe.[29]



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In-situ FTIR,[70–72] Temperature-programmed desorption (TPD),[73,74] and other techniques were used to thoroughly study the acid-base properties of $TiO_2$-$ZrO_2$ binary oxide and other similar samples. Tanabe and colleagues conducted n-butylamine titration experiments with a variety of acid-base indicators decades ago to study the acidic properties of several binary oxides.[65] TPD is widely used technique for the characterization of surface properties of catalyst. It can provide valuable information on the nature and strength of the surface sites and their surface stability. The average electronegativities of metal ions in the binary oxides were found to be fairly well correlated with the observed highest acid strengths. n-Butylamine and trichloroacetic acid were used as the titrating base and acid, respectively, to measure the surface acid-base properties of $TiO_2$-$ZrO_2$. The $TiO_2$-$ZrO_2$ (1: 1 molar ratio) acid amount and acid strength were found to be the largest and strongest.[75]

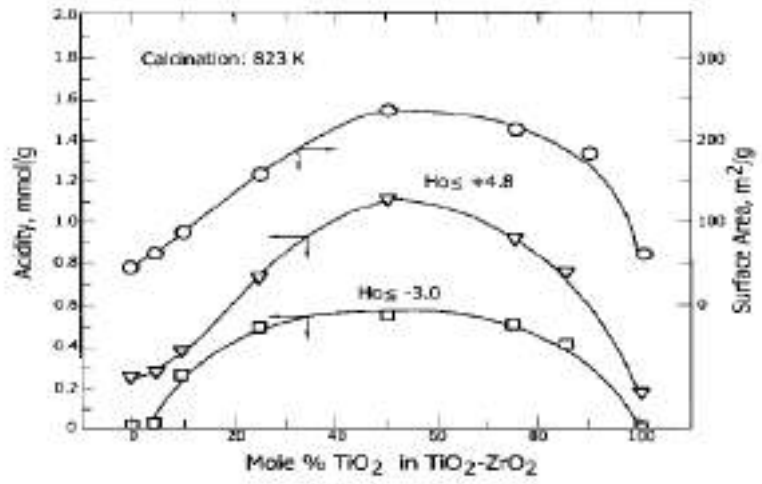


Figure 6: Surface area and acidity of TiO2-ZrO2 at various compositions; (O), surface area; (∇), acid strength $H_0 \leq +4.8$; (□), acid strength $H_0 \leq 3.0$.[69]

Another excellent method to study the acid-base properties of catalyst is microcalorimetry, which measures the differential molar enthalpy of adsorption using various adsorbents like ammonia, pyridine, n-butylamine, $CO_2$, and $SO_2$.[73,76]

**Applications**

Binary metal oxide semiconductors are widely used in a broad range of applications, including sensor technology, solar energy conversion, and heterogeneous catalysis. Since $TiO_2$-$ZrO_2$ composite has superior optical and electronic properties and is effective at degrading organic pollutants, it is a material that is universally appealing to the study community. Due to their redox and acid-base characteristics, $TiO_2$ and $ZrO_2$ make excellent options for catalytic activities.[77] The $TiO_2$-$ZrO_2$ membranes' stability and porosity make them ideal for applications in ultra- and nano-filtration.[78] The ZrO2-TiO2 scaffold layer is advantageous for perovskite solar cells because of its roughness and enhancement in light scattering, which increase short-circuit current density in the composite.[79] Water



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splitting for hydrogen production, selective reduction of NOx with hydrocarbons, isomerization and cracking of alkanes, hydration and polymerization of alkenes are the other potential applications using TiO2-ZrO2 nanocomposite.[32,80,81] In the following section we will briefly discuss some applications of TiO2-ZrO2 nanocomposite.

**Catalysis**

Metal oxides are one of the most significant and frequently used types of solid catalysts, whether as active components or supports. TiO2-ZrO2 nanocomposites have shown potential for catalytic applications such as oxidation, reduction, and hydrogenation reactions.[82] The high surface area of nanocomposite provides more active sites for catalytic reactions. The addition of ZrO2 to TiO2 has been found to enhance its catalytic activity, selectivity and stability. The rise in activity can result from the surface acidity being considerably higher than that of its pure equivalents. By inhibiting electron hole recombination, the surface hydroxyl groups that can capture photo-induced holes raise the system's surface acidity and hence boost photocatalytic activity. Additionally, because the generated hydroxyl groups are almost always visible on the surface, the holes become trapped there, which facilitates the efficient oxidation of pollutant molecules.[83,84] The acid-base properties of oxide catalysts are very important for the development of scientific criteria in catalytic applications. The conversion and selectivity of a reaction not only depends on the nature of active sites, but also on their strength and number.

TiO2-ZrO2 mixed oxide is much focused as a strong solid catalyst since they possess Lewis acid sites, i.e., has co-ordinately unsaturated cationic centres, making them excellent for the replacement of hazardous liquid acid catalysts like HF, H2SO4 and HCl which are mainly used in oil refineries and chemical industries. Besides this, the major advantage of adding ZrO2 into TiO2 is that it increases the surface area which in turn delays the crystallization at higher temperature.

Several studies are carried out in finding the catalytic applications of this binary metal oxide.

A study conducted by J.G. Torres-Torres et al. (2015) shows high yield in the production of 5-HMF from glucose when TiO2-ZrO2 nanocomposite replaces other catalysts.[84] The study also reveals that the catalyst also eliminates the formation of unwanted by products. They also find out that out of many composition ratios of TiO2 and ZrO2 the equal ratio (50:50) provides maximum amount of acid sites.

**Photocatalysis**

TiO2-ZrO2 nanocomposites have also shown great potential in photocatalysis applications. Photocatalysis has emerged as a promising technology for the removal of pollutants from water and air. TiO2 is most commonly used photocatalyst due to its strong oxidizing power and high stability.



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However, its photocatalytic efficiency is limited by its wideband gap, which results in the narrow range of light absorption. Introducing ZrO2 to TiO2 overcome this limitation.[85,86] The incorporation of ZrO2 into TiO2 has been shown to improve its photocatalytic efficiency by increasing light absorption, enhancing charge separation, and improving the surface properties. The synergistic effect between TiO2 and ZrO2 has been attributed to the formation of a heterojunction between the two nanoparticles, which promotes charge separation and transfer. Additionally, the high surface area of nanocomposites provides more active sites for adsorption and photocatalytic reactions.[7,85] A study by Suhail Sabir and et al. Reports that incorporation of ZrO2 to TiO2 enhance band gap also, incorporation of intermediate energy levels expands its absorption edge into the visible light region. The TiO2/ZrO2 composites show an efficient photocatalytic activity for degradation of the organic pollutants such as aqueous PBS effectively.[7]

These finding has significant implications for the development of efficient photocatalysts for environmental remediation and energy conversion applications. Further research is needed to optimize the composition and structure of TiO2/ZrO2 composites for practical use in real-world settings.

## Conclusions and future prospects

In conclusion, the review of $TiO_2$-$ZrO_2$ nanocomposites have shown that they possess unique properties and exhibit improved performance in various applications, such as catalysis, photocatalysis, sensing, and biomedical applications. The incorporation of polymers, metals and metal oxide into this composite enhances its applicability. The synergistic effect between $TiO_2$ and $ZrO_2$ has been attributed to the formation of a heterojunction between the nanoparticles, which enhances their properties and performance.

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# GREEN FINANCING: KEY FOR SUSTAINABLE GROWTH IN KERALA

***Mini B***

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**Abstract**:

Green financing may be defined as the financial support for green growth which reduces greenhouse gasses and air pollutant emissions. The idea of green financing is relatively a new concept. It is a paperless banking; which no longer reduces the cost of banking activities but it also enables the surroundings sustainability. It indicates the growth through the harmony between the economy and the environment. The main aim of this study is to analyze the level of green banking penetration among customers in terms of their awareness and perception. It is the changing face of banking system all over the world. Kerala is popular owing to its literacy and financial literacy rate and hence green financing is necessary for sustainable growth in Kerala. The study is mainly based on both primary and secondary data. The study observed that in Kerala economy green finance market is an emerging stage and it has not been able to attract large number of investors. Therefore it suggested that awareness about the green finance is crucial for the sustainability of the economy .The findings show that green finance has vital role in the environment and for climate change but many challenges such as lack of awareness about green finance.

**Key words**: Green financing ,sustainability, Green bonds.

## INTRODUCTION

The concept of environmental sustainability by the bank has led green financing. Green financing is the subject of sustainable development refers to the increase in financial flows from private and public sector to environment friendly development priorities and helping sustainable development. To achieve such a sustainable growth we use green project and green financing of investment that provide environmental benefits through new financial instruments like green bonds.it plays a crucial role in promoting sustainable development by mobilising financial resources towards environmentally sustainable projects.

In 21$^{st}$ century tremendous changes in green financing especially Kerala have crucial role to maintain sustainable growth. Green financing may be defined as the financial support for green growth which reduces greenhouse gasses and air pollutant emissions. The idea of green financing is relatively a new concept. It is a paperless banking; which no longer reduces the cost of banking



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activities but it also enables the surroundings sustainability. It indicates the growth through the harmony between the economy and the environment. Kerala is popular owing to its literacy and financial literacy rate and hence green financing is necessary for sustainable growth in Kerala.

**Importance of the study**

Green financing is relatively a new concept in the world of banking. It is a type of banking which takes social and environmental attention and basically to achieve sustainable growth. in Kerala it has been found that the Green Banking Practices are infancy stage. So, to identify the present scenario, awareness among users, awareness among customers is highly needed.

**Objectives**

1. To study the concept of green financing and it's role sustainable growth in kerala.
2. To analyse customers perception about green financing and usage among respondents.
3. To analyse the factors influencing the adoption of green financing.

**Research Methodology**

The study is conceptual in nature based on literature review. Both primary and secondary data are used for the study. Primary data can be collected from questionnaire and secondary data from books and journals; website of financial institutions and so on. This creates a background to the study by examining and evaluating other research exhausted the similar area. So a thorough understanding of what has already been done on the world by other research scholars, academicians, politicians and policy makers are quite significant. Varieties of the important reviews among them are:-

Ahuja (2015) gave an overview of literature review about green banking, for making the conceptual framework. She identified problems in the execution of the green concept, where from her review, she identified customer education and awareness is biggest concern and Private sector banks are able to implement the concept in a better way. Later she explores the green initiatives by SBI to describe green banking.

Islam and Das (2013) analysed the green banking practices in Bangladesh. They collected secondary data from bank websites, and studied the statistics on Green fund allocation, online banking and Mobile banking. They concluded that, concept of Green Banking is new in Bangladeshi banks and yet need to be developed. Jeyarani and Thangaraja (2016) gave conceptual foundation for green banking.



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**Results and Analysis**

**Table 1**

**Awareness of Green financing**

| Sources of Awareness | No .of respondents | Percentage |
|---|---|---|
| Bank employee | 06 | 12 |
| Social media | 12 | 24 |
| Friends | 10 | 20 |
| Website | 18 | 36 |
| Other sources | 04 | 8 |
| Total | 50 | 100 |

(Source . primary data )

From the above it may be noted out of 50 respondents, 36% customers aware about green financing through website. It reveals that the awareness level of respondents on green financing .The success and effectiveness of green financing initiates depends on the awareness level of bank customers with regard to green financing products and services and it is ultimately lead to create socially and environment responsible customers as well as citizen.

**Table 2**

**Analysis of usage of Green financing products**

| **Products** | **Usage among customers** | **Percentage** |
|---|---|---|
| ATM | 12 | 24 |
| Mobile banking | 13 | 26 |
| Electronic fund transfer | 07 | 14 |
| Online banking | 16 | 32 |
| Paperless statement | 02 | 4 |
| TOTAL | 50 | 100 |

Source : primary data

Green finance products are being developed appropriately to achieve sustainability. From the above table we can understand 32% customers are used green financing products. So customers aware about the use and importance of green products.



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**Table 3**

**Factors influenced the adoption of green financing services.**

| Factors | No of respondents | Rank |
|---|---|---|
| Ease to use | 12 | II |
| Time saving | 08 | III |
| Convenience | 24 | I |
| Environmental concern | 06 | IV |
| Total | 50 | |

Source . primary data

Convenience is achieved highest rank among the other factors influencing the adoption green financing services.

**Findings**

Green financing preventing environmental deterioration and making the earth eco-friendlier. It plays a part in protecting the world from environmental damage and guaranteed sustainability.

- ✓ out of 50 respondents 36% of people are aware about green financing through website ,24% of people are aware about green financing through social media.
- ✓ out of 50 respondents mostly used green financing service is online banking least used paperless statements.
- ✓ Most customers prefer green financing mainly for convenience.

**Suggestions**

- ✓ Give more awareness to customers about green financing
- ✓ Greening the economy
- ✓ Encourage customers to use online facilities or use green financing products to maintain sustainable economic growth.

**Conclusion**

Green financing is fast emerging as a priority for achieve sustainability. In this study we analyse the role and awareness of green financing in Kerala and our findings indicate that there have been some improvements in public awareness and financing in recent years .it also facilitates a shift to sustainable economic growth. Achievement of sustainable development goals calls for the need to initiate green projects through instruments such as green bonds, green banks, carbon market



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tools, newer financial policies and instruments, a green central bank, while expanding the investment financing that promotes environmental benefits.

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5. Perception on Green Banking Practices In Selected Commercial Banks In Kerala *Sarath Chandran M.C. & **Dr. B. Sathiyabama Journal of Shanghai Jiaotong University



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# ENHANCED SURFACE PLASMON COUPLED FLUORESCENCE EMISSION FROMMETAL DIELECTRIC METAL PLANAR STRUCTURES

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**Abstract**

Fluorescence is a powerful and commonly used technology due to its superior sensitivity, simplicity of detection and quick response. Enhancing the sensitivity of fluorescence-based methods requires directional control and emission enhancement of fluorescence. The coupling of surface plasmons with fluorophores produced directional control over fluorescence via surface plasmon coupled emission (SPCE). In this work SPCE was demonstrated using metal dielectric metal planar structures in Reverse Kretschmann (RK) configuration. The observation of highly directed and increased emission was attributed to the combined effect of activation of plasmon modes and the confinement of photon mode within MDMP structure. Here thin silver film in the nanometer range was used as the metal layer and Polyvinyl Alcohol (PVA) as the dielectric. Randomly oriented fluorescent molecules embedded within the dielectric substrate provided the beaming emission from MDMP structures. The study also investigated the relationship between input excitation power and SPCE emissions.

**Key words**: Surface plasmon coupled emission, Fluorescence, RK configuration

## Introduction

Fluorescence is a widely used technique in biological, medical and chemical fields for sensing, imaging and diagnosis. The majority of fluorescence applications rely on the spontaneous release of photons that are distributed almost isotopically in every direction. Capturing more than one percentage of the total emission is challenging due to this omnidirectional nature of fluorescence. The application of plasmonics and nanophononics to guide and regulate the flow of optical radiation has increased recently [1,2]. It is being researched to customize the optical environment surrounding a fluorescent molecule and consequently affect its emission properties



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using nanometer scaled structures composed of metallic, dielectric or hybrid materials [3-8]. The phenomena of Surface Plasmon Resonance (SPR) associated with emission caused by fluorophores interacting with adjacent metallic films is very interesting due to fluorescence intensification, steering, directionality and emission tuning [9-14]. Controlling the fluorescence emission direction improves the current sensor technology and many chemical, biophysical and medical analysis.

The current research work presents a technique for enhancing emission in Metal-Dielectric-Metal (MDMP) planar structures by coupling the SPR phenomena with fluorescence emission. An analysis of the fluorescence enhancement with changes in excitation power is also conducted. From the fluorophores inserted in MDMP system, we demonstrate an increased spontaneous emission. Additionally, an effort was made to use traditional SPR to correlate the observed Surface Plasmon Coupled Emission (SPCE) enhancement. This might lead to opportunities in the fields of spontaneous emission, optical circuits, micro photonic components and a variety of device applications for both commercial and research purposes.

**Experimental methodology**

Plasmon coupled emission of fluorescence has been studied experimentally using the Reverse Kretschmann (RK) configuration [15,16]. Using a thermal vapour deposition method, a thin metallic layer of silver (~50 nm) was first deposited on a glass slide. Spin coating (3000 rpm) was applied to form a dielectric layer of Poly vinyl Alcohol (PVA) containing fluorescein (FL) above the metal layer. Thickness of the dielectric layer containing fluorescein was ~395 nm. The MDMP structure was completed by depositing another silver layer (~50 nm) on top of PA + FL layer.

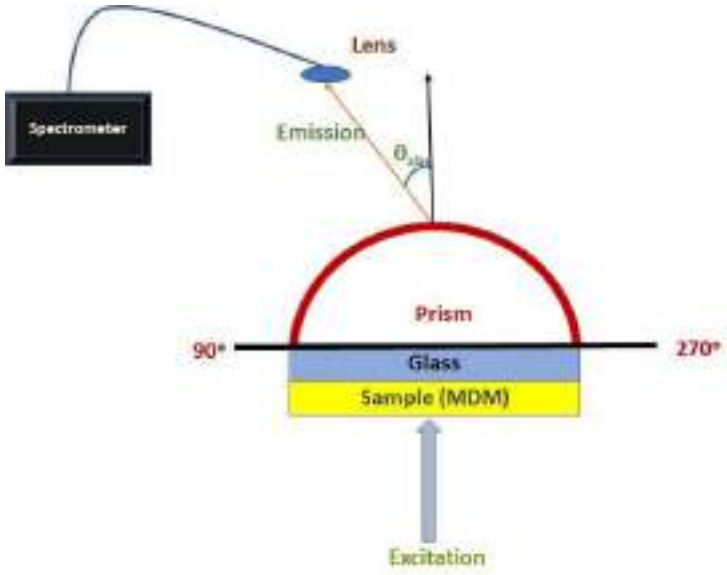


**Figure-1: SPCE experimental set up in RK configuration**



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The resultant MDMP sample fabricated was named as MDM395. The sample was then attached to a hemicylindrical glass prism with glycerol serving as the refractive index matching fluid. In the RK setup, a laser was used to illuminate the samples from the sample side normal to the air side. In order to record the spectra at various angles ranging from 5$^o$ to 90$^o$, the collection optics was set on a rotating stage. The reference angle was determined to be 0$^o$ degrees and was set in the direction opposite to the excitation of laser. The emission spectra were collected by the spectrometer and controlled using the Ocean Optics Spectra Suite software. Figure-1 shows the experimental set up in RK configuration to study the SPCE from the fabricated MDMP structure.

**Results and discussion**

The open-source free software WINSPALL was used to study the surface plasmon resonance of the fabricated structures [17]. It is based on Fresnel equations and Transfer Matrix Model (TMM) simulations [18,19]. SPR curves for Ag/PVA/Ag layers were simulated. A PVA layer of equal thickness was used in place of the PVA + FL layer for simulations. For the sample with dielectric thickness 395 nm, SPR reflection curve was produced by giving the silver and PVA layers with the proper refractive indices. The result is shown in the figure 2. This sample shows two reflection dips, one at 43.4$^o$ and the other at 46.2$^o$. The reflection dip at 46.2$^o$ is observed to have lower reflection intensity compared to other dip.

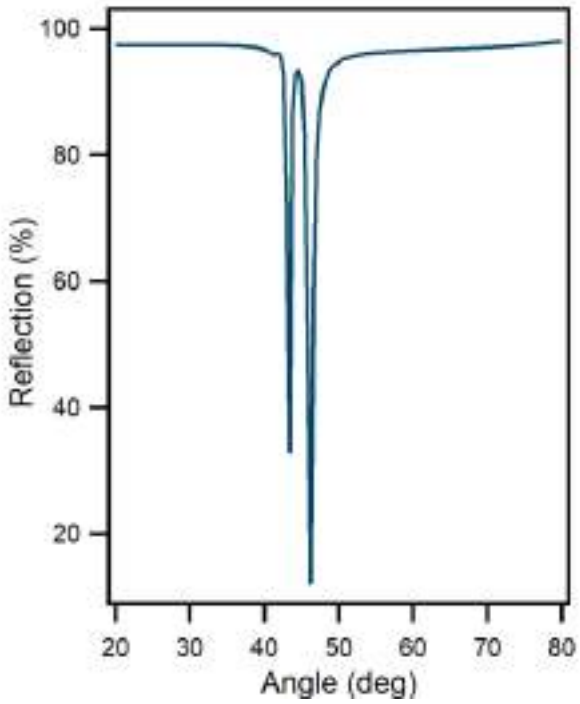


**Figure-2: Simulated SPR reflection curves for the MDMP sample**



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The fabricated sample was subjected to experimental emission analysis in the RK configuration. A diode laser of 480 nm wavelength was used to excite the sample. The sample was attached to the prism with glycerol as refractive index matching liquid. The emission was detected from the prism side. After absorbing the excitation energy, FL molecules released light with wavelengths longer than 480 nm. Because of the surface plasmonic effect, fluorescein molecules emit light with strong directionality. The emission observed at angle 46$^{o}$ was recorded and shown in the figure-3 (a). The observed emission directionality matched with the estimated SPR angles. Thus, a correlation between simulated SPR and the observed emission directionality was able to achieve through this study.

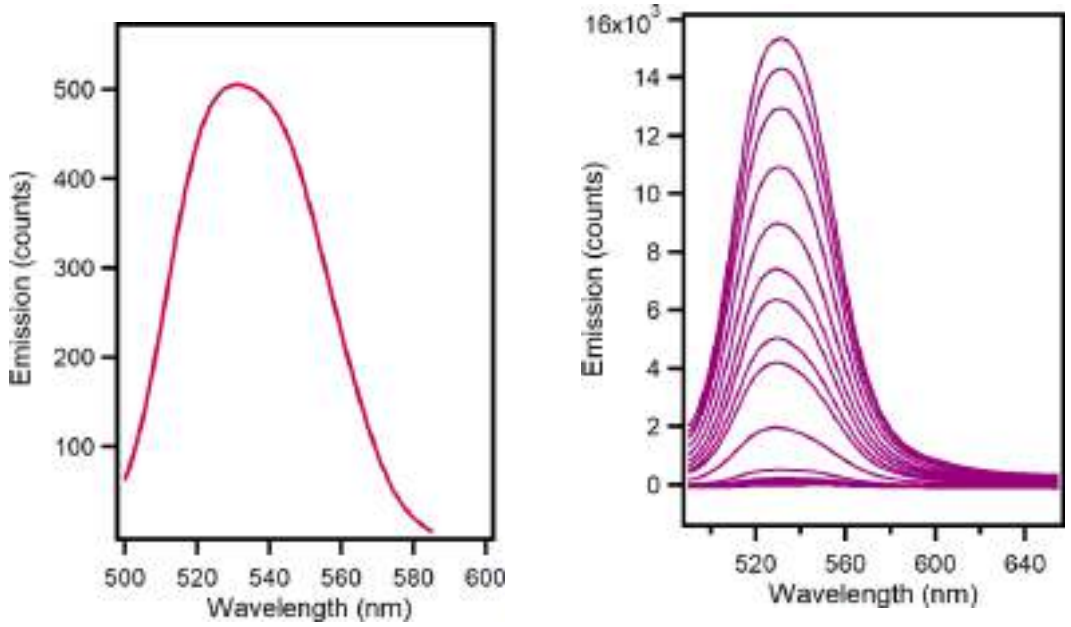


Figure-3: (a)SPCE from sample MDM395 (b) power dependent emission spectra of the fabricated MDM395 structure

Initially the emission was observed for a power of 100mW. Then the emission count was ~550 counts. To understand the effect of variation of the input power on the sample, the power of the excitation radiation was increased slowly. On applying a power of 150mW, the emission intensity was found to be increasing and was about 1900 counts. On further increase in the power, a sudden rise in the emission level was observed other than normal increase in the emission intensity. The emission counts reached up to 15500 for a power of about 200mW (figure-3 (b)). This shows a very high spontaneous and directional emission due to plasmon coupling of the fluorophores. The nature of the variation of the emission intensity with input power is shown in the figure-4. It shows a sudden shoot up in the emission above a threshold input power of 150 mW. Very high increase in the emission intensity was able to achieve from MDMP structures.



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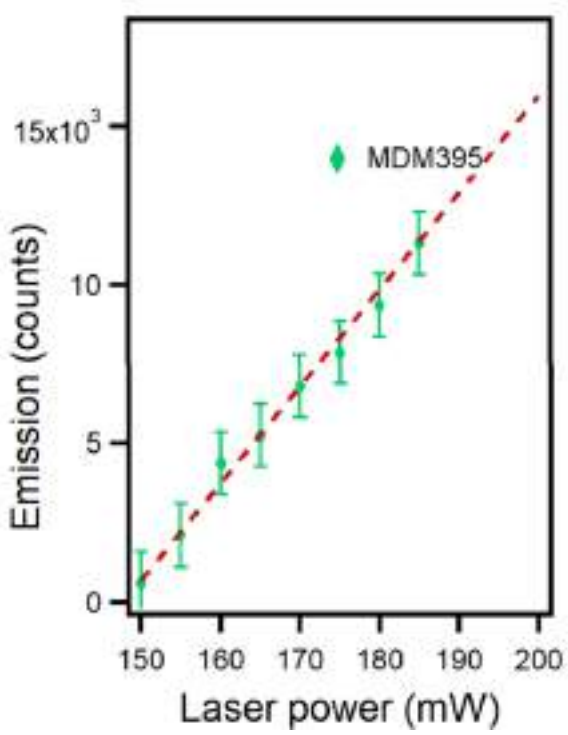


**Figure-4: Emission variation with input power for the sample MDM395**

## Conclusion

Plasmon coupled emission analysis was conducted in the metal dielectric metal planar (MDMP) structures by RK configuration. Directional fluorescence was able to achieve in this study from MDMP structures. A correlation between emission direction and SPR dip of the sample was able to achieve. The power variation studies show a drastic enhancement in the power of the emitted light with slight increase in the power of excitation radiation. Thus, the MDMP structure can produce plasmon coupled emission with directionality and high intensity. Tuning of the input excitation power can change the intensity of the emitted radiation. This study will be a valuable tool in enhancing the sensitivity of optical, biological and chemical sensors.

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# UTILISATION OF COMPREHENSIVE GOVERNMENT HEALTH INSURANCE SCHEME (MEDISEP) IN KERALA

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**Abstract:**

The utilization of the Comprehensive Government Health Insurance Scheme (MEDISEP) in Kerala has emerged as a crucial aspect in enhancing healthcare accessibility and affordability. This abstract explores the trends, challenges, and outcomes associated with the implementation of MEDISEP, focusing on its impact on healthcare utilization patterns among the population. By analyzing data from diverse sources, including patient records, surveys, and government reports, this study aims to provide insights into the extent to which the scheme has succeeded in achieving its objectives. The utilization of government employees' health insurance through MEDISEP in Kerala lies in its potential to illuminate critical aspects of public sector healthcare provision. By examining the adoption rates, impact, and challenges associated with this specialized insurance scheme, this research contributes valuable insights into the well-being and job satisfaction of government employees, fostering an understanding of the link between healthcare access and public workforce productivity. Furthermore, as MEDISEP serves as a noteworthy example of state-sponsored healthcare initiatives. The findings of this research contribute valuable insights for policymakers, healthcare professionals, and researchers aiming to optimize government health insurance schemes. By understanding the nuances of MEDISEP utilization in Kerala, stakeholders can work collaboratively to refine the scheme, ensuring that it continues to be a cornerstone in promoting health equity and well-being in the region.

**Keywords:** coverage, health insurance, insurance utilization, out of pocket expenses (MEDISEP)

## Introduction:

In the Indian state of Kerala, the utilization of government health insurance has reached new heights with the introduction of the "Medical Insurance for State Government Employees in Kerala" (MEDISEP). This pioneering initiative stands as a testament to Kerala's commitment to the well-being of its public workforce. As a comprehensive health insurance scheme tailored specifically for government employees, MEDISEP holds the potential to not only safeguard the health of this vital demographic but also to serve as a blueprint for innovative, sustainable, and equitable healthcare provision within the public sector. This study embarks on a journey to unravel the intricacies of



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MEDISEP, examining its historical underpinnings, the extent of its adoption among government employees, and the impact it has had on the overall health and well-being of this workforce. By doing so, it seeks to shed light on the significance of such initiatives within the broader context of healthcare access and the welfare of government employees in Kerala.Through an in-depth exploration of MEDISEP, this research aims to provide valuable insights into the evolving landscape of public health insurance within the public sector and its implications for government employees in Kerala. Additionally, it seeks to examine the challenges and opportunities that lie ahead, ultimately contributing to a better understanding of the role that government health insurance can play in ensuring the health and security of those who serve the public interest.

K Swathi and R Anuradha (2017), Health insurance in India- An overview. The paper highlights the concept and benefits of health insurance besides presenting an overview of health insurance sector in India. A brief of number of persons covered under various schemes such as government sponsored, group insurance, family insurance, individual policies is portrayed. Sector wise health insurance policies along with number of persons covered by public, private and specialized insurers are depicted. Suggestions of the study are for government to introduce new health insurance schemes for welfare of the common people. The Insurance Regularity and Development Authority (IRDA) is suggested to take initiatives to promote competition in health insurers as available in telecom service providers. Government is also advised to conduct awareness campaigns to inform people about benefits of taking health insurance policies.

**Research problem:**

To what extent and by what factors is the utilization of the MEDICEP health insurance program influenced among government employees in Kerala? This study seeks to identify the determinants affecting enrollment, healthcare access, and overall satisfaction with the scheme, with a focus on understanding the impact of demographic, socioeconomic, and organizational factors on its usage. Additionally, it aims to address the challenges and barriers that may hinder optimal utilization, thereby offering insights into potential areas for improvement in this crucial healthcare initiative."

**Objectives:**

1.To Evaluate the cost-effectiveness of (MEDISEP)

2.To Measure satisfaction and the quality of care received

3.To Investigate the affecting factors for utilizing the coverage



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**Methodology**:

The study is based on primary data collected randomly from Kerala. The study will use statistical tools such as percentage distribution bar diagram, cross tabulation, one way ANOVA test and chi square test to analyze and interpret the data. The secondary data were collected from different authentic sources including articles, journals, websites etc. All data analyses were performed using Statistical Package for Social Sciences for Windows version 17.0 (SPSS Inc, Chicago, IL).

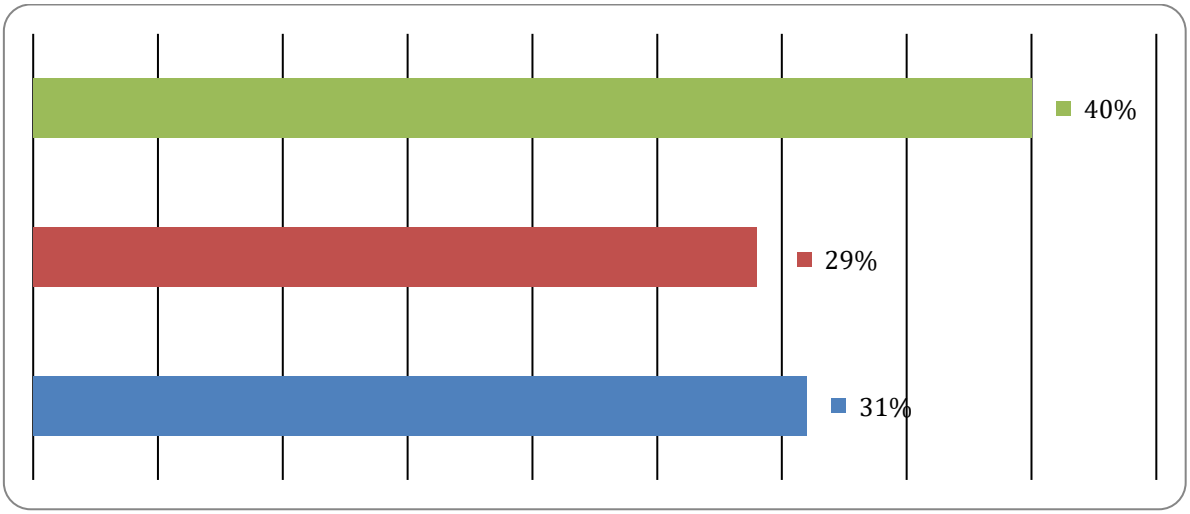
## ANALYSIS AND INTERPRETATIONS:

Analyzing Kerala's utilization of the (MEDISEP) comprehensive government health insurance scheme is the primary goal of the research. Hundred samples of government workers in Kasarkode, Palakkad, and Malappuram provided the data. The basic result of the study has been discussed below.

**TABLE 1: Regarding cost effectiveness**

| OPTIONS | NO OF RESPONDENTS | PERCENTAGE |
|---|---|---|
| COST EFFECTIVE | 31 | 31% |
| NEUTRAL | 29 | 29% |
| NOT COST EFFECTIVE | 40 | 40% |
| TOTAL | 100 | 100% |

**CHART 1 : Regarding cost effectiveness**



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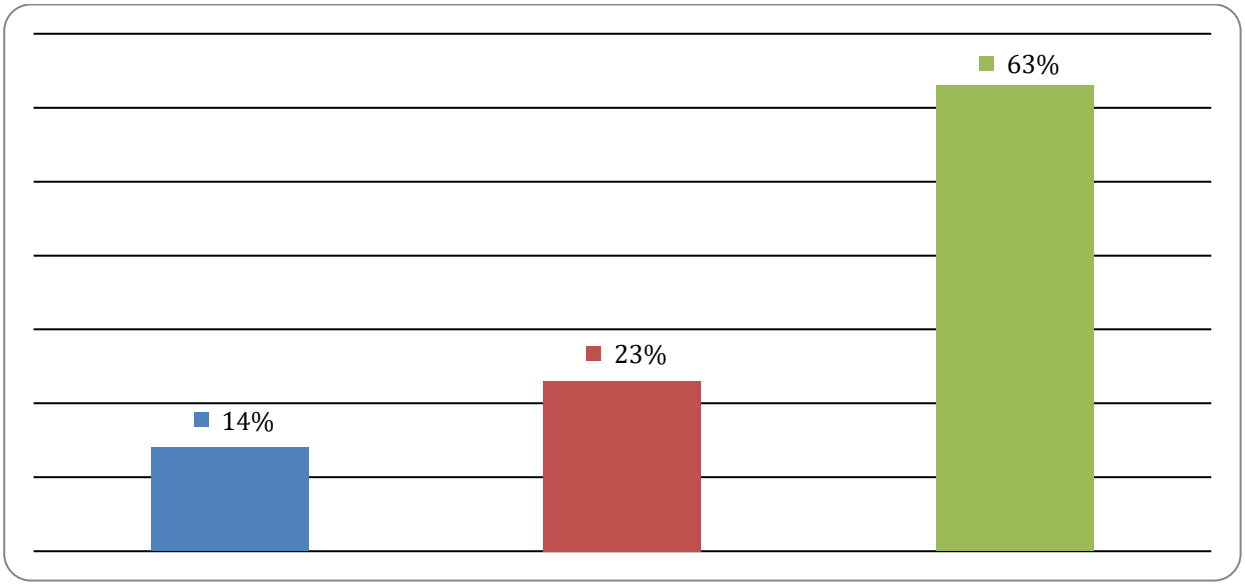
The graph reveals that 40% of respondents are considering MEDISEP as a not cost-effective scheme and 31% stands with cost effective other 29% are in a stand of neutral.

**TABLE 2: Regarding Satisfaction level of (MEDISEP)**

| OPTIONS | NO OF RESPONDENTS | PERCENTAGE |
|---|---|---|
| SATISFIED | 14 | 14% |
| NEUTRAL | 23 | 23% |
| DISSATISFIED | 63 | 63% |
| TOTAL | 100 | 100% |

**CHART 2: Regarding Satisfaction level of (MEDISEP)**




The graph shows that 63% of respondents are dissatisfied with the MEDISEP scheme and 23% stands with a neutral and remaining 14% are satisfied with the scheme.

**TABLE 3: Regarding 24 hours compulsory treatment for claim**

| OPTIONS | NO: OF RESPONDENTS | PERCENTAGE |
|---|---|---|
| AGREE | 23 | 23% |
| DISAGREE | 77 | 77% |
| TOTAL | 100 | 100% |



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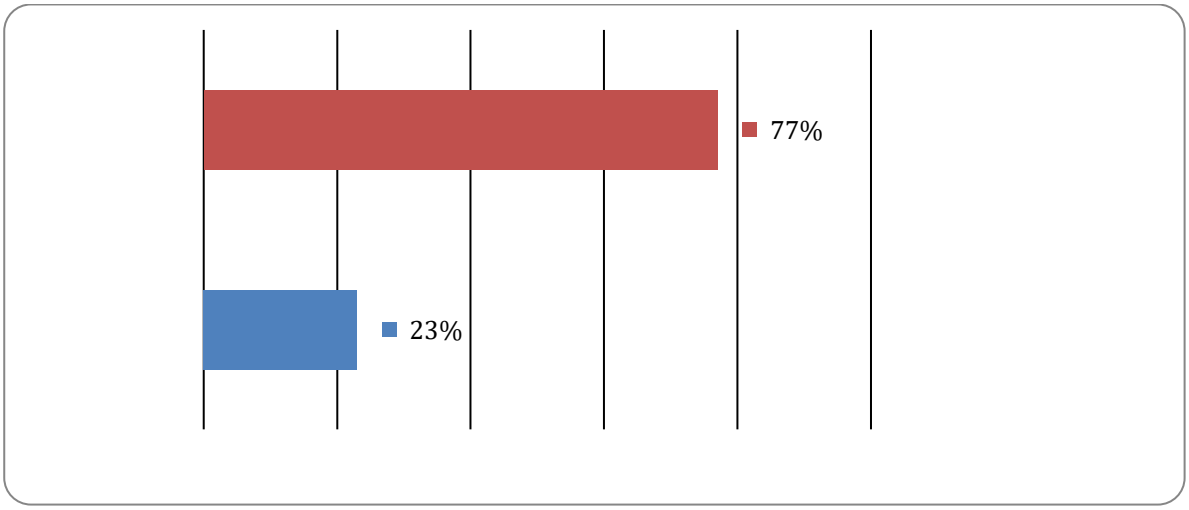
**CHART 3: Regarding 24 hours compulsory treatment for claim**

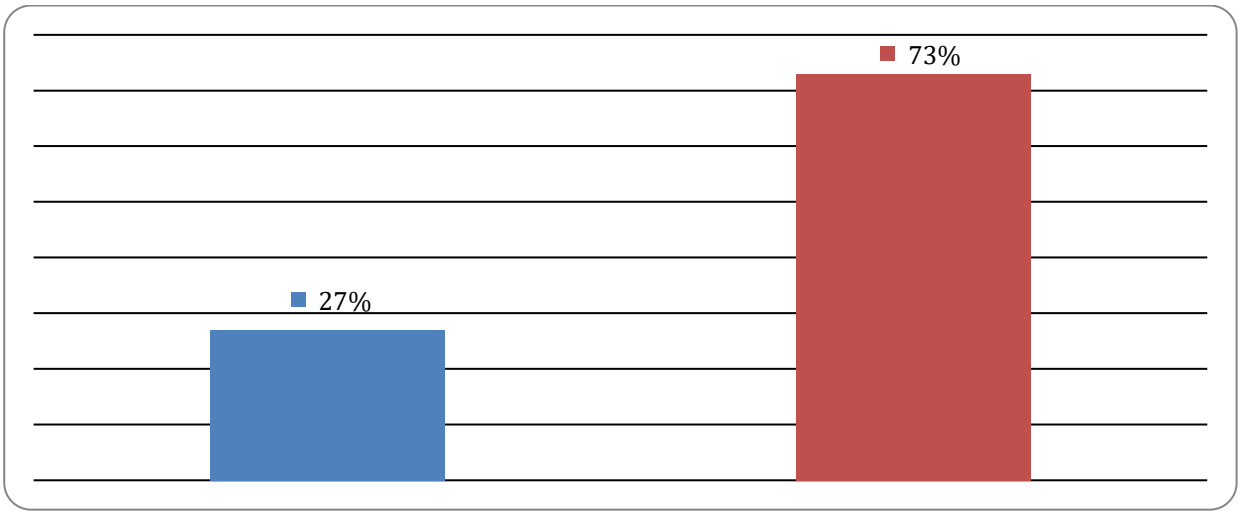



The graph reveals that 77% of respondents are considering 24 hours compulsory treatment as a affecting factor for utilizing the coverage, and 23% of them are agree with it.

**TABLE 4: SECTORS WHICH PROVIDE BETTER INSURANCE POLICY**

| SECTORS | NO.OF RESPONDENTS | PERCENTAGE |
|---|---|---|
| GOVERNMENT SECTOR | 27 | 27% |
| PRIVATE SECTOR | 73 | 73% |
| **TOTAL** | **100** | **100%** |

**CHART 4: SECTORS WHICH PROVIDE BETTER INSURANCE POLICY**




The graph depicts that the majority (73%) of the government employees are considered the private sector as a better insurance providers. and remaining 27% of them are with government sector.



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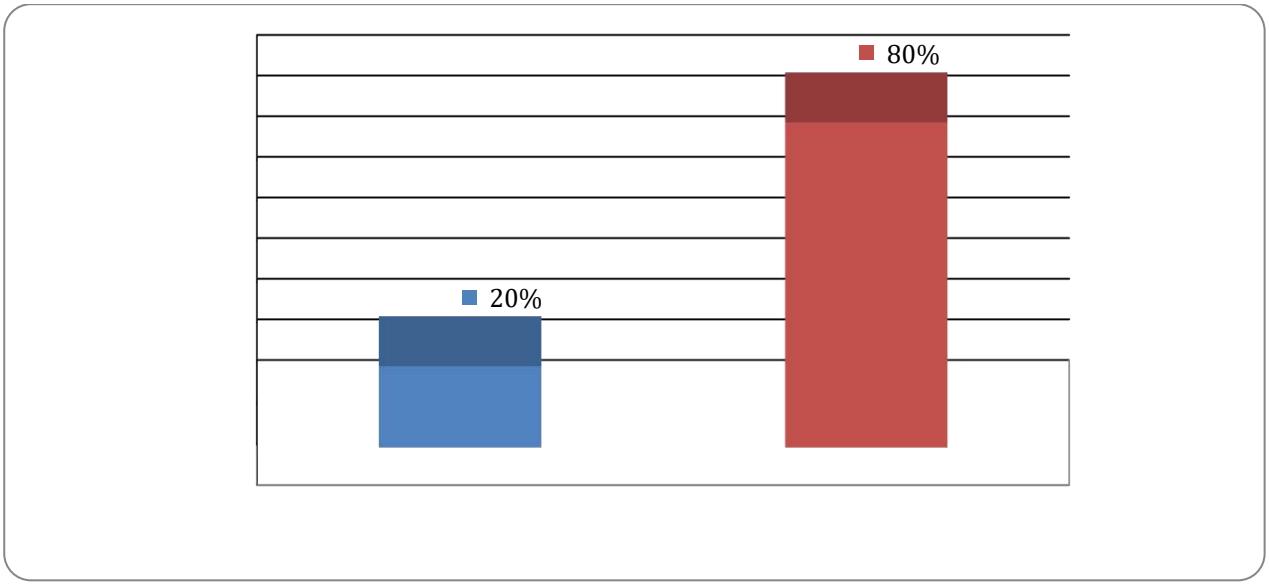
**TABLE 5: COMFORTABILITY WITH THE ANNUAL COVERAGE UPTO (3 LAKH)**

| OPTIONS | NO: OF RESPONDENTS | PERCENTAGE |
|---|---|---|
| YES | 20 | 20% |
| NO | 80 | 80% |
| **TOTAL** | **100** | **100%** |

**CHART 5: COMFORTABILITY WITH THE ANNUAL COVERAGE UPTO (3 LAKH)**




The graph depicts that the most of the (80%) government employees are not comfortable with the annual coverage 3 lakh per year only 20% are comfortable with the annual coverage.

**Findings of the study**

- The majority of respondents evaluated (MEDISEP) as neutral in terms of cost effectiveness
- when measuring the degree of satisfaction majority of them take a neutral stance.
- Based on our research some things hinder the respondents from using the (MEDISEP)
- The majority of them sign up for (MEDISEP) because its mandatory for government employees.
- Most of the respondents oppose the annual coverage of up to 3 lakh per year (MEDISEP)
- The respondents are strongly believes that the private insurance are better than government health insurance.

**SUGGESTIONS**

- Expand the number of private hospitals offering treatment for (MEDISEP) holders
- Expand the list of deceases under (MEDISEP)



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- Raise the yearly coverage to five lakh instead of three lakh
- Make (MEDISEP) an easy to use
- Avoid for compelling government employee to enroll in (MEDISEP)
- Only one government employee per family may register for (MEDISEP) if there are two or more.
- Implement the reimbursement method.

**CONCLUSION:**

The use of the comprehensive government health insurance scheme (MEDISEP) by government workers is considered as a worthless scheme. Most of the employees enrolled in this scheme only because it was required for government employees. A portion of them disagree with the coverage provided by MEDISEP, while others have critiqued the procedures and certain elements affecting the schemes utilization. from an overall perspective a bulk of government workers are against this policy while no additional benefit has been given to government employees. In the current scenario the government considered the MEDISEP as a burden because of financial crisis experiencing by the Kerala government. While concluding, the study advises that in order to erase all the challenges and problems facing the MEDISEP scheme, the government should take sudden action to ensure the well-being and better health of government employees and improve their allegiance to the government.

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# GENDER DIFFERENCE IN WEALTH ACCUMULATION: A COMPARATIVE STUDY ON DIFFERENT INCOME CLASSES WITH SPECIAL REFERENCE TO MANNARKKAD MUNICIPALITY

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***Abstract*:**

The study tries to examine the gender difference in wealth accumulation: A comparative study on different income classes based on the samples collected from Mannarkkad municipality. A comparative study examining gender differences in wealth accumulation across various income classes is of paramount significance in the realm of economic and social analysis. Such research can unveil the complex interplay of factors that contribute to disparate weal outcomes for men and women, shedding light on the structural and societal barriers that perpetuate gender disparities in wealth. By scrutinizing variations across income strata, this study can elucidate whether the gender wealth gap widens or narrows as individuals move up or down the income ladder, thereby informing targeted policies and interventions to promote greater gender equity in wealth accumulation. Furthermore, the findings can underscore the importance of addressing the unique financial challenges faced by women in different income groups and the implications for broader economic inequality and social justice.

**Key words**: Gender difference, Wealth, income classes

## Introduction

The difference in wealth accumulation is a major concern for people all over the world, and Kerala, a state in South West India, is no exception. Kerala is renowned for its relatively high human development indicators, including literacy, life expectancy and health care. Nevertheless, despite these encouraging social indicators gender inequality remains a challenge, especially when it comes to wealth accumulation. This study will also examine how different income classes affect Kerala's wealth accumulation. Jeremy Freese of North-western University and James D. Montgomery of the University of Wisconsin postulate that psychological differences could throw light on gender differences in religiosity. They advocate for more research into which psychological aspects are most influential on religious devotion and how differences are shaped by genes and social environments. Baylor University sociologist Rodney Stark postulates that men’s physiology – specifically their generally higher levels of testosterone – accounts for gender differences in religion.



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His argument rests on what he views as increasing evidence that testosterone is associated with men's greater propensity to take risks, which he argues is why men are less religious than women. Causes of wealth gap Labour market inequality leads to an earnings inequality, which, in turn , leads to wealth inequality The gendered nature of economic inequality is a persistent phenomenon in many countries. Despite extensive research on gender differences in income and pay, the Gender Wealth Gap (GWG) only recently gained more scrutiny from social scientists across various disciplines (Deere and Doss Citation2006; Sierminska, Frick, and Grabka Citation2010; Ruel and Hauser Citation2013; Grabka, Marcus, and Sierminska Citation2015; Lersch, Jacob, and Hank Citation2017; Schneebaum et al. Citation2018). we reason that women's position in the occupational class structure does not only exacerbate gender wage differentials but also restricts women from wealth accumulation. Hence, the aim of our paper is to pursue an integrative approach studying three dimensions of inequality – gender, wealth, and occupational class – together. We assume that the association between these three dimensions varies along the wealth distribution – given the strong concentration of wealth at the top and the crucial role of gendered occupational segregation in wage dispersion. Therefore, we investigate gender differences in wealth and their association with occupational classes among the working population at different points of the wealth distribution.

**Research problem**

Gender difference is an important problem in wealth accumulation. It is a multifaceted problem with complicated social, economic, cultural and religious interactions. The gender difference in Kerala continues to be a problem, affecting various aspects of women's lives as well as the general development of the state. Excessive inequality can erode social cohesion, lead to political polarisation, and lower economic conditions. Gender difference in wealth accumulation is an issue that concerns men and women, that exists in economically, politically and institutionally. It is imperative to discuss the gender differences that still exists in various income classes. There are many studies related to wealth accumulation but these studies do not discuss the gender difference in wealth accumulation of different income classes. This study mainly focused on comparative study.

**Objectives**

- ✓ To understand the socio-economic condition of respondents
- ✓ To examine the income and employment status of the respondents
- ✓ To differentiate the gender wise distribution of income and wealth accumulation of respondents among different income classes



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**Methodology**

The study is based on primary data collected randomly from Mannarkkad municipality. The study will use statistical tools such as percentage distribution bar diagram, cross tabulation, one way ANOVA test and chi square test to analyse and interpret the data. The secondary data were collected from different authentic sources including articles, journals, websites etc.

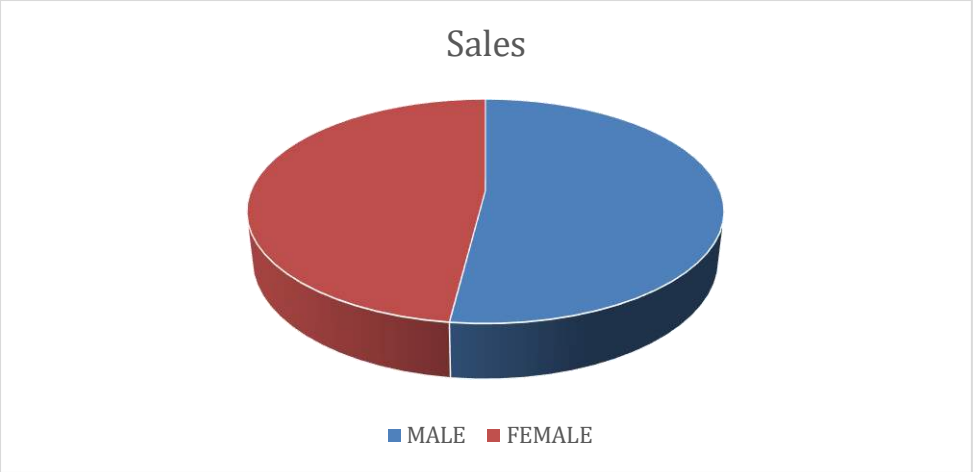
## ANALYSIS AND INTER PRETATIONS

The main purpose of the study is to analyse the gender difference in wealth accumulation a comparative study on different income classes: A special references to mannarkkad municipality by collecting data from 100 samples. The basic result of the study has been discussed below

**TABLE :1 GENDER**

| GENDER | No of RESPONDENT | PERCENTAGE |
|---|---|---|
| **Male** | **52** | **52.0%** |
| **Female** | **48** | **48.0%** |
| **Other** | **0** | **0** |
| **Total** | **100** | **100%** |

**CHART 1: GENDER**




**Above table show 52.% of respondents are male. And 48% of samples are female.**



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**TABLE 2: Annual Income**

| INCOME CLASSES | NO. OF RESPONDENTS | PERCENTAGE |
|---|---|---|
| Blow 1 lakhs | 51 | 51.0% |
| 1 lakh to 5 lakhs | 35 | 35.0% |
| Above 5 lakhs | 14 | 14.0% |
| | 100 | 100% |

**CHART 2: Annual Income**

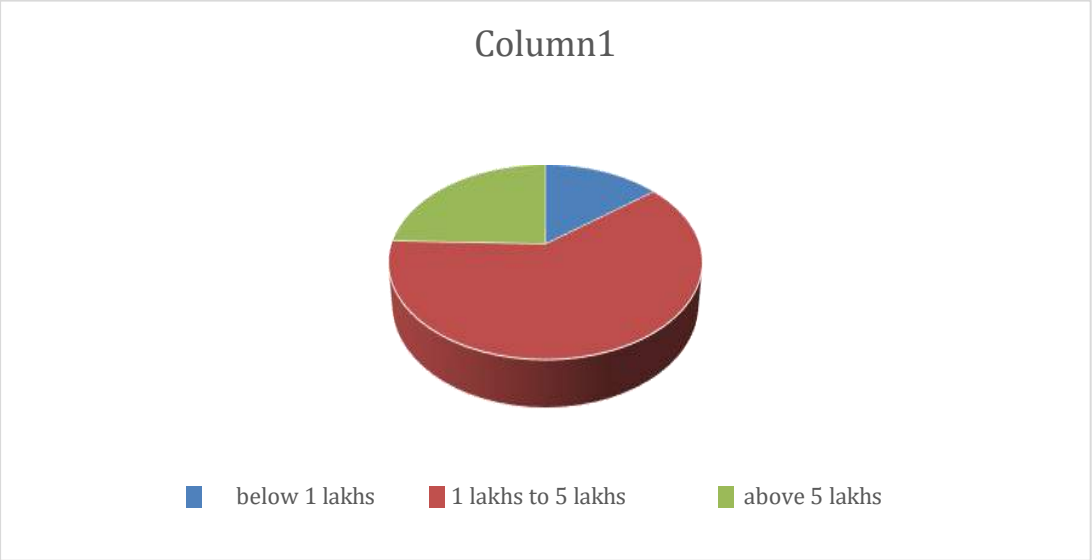


Table shows that 51% of the sample are including in low income and 35% of the sample including in middle income and 14% of sample are including in high income

**TABLE 3: Regarding financial literacy in gender**

| OPTIONS | NO OF RESPONDENTS | PERCENTAGE |
|---|---|---|
| Yes | 60 | 60.6% |
| No | 39 | 39.4% |
| Total | 100 | 100% |



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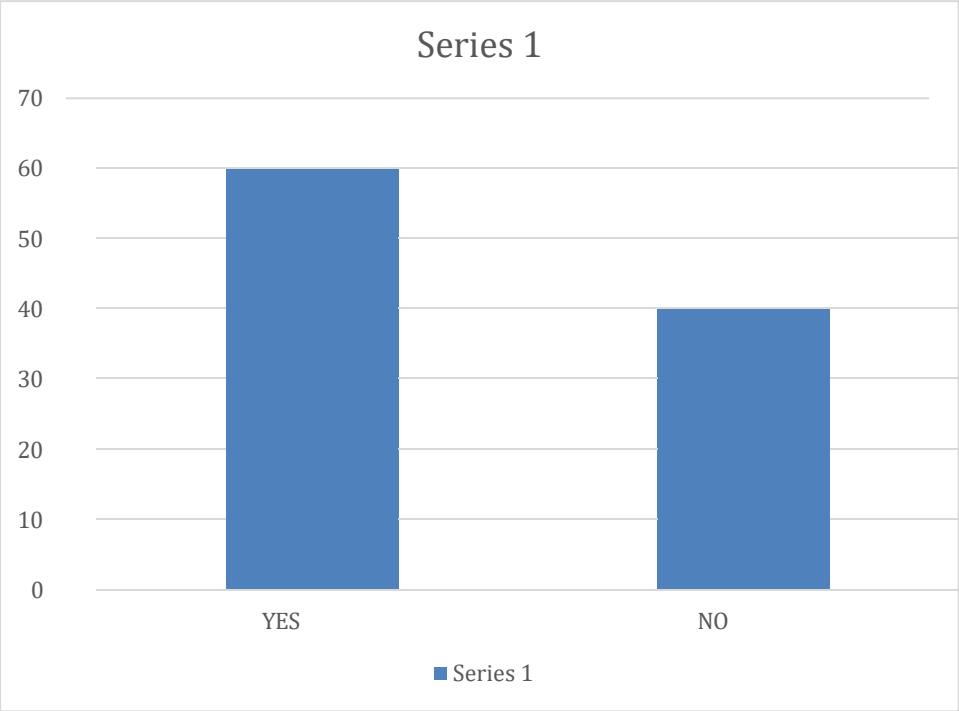
**CHART: 3 Regarding on financial literacy in gender**




Above the table shows the variation of financial literacy in gender. The 60.6% of the samples are agreed the statement 39.4% of samples are not agree with the statement

**TABLE :4 Regarding family responsibility will affect the career**

| OPTIONS | NO. OF RESPONDENTS | PERCENTAGE |
|---|---|---|
| Yes | 56 | 56.6% |
| No | 43 | 43.4% |
| Total | 100 | 100% |



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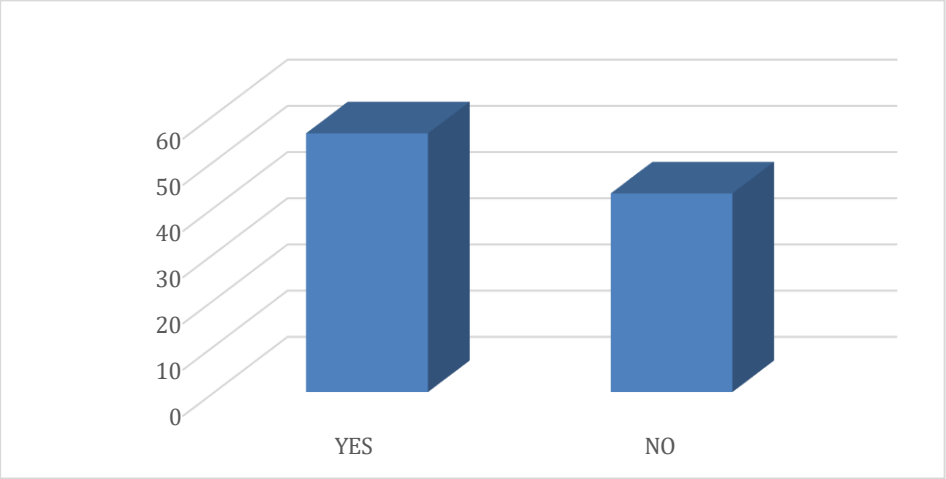
**CHART:4Regarding on family responsibility and career**




Following table shows response about the family responsibility and career. 56.6% of samples are agreed and 43.4 % are not agreed

## Findings of the study:

- We can find the majority of samples are including in low income family
- In this study the 54.5 percentage of sample are agreed the financial literacy varying in gender
- We can find there is an differences. In financial literacy
- This study indicates 56.6 percentage of samples agreed the family responsibility will affect the career

## Suggestions:

- Improving the financial literacy among both gender
- Both genders are equally participated in family responsibility
- Give awareness to the gender neutrality in family responsibility and ownership of wealth

## Conclusions:

The work gender differences in wealth accumulation a comparative study on different income classes this study mainly point out that there in some differences in gender. That are financial literacy will varying in gender and the case of family responsibility they have no equal consideration in both genders. in the modern society need better awareness in gender studies and also the family will maintain the equality in gender.



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# WASTE MANAGEMENT: A PATHWAY TO HEALTHIER EARTH AND POVERTY REDUCTION

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**ABSTRACT:**

This abstract explores the multifaceted role of waste management as a transformative force in achieving both environmental sustainability and poverty reduction. The paper highlights the interconnectedness of effective waste management strategies with public health, economic development, and social equity. Emphasizing the environmental conservation benefits, the study examines how proper waste disposal and recycling practices contribute to the preservation of ecosystems, prevention of diseases, and the overall improvement of public health. Furthermore, the paper delves into the economic opportunities generated by waste management initiatives, showcasing how job creation, resource recovery, and the promotion of a circular economy can alleviate poverty at the local level. Community empowerment and inclusivity are discussed as critical components, emphasizing the importance of engaging local residents in waste management programs. The role of infrastructure development, inclusive policies, and global cooperation are also explored, underscoring the need for government leadership, regulations, and international collaboration to address the global challenges of waste management. The abstract concludes by mentioning innovative technologies and its comprehensive approach to waste management, offering insights into how a well-rounded strategy can contribute to a healthier Earth and significant strides in poverty reduction.

**Key Words**: - Sustainability, Waste Management, Ecosystems, Public Health, Poverty, Job Creation

## Introduction

Earth's health and human poverty are two of the biggest problems facing the world today. This paper tries to focus on that the proper waste management can be used as a remedial measure for both these problems.

Waste management is a crucial aspect of sustainable development. The improper waste management of households poses a significant and immediate threat to the life of Earth and humans. In many regions, inadequate waste disposal practices contribute to environmental pollution, soil degradation, and water contamination. Improperly discarded household waste, including plastics, electronic devices, and hazardous materials, often ends up in landfills, where it releases harmful



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chemicals that can seep into the ground and contaminate water sources. Incineration of waste in some cases adds pollutants to the air, compromising air quality and affecting respiratory health.

The Improper waste management also affect the health of local communities directly. The pollutants from improperly managed household waste can lead to a range of health issues. Adopting responsible waste disposal habits, promoting recycling, and educating communities about the importance of proper waste management, we can mitigate these threats and foster a healthier and more sustainable future. Thus, effective waste management can contribute to a healthier earth and poverty reduction.

This research paper aims to explore the relationship between waste management and sustainable development and waste management and poverty reduction. It will examine the various waste management strategies that can be adopted to reduce the negative impact of waste on the environment and society. The paper will also highlight the potential benefits of effective waste management, such as the creation of job opportunities, and the promotion of public health.

In relation with the topic 'Waste Management: A Pathway to Healthier Earth and Poverty Reduction', the researcher considers the following as the research problems.

1. Tries to identify the various effective waste management systems in Kerala.
2. Explain the relationship between effective waste management and the health of earth.
3. How the effective waste management can be converted as an income to the households?

**Methodology**

The present study is constructed on the basis of SWOT analysis. For this the facts are considered from Kerala, in India. The datum used for the analysis are secondary, which are mostly collected from articles and publications of government and similar authorities. The facts from text books and websites are also considered for the case study.

**Waste Management System**

Waste management system encompasses a comprehensive approach that begins with waste reduction strategies and extends to proper collection, segregation, recycling, and disposal. Government regulations and policies play a crucial role in shaping and enforcing waste management practices, with public awareness.

In Kerala, waste management systems have been a focal point of the state's environmental policies and initiatives. The government has implemented various strategies to address the challenges of waste management. The state has adopted a decentralized approach to waste management, which involves the segregation and processing of waste at the source to the maximum extent possible and



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then at the community level. The state has been at the forefront of organic waste management, with the implementation of decentralized composting units and biogas plants in many localities.

The Kerala Solid Waste Management Project (KSWMP) is a comprehensive initiative that aims to provide sustainable waste management solutions for urban local bodies in the state. The project is implemented in 93 municipalities of the state with the support of the World Bank and the Asian Infrastructure Investment Bank at a cost of Rs 2400 crore.

The Haritha Kerala Mission is the state government's flagship program for promoting sustainable development, waste management, and environmental conservation in Kerala. The mission emphasizes community participation in maintaining cleanliness, waste segregation, and promoting green practices. Haritha Karma Sena is a professional team consisting of Kudumbashree Women who are assigned with the responsibility of collection, transportation, processing, recycling / disposal, and management of waste materials in association with respective LSGs and Suchithwa Mission. The powers to select Haritha Keralam Sena are with the local bodies. The Kudumbashree Mission works with Haritha Keralam Mission, Suchitwa Mission, and Clean Kerala Company for a garbage-free Kerala

There are some leading solid waste management agencies in Kerala, with years of experience. They follow decentralized food waste processing through an aerobic system that generates high-quality organic compost. Their power-operated automatic Organic Waste Converter helps quick conversion of food waste to compost. CCC Zero Waste P Ltd is an example for such agencies in Kerala.

Similarly, Djunk, another waste recycling company in Kerala, collects, transports, segregates, and recycles all kinds of trash. They collect electronic wastes to hazardous medical wastes like diapers, sanitary pads, expired medicines, etc. It’s awarded as one of the top waste management start-ups in India by Industry outlook magazine.

Additionally, Kerala has also emphasized the importance of source segregation of waste to facilitate efficient recycling and disposal. The state has also been proactive in promoting public awareness and participation in waste management through campaigns and educational programs.

**Effective waste management and earth’s health**

Effective waste management in Kerala has had a positive impact on the health of the Earth by mitigating environmental pollution and promoting sustainability. The implementation of decentralized waste management practices, including source segregation, composting, and recycling, has significantly reduced the burden on landfills and minimized the release of harmful greenhouse gases associated with organic waste decomposition. By diverting organic waste from landfills and converting it into compost and biogas, Kerala has not only reduced methane emissions but has also



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contributed to the conservation of valuable landfill space. Furthermore, the emphasis on community participation and awareness campaigns has fostered a culture of environmental responsibility, leading to cleaner and healthier surroundings.

**Waste Management as an Income to Households**

Waste management can be a source of income for households. According to the World Bank, waste generation is positively correlated with income level. High-income countries generate about 34% of the world's waste, while low-income countries generate only 16%. In low-income countries, waste collection rates are lower than in high-income countries. However, some households in low-income countries have found ways to turn waste into a source of income. Households can actively participate in recycling programs, collecting and segregating materials like paper, plastics, metals, and glass. By selling these recyclables to collection centers or participating in buy-back schemes, families can generate additional income while contributing to environmental conservation. Informal waste pickers, often operating in marginalized communities, play a significant role in the recycling chain. Furthermore, waste-to-energy projects can provide opportunities for job creation and income generation.

According to a report by the Local Self Government Department of Kerala, the state has made significant strides in decentralized solid waste management. The report highlights the role of Haritha Karma Sena (HKS) responsible for waste collection and waste management in the state. They also ensure assistance from Green Aid Institution if required and are looking for new income opportunities by starting green enterprises that manufacture new products from waste materials. The report also mentions that HKS members receive remuneration for their services. The average income of HKS members is one of the factors that determine the willingness to pay for household solid waste management in Kerala.

**Results and Discussions**

A SWOT analysis is a strategic planning tool that can be used to evaluate the Strengths, Weaknesses, Opportunities, and Threats of a business or project. In the context of waste management, a SWOT analysis can help identify areas for improvement and growth.

Here are some possible points for a SWOT analysis of waste management as a pathway to healthier earth and poverty reduction:



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**Strengths:**

1. Waste management can lead to a healthier earth by reducing pollution and preserving natural resources.
2. Waste management can promote sustainable development and environmental conservation by encouraging recycling and reuse of materials.
3. Proper waste management can reduce the spread of diseases and improve public health.
4. Proper waste management can create job opportunities and contribute to poverty reduction by providing employment in recycling, waste collection, and waste treatment industries.
5. Engaging communities in waste management initiatives empowers individuals, fosters a sense of responsibility, and enhances environmental consciousness.

**Weaknesses:**

1. Inadequate infrastructure and technology for waste management in many regions can hinder effective waste management practices.
2. Lack of awareness and education about proper waste disposal and recycling can lead to improper handling of waste and increased pollution.
3. Waste management can be expensive, and many communities lack the funding necessary to implement effective waste management programs.

**Opportunities:**

1. Education campaigns can help raise awareness about the importance of proper waste management and how to properly dispose of waste.
2. Emphasis on waste management can lead to the creation of green jobs, contributing to economic growth and poverty reduction.
3. Advances in technology can help improve waste management, such as new recycling methods, waste-to-energy technologies, and more.
4. Partnerships between governments and private companies can help fund and implement waste management programs

**Threats:**

1. Rapid urbanization and population growth can lead to increased waste generation, putting pressure on existing waste management systems.
2. Inadequate government policies and regulations can lead to ineffective waste management practices and increased environmental pollution.
3. Limited public and private sector investment in waste management infrastructure and technology can hinder progress in waste management efforts.



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## Conclusion

In summary, waste management has the potential to be a powerful tool for creating a healthier Earth and reducing poverty. Addressing weaknesses and threats, while capitalizing on strengths and opportunities, is crucial for maximizing the positive impacts of waste management on both environmental health and poverty alleviation.

## Acknowledgement

I express my sincere gratitude for the opportunity to present my paper, "Waste Management: A Pathway to Healthier Earth and Poverty Reduction," at the MESKCON, an International Conference conducted by MES Kalladi College, Mannarkkad. I am honored to have been selected to participate in this prestigious event.

I would like to thank Dr.C. Rajesh, the Principal, MES Kalladi College, Mannarkkad, and conference coordinators for their hard work and dedication in putting together such a wonderful event. I would also like to express my appreciation to my colleagues who have supported me throughout this project. Their encouragement have been invaluable.

Thank you again for this wonderful opportunity. I look forward to presenting my paper at the conference.

Sincerely,

Athika M K

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# SEX DETERMINATION USING EAR PINNA MEASUREMENTS

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## ABSTRACT

Ear lobe and morphology provide valuable information about gender and age and play an important role in forensic investigations. In addition, morphometric analysis of the ear proves to be decisive in the clinical diagnosis of congenital malformations and syndromes. This study focuses on gender prediction using 40 subjects (20 male, 20 female) students aged 18-23 years at Aditya Degree College, Surampalem, East Godavari District, Andhra Pradesh. The aim is to determine the relationship between ear surface measurements and gender. Four linear dimensions - ear length, ear width, ear cartilage and ear length - were measured and compared. The findings suggest a correlation between these ear measurements and gender, providing a basis for gender prediction in forensic applications. This has significant implications for law enforcement and medical professionals. The study highlights the potential use of manual measurement for accurate gender assessment of adults. Such knowledge increases the efficiency of forensic practices and provides a non-invasive and reliable method for gender determination. This study provides valuable information for both forensic investigations and clinical diagnoses of ear-related diseases and highlights the importance of ear morphometry in understanding sex- and age-related characteristics.

**Keywords:** Auricle, morphometry, forensic examination, gender determination, linear measurements, clinical diagnosis.

## INTRODUCTION

In Medicolegal investigations, personal identification is one of the main tasks of forensic investigators. Sex determination can lead to narrowing down to look out of the person for the investigative purpose. An ear is a 2-d duplicate of an auricle, that can make touch with diverse surfaces and can produce print.

The ear is the organ that permits hearing and, in mammals, frame balance using the vestibular gadget. In mammals, the ear is generally described as having 3 elements - the outer ear, the middle ear, and the inner ear. The outer ear is the most effective seen part of the ear in maximum consequently the phrase "ear" regularly refers to the outside component alone.

The medical term for the outer ear is the auricle or pinna. The outer ear is the external part of the ear and consists of the fleshy seen pinna. It is also referred to as as the auricle, the ear canal, and



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the outer layer of the eardrum also called the tympanic membrane. The outer ear comes in all types of shapes and sizes. This structure helps to give each of us our unique appearance. The pinna is made up of cartilage and skin. Two sets of muscular tissues are related to the outer ear: the intrinsic and extrinsic muscle tissue. In some mammals, those muscle mass can modify the course of the pinna. There are three different parts to the outer ear; the tragus, helix and the lobule The pinna consists of the curving outer rim called the helix, the inner curved rim called the antihelix, and opens into the ear canal. The tragus protrudes and partially obscures the ear canal, as does the going through antitragus. The hollow place in front of the ear canal is known as concha. The ear canal stretches for approximately 1 inch (2.5 cm). The primary part of the canal is surrounded with the aid of cartilage, while the second part close to the eardrum is surrounded via bone. this bony part is referred to as the auditory bulla and is fashioned through the tympanic part of the temporal bone. The skin surrounding the ear canal consists of ceruminous and sebaceous glands that produce defensive ear wax. The ear canal ends at the outside floor of the eardrum. The developing auricle is first noticeable around the sixth week of gestation in the human foetus, developing from the auricular hillocks. Auricular appearance and its symmetry contribute enormously to the facial aesthesis. Cosmetic surgery and facial rejuvenation have become quite popular not only in the West but also in many developing countries. The treatment of auricular dimensions or to perform facial rejuvenation by a plastic surgeon requires morphometry data of auricle.

The identification of living people is an increasing challenge due to the occurrence of social problems such as theft and murder. In this context, images of good quality may comprise the only available and suitable material to be used for human identification. As they have been also described as a useful tool for the exclusion of suspects in crime scene investigation , photographs of the ear can also be used in the post mortem identification as it is a body region that has individualizing characteristics that can remain preserved for some time after death , although its application depends on the quality of the material available for analysis .

The human ear is the most defining function of the face. Ear print evaluation (forensic otoscopy) is used as a means of forensic identity intended as an identity device similar to fingerprinting. that have touched a specific surface. Ear print has been successfully used to solve crimes in many parts of the world. The height of an ear imprint at a crime scene may also provide investigators with information regarding the stature of the perpetrator. The human ear is regarded as distinctive due to its absolute morphological arrangement as the shape of the ear, size, and formation of the tragus, thickness and earlobe, helix Shape, Darwin's tubercle forms, Unique and special characteristics of the ear, etc. Predominantly human ear remains the same from birth till death and growth are relative. The ear has been used as a tool for human identification since the late 19$^{th}$ century when Alphonse Bertillon used the ear as one of the 11 anthropometric measurements for his manual



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system of identifying individuals. The shape and size of the ear can be used for facial reconstruction in forensic Investigation as per proved by some researchers. It is well known that the human bones are of greater importance in providing us with the skeletal differences between the sexes for anthropological and medico-legal purposes. (Pat et al 2004). Anthropologists suggest that the shapes and characteristics of the human external ear are extensively different and distinguishable to the extent that is possible to use the ear to differentiate between individuals (Kasprazak,2000). Ear print has been correctly used to resolve crimes in many components of the world. The peak of an ear imprint at against the law scene may provide investigators with information concerning the stature of the perpetrator. The human ear is regarded as distinctive due to its absolute morphological arrangement as the shape of the ear, size, and formation of the tragus, thickness and earlobe, helix Shape, Darwin's tubercle forms, Unique and special characteristics of the ear, etc. Predominantly human ear remains the equal from birth until demise and growth are relative. The ear has been used as a tool for human identification since the late 19$^{th}$ century when Alphonse Bertillon used the ear as one of the 11 anthropometric measurements for his manual system of identifying individuals. The form and duration of the ear may be used for facial reconstruction in forensic research as in keeping with proved through a few researchers. It is well known that the human bones are of greater importance in providing us with the skeletal differences between the sexes for anthropological and medico-legal purposes. (Pat et al 2004). Anthropologists suggest that the shapes and characteristics of the human external ear are extensively different and distinguishable to the extent that is possible to use the ear to differentiate between individuals (Kasprazak,2000).

An ear print is an impression of the external ear. It may show the imprints of the parts of the external ear such as the helix, antihelix, tragus, and antitragus. Ear prints have shown potential as a means of establishing identity and have been successfully used in identification in forensic examinations in the recent past. The criminals or perpetrators may inadvertently leave the impression of their ear at a crime scene. The prints may be left in a way that when a person listens at a door or a window before breaking and entering for burglary, the oily and waxy substances on the ears leave the latent prints. The ear prints left at crime scenes can be made visible and lifted using techniques similar to those used for developing and lifting fingerprints.

Regulation enforcement authorities can already discover criminals the usage of frame hint recognition strategies including dna profiling. but the reliability of the information and the value of amassing it range from place to place. Taking information from the ear print is an attractive alternative because it is cheaper than DNA proof and more dependable as evidence in court because it cannot be tampered with or accidentally introduced to the crime scene.

Researchers from universities, forensic labs and national police training centres adapt existing technologies and find new methods for using ear print as trace evidence. Ongoing research shows that



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the forensic analysis of ear prints is more economical and more reliable in legal proceedings, as it is virtually impossible to either tamper with, or accidentally leave at a crime scene, an ear print. Ear print to be left against a wall or other hard surface during a struggle or when a body is being positioned or moved. A benefit to the collection of ear prints along with other crime scene evidence is in its use as confirmatory data. The legal system typically requires two different types of corroborative evidence in order to confirm placement of a suspect at a crime scene. While it is possible to "plant" fingerprints or even DNA material, it is difficult to intentionally place an ear print. The present study represents EAR PRINTS to forensic point of view is an important step, supportive tool in forensic criminal identifications at a crime scene. They also emphasized that for an ear print to have good evidentiary value in forensic examinations, the ear print must have a set of features for which the interindividual rate of occurrence is low and the intraindividual rate of occurrence is high.

Ear print evidence has been utilized successfully by courts around the world as key or supporting evidence in various cases and has contributed to the successful conviction of perpetrators. Nevertheless, concerns about the accuracy and reliability of ear prints have been expressed. It must be stated that ear prints have not been fully accepted by the scientific community. The fact that an ear print itself is rarely directly connected (it only indicates that a person has been on or near the crime scene at a certain time, and does not necessarily mean that the crime has been committed by the person whose ear prints have been recovered) means that the ‘science’ of ear prints is still in its infancy.



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## AIM AND OBJECTIVES

### AIM

The aim of this project is to determine sex of an individual by using ear morphological measurements in a population of Aditya Degree students.

### OBJECTIVE

- ✓ To identify the gender by estimating ear measurements of different sex.
- ✓ To formulate a connection to find sex from ear measurements.
- ✓ To establish a correlation between Gender and ear.



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## MATERIALS AND METHODOLOGY

### MATERIALS REQUIRED

- Vernier Calliper
- Scale
- Calculator
- Pencil


Figure 1: Digital Vernier Calliper

### METHODOLOGY

The sex determination is conducted on 30 Indian students (15 males and 15 females) of Aditya Degree College, Surampalem, East Godavari District, Andhra Pradesh. The study subjects comprised of individuals aged ranged between 18 to 23 years. The subjects included in the study were healthy individuals free from any apparent skeleton deformity. Prior to the procedure informed consent was obtained.

Each subject was made to sit in a natural head position in a chair with a backrest and positioned the head so that the subject looks straightforward with the lower borders of the eye sockets in the same horizontal plane as the external auditory meatus. Four parameters were measured on each of the left and right ears.

The following measurements are Taken:

- ✓ Total ear length (From tip of the helix to end of the lobule)
- ✓ Total ear width (From tragus to Tubercle of ear)
- ✓ Ear pinna length (Total length of Ear length)
- ✓ Ear lobule length (Length of Tip of the ear)

The auricular index was calculated using the formula- The width of the auricle x 100 / length of the auricle.



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The collected data is analysed by calculating mean and standard deviation to determine the correlation between the sex and Measurements of ear.

**RESULT AND DISCUSSION**

The auricle reaches its mature pinnacle at 13 years in male and at 12 years in woman. Many anthropometric studies have been carried out on the external ear on children's external ear to find diagnostic values of abnormality of external ear, as a result of coincidence in the period of embryogenesis has been reported .The ear is an important and under recognized defining feature of the face whose shape conveys information about age and sex that is clearly difficult to characterize.

The present study shows the correlation between the ear measurements and gender of an individual. In the population of students of Aditya degree college total ear length and width of ear was higher on left side than on the right one on both males and females, whereas Ear pinna length and ear lobule length was smaller on left side than on the right side.

Graph 1 shows auricular index among males and females on an Indian population.

Existence of sexual dimorphism were documented. It was shown that the sexual dimorphism exists in auricular linear between males and females with higher values in males. The differences in males and females may be due to auricle expansion which starts earlier in males than females, which continues up to the older age. The variations in gender may also be influenced by genetic factors which vary with sex. The Indian male Aditya students total ear length, ear width, ear pinna length, ear lobule length were higher than female Indian Aditya students. The present study was in correlation with the study done by Brucker et.al (2003). It was shown that the sexual dimorphism exists in auricular linear dimensions between males and females with higher values in males.



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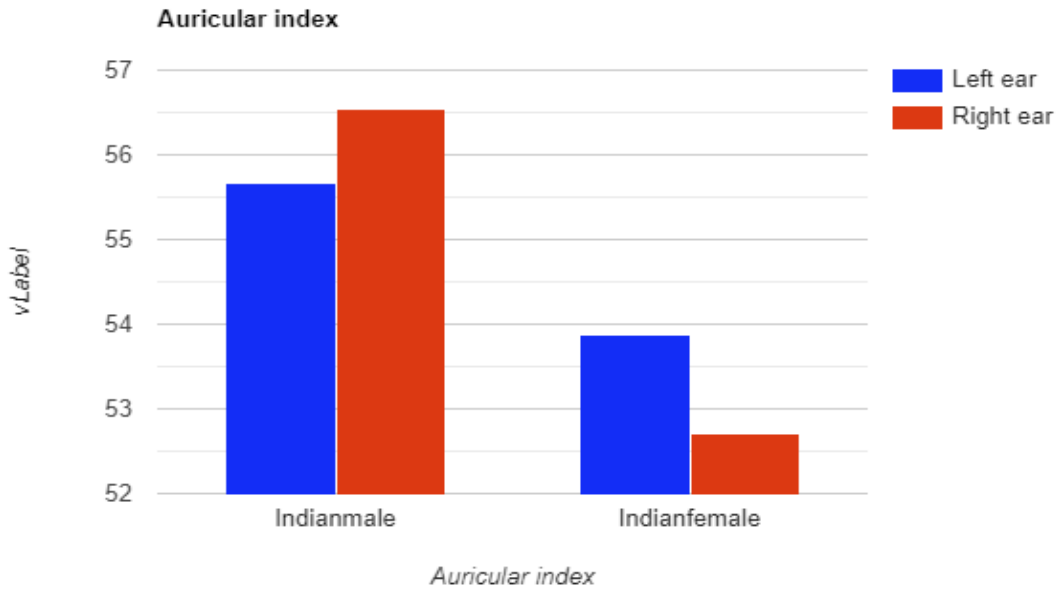
**Auricular index of ear**

| S.NO | GENDER | | AURICULAR INDEX |
|---|---|---|---|
| 1 | MALE | LEFT EAR | 55.66 |
| | | RIGHT EAR | 56.54 |
| 2 | FEMALE | LEFT EAR | 53.88 |
| | | RIGHT EAR | 52.71 |




**Graph : Auricular index graph**

## CONCLUSION

The current study provides detailed information about ear dimension among the students of Aditya degree college. The ear lobule morphometry gives information on sex which plays a valuable role in forensic investigation. Age dependent changes in lobules and its influence on individual identification through photographs or ear prints are of significance in forensic medicine and criminology. Initially ear lobule parameters were studied for the surgical treatment of congenital deformities and reconstruction. Now the ear lobules are also used in otomorphology for identification. In conclusion, Indian Aditya students' dimension of ear of males showed higher values than compared to females. It is believed that that the data obtained in the present study would serve some purposed in ear morphology and for anthropometric considerations. In future the study would continue to relate the results of our present study to height of an individual, and some cranial/facial anthropometric parameters in forensic investigations.



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# A PRELIMINARY STUDY ON THE MOTH FAUNA (LEPIDOPTERA-HETEROCERA) IN THE MIXED VEGETABLE AGROECOSYSTEMS OF MALAPPURAM DISTRICT, KERALA

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**ABSTRACT**

Moths and butterflies are among the most fascinating creatures in the living world. They together form one of the most prevalent order of insects known as Lepidoptera. Among lepidopterans, moths are not studied much like butterflies. They also include so many major and minor pests which feed upon different varieties of host plants.

The present study was conducted between February 2019 and February 2020 in mixed vegetable agroecosystems of Malappuram district, Kerala, India to collect and study the moth fauna of this ecosystem. Samples were taken from four different mixed vegetable agroecosystems of Malappuram district. The collection of moths was done by the light sheet method. Moth species have been collected, preserved, identified and analysed using several reference books (Fauna of British India, The Moths of Borneo etc.) literature, details provided on websites of KAU, Thrissur, TNAU, Coimbatore, NBAIR, Bangalore and a few other specimens with the help of experts from ZSI, Calicut.

Result of the study indicates Erebidae > Crambidae > Geometridae > Noctuidae > Sphingidae, Pyralidae > Cossidae, Thyrididae > Limacodidae, and Hepialidae are dominating families. A total of 86 species are recorded which belong to 14 families and 25 subfamilies, of which 52 were identified up to species level and 34 up to genus level. From the pest status analysis of the collected moths, 5 of them are major pests which cause serious damage to the mixed vegetable agro-ecosystem. They are *Hyposidra talaca*, *Banisia* sp., *Eudocima* sp., *Mocis frugalis*, *Eudocima homaena.* There also identified 20 minor pests in the studied mixed vegetable agro-ecosystems. They are *Theretra Nessus*, *Phragmataecia parvipuncta*, *Perina nuda*, *Artaxa guttata*, *Syntomoides imaon*, *Agrius convolvuli*, *Hypena sp.*, *Pleuroptya balteata*, 3 *Herpetogramma* sp., *Agrotis* sp., *Glyphodes caesalis*, *Spoladea recurvalis*, *Maruca vitrata*, *Anomis flava*, *Anomis* sp., 2 *Artaxa* sp., *Omiodes* sp.

**KEYWORDS:** Insect, Lepidoptera, Moths, Pest, Agro-ecosystem



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## INTRODUCTION

Moths and butterflies are among the most fascinating creatures in the living world. They together form one of the most prevalent order of insects known as Lepidoptera which perform essential ecosystem services such as pollination, nutrient cycling and providing prey for many other animals. The order Lepidoptera is also the second most diverse insect pest order outnumbered by the beetles (Mathew 1999). Recent estimates report over 1, 27,000 species of moths from all over the world (Alfred et al. 1998). Of these, over 12,000 species are recorded from India (Chandra & Nema 2007). Moths are also an important component of terrestrial ecosystems due to their role as food resources for birds (Wilson et al. 1999) and small mammals (Vaughan 1997), as pollinators (Proctor et al. 1996; Devoto et al. 2011), and nutrient recyclers (Merckx et al. 2013).

Lepidoptera are Holometabolous, their life cycle consists of four phases: egg, multiple instars, pupa, and adult. "Complete metamorphosis" is the common term for this life cycle. The members of the order Lepidoptera also pose a serious threat to major crops of agriculture, horticulture and forestry and identification and control of them is a major concern for scientists and agricultural workers. The colours and patterns of their wings are made up of thousands of tiny scales, overlapping like tiles on a roof. Moths are mainly nocturnal but species are also active during day time. In terrestrial ecosystems, moths are mostly herbivores in their larval stages and they pose a serious threat to crops of agricultural, ornamental plants and forest plantations. Moth caterpillars have a great impact on plants by eating their leaves. This has led to many types of plants evolving special chemicals to make them less appealing to caterpillars and limit the damage. Their larval stages are particularly sensitive to environmental changes that affect plant quality and quantity as their diets thus acting as good indicators of changes in the terrestrial ecosystems.

In agroecosystems, moth abundance and richness are positively related to a high abundance of crop species, availability of nectar and adjacent vegetation. Nocturnal macro moths are a highly diverse and ecologically important group of insects that play key roles the prey for birds and bats and are potential indicators of ecosystem health and change across a wide variety of landscapes (Erhardt and Thomas 1991, Kitching et al. 2000, Summerville and Crist 2004).

The present work concentrates on the documentation of the diversity and the pest status of moths occurring in mixed vegetables agro ecosystems of Malappuram district.

It is expected that the many interest records of moths will be available from the mixed vegetables agro-ecosystems of Malappuram district.



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## MATERIALS AND METHODS

### Place of Collection

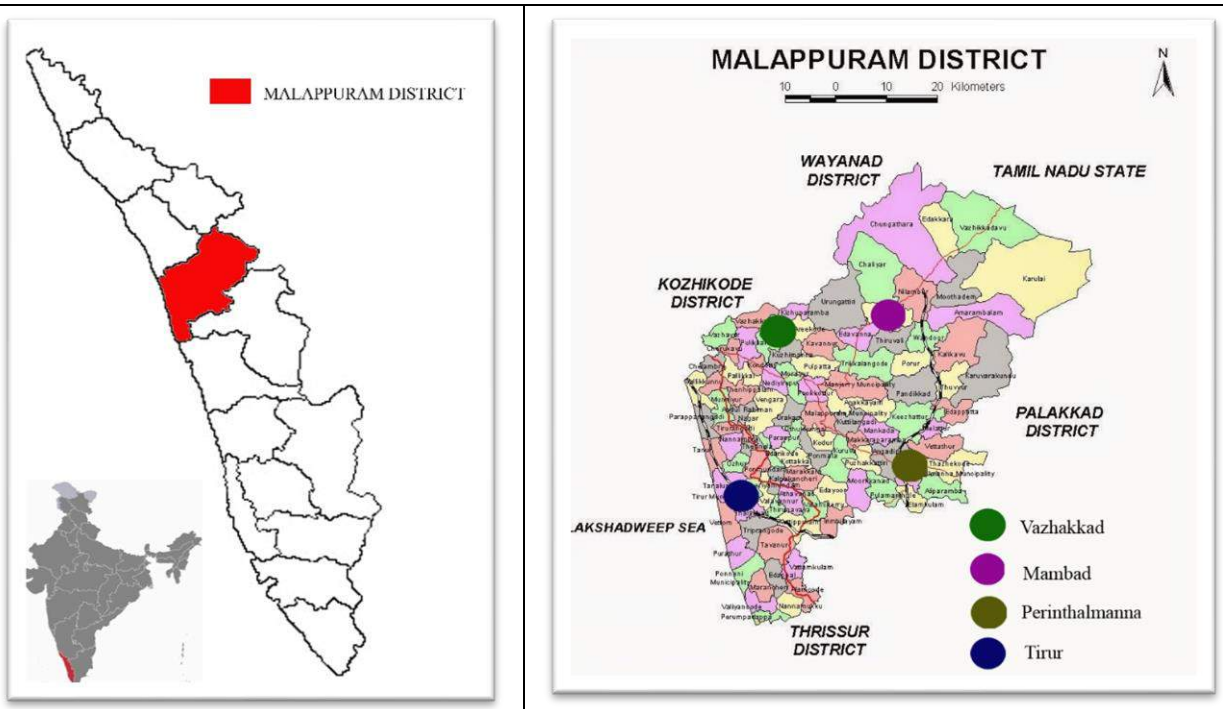


**Fig. 1 – Map showing place of collection**

The moths were collected from the different areas of Malappuram district (Fig.1). The collection sites were selected based on different direction of Malappuram district. The collection settings were put nearby the mixed vegetable field and specimens were collected.

**Table 1: - Location of Study Sites Along With Latitude & Longitude**

| District | Site | | Latitude / Longitude |
|---|---|---|---|
| **Malappuram** | Vazhakkad | S1 | 11.2535° N, 75.9724° E |
| | Mambad | S2 | 11.2503° N, 76.1958° E |
| | Perinthalmanna | S3 | 10.9760° N, 76.2254° E |
| | Tirur | S4 | 10.9167° N, 75.9245° E |

### Collection of Specimens

The moths were collected from the different areas of Malappuram district (Fig.1) from February 2019- February 2020 during night using vertical light sheet as followed by Carnegie & Leslie (1990), Rak Cizej & Trematerra (2017), Keszthelyi *et al.*( 2018) in Europe and Mathew &



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Rahamathulla, (1995) in Kerala. A light trap consisting of two 65W CFL bulbs and a 160-watt mercury vapour lamp was powered by a battery box, portable generator (Honda TM EP 1000) or electrical mains, if available, and placed in front of a 4 × 5 ft. white cotton screen (Shamsudeen *et al.*, 2005). The collected moths were killed by using ethyl acetate and by instant freezing using freezing pads.

**Preservation and Identification of Collected Specimens**

The collected specimens were later stretched using standard spreading boards, pinned, and preserved in airtight insect box, having naphthalene balls as fumigant as discussed by Mikkola (1986) and Landry & Landry (1994). The standard techniques given by Zimmerman (1978) have been followed for spreading of wings. Each specimen was provided with a label indicating the scientific name, locality and date of collection. Concerning the systematic arrangement of families, Heppner (1998) was followed. The specimens were then identified up to species or genus level with the help of identified specimens and available literature by Hampson (1891-1896), Bell & Scott (1937), Barlow (1982), Holloway (1983-2011), Pinratana and Lampe (1990), Robinson (1994), Kendrick (2002), Kononenko & Pinratana (2005, 2013), Gurule & Nikam (2013), Gurule (2013) and Kirti & Singh (2015,2016) with the assistance of experts from Zoological survey of India (ZSI), Calicut.

**Analysis of Data and Assessment of Pest Status**

The details of identified specimens were tabulated and the relative number of species in each family was analysed using a bar diagram. The assessment of pest status of identified moths in mixed vegetable agroecosystem was done using the details provided by research scholars in ZSI, Calicut, other experts and websites of KAU (Kerala Agriculture University, Thrissur), TNAU (Tamil Nadu Agricultural University, Coimbatore) and NBAIR (National Bureau of Agricultural Insect Resources, Bangalore)



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## RESULT AND DISCUSSION

**Table 2 – checklist of moths based on subfamily and genus.**

| FAMILY | SUB FAMILY | GENUS | NUMBER OF SPECIES | TOTAL NUMBER OF SPECIES | |
|---|---|---|---|---|---|
| Geometridae | Ennominae | *Psilalcis* | 1 | 5 | 12 |
| | | *Petelia* | 2 | | |
| | | *Hyposidra* | 1 | | |
| | | *Semiothisa* | 1 | | |
| | Geometrinae | *Pingasa* | 1 | 3 | |
| | | *Comostola* | 1 | | |
| | | *Argyrocosma* | 1 | | |
| | Sterrhinae | *Scopula* | 4 | 4 | |
| Erebidae | Erebinae | *Artena* | 1 | 7 | 31 |
| | | *Thyas* | 2 | | |
| | | *Mocis* | 1 | | |
| | | *Hypospila* | 1 | | |
| | | *Erebus* | 1 | | |
| | Hypeninae | *Hypena* | 6 | 5 | |
| | Lymantriinae | *Calliteara* | 1 | 5 | |
| | | *Perina* | 1 | | |
| | | *Artaxa* | 3 | | |
| | Arctiinae | *Syntomoides* | 1 | 9 | |
| | | *Utetheisa* | 1 | | |



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| | | | | | |
|---|---|---|---|---|---|
| | | *Pareuchaetes* | 1 | | |
| | | *Lyclene* | 3 | | |
| | | *Cyana* | 2 | | |
| | | *Rajendra* | 1 | | |
| | Boletobiinae | *Ataboruza* | 2 | 2 | |
| | Catocalinae | *Artena* | 1 | 1 | |
| | Calpinae | *Eudocima* | 1 | 1 | |
| | Scoliopteryginae | *Anomis* | 1 | 1 | |
| Sphingidae | Sphinginae | *Agrius* | 1 | 1 | 3 |
| | Macroglossinae | *Theretra* | 1 | 2 | |
| | | *Hyles* | 1 | | |
| Cossidae | Zeuzerinae | *Phragmataecia* | 1 | 1 | 2 |
| | Cossinae | *Dervishiya* | 1 | 1 | |
| Pyralidae | Pyralinae | *Endotricha* | 1 | 1 | 3 |
| | Phycitinae | *Nephopterix* | 1 | 2 | |
| | | *Ectomyelois* | 1 | | |
| Limacodidae | Limacodinae | *Miresa* | 1 | 1 | 1 |
| Thyrididae | Striglininae | *Banisia* | 1 | 2 | 2 |
| | | *Sonagara* | 1 | | |
| Crambidae | Crambinae | *Ancylolomia* | 1 | 1 | 26 |
| | Limenitidinae | *Cnaphalocrocis* | 1 | 1 | |
| | Schoenobiinae | *Scirpophaga* | 1 | 1 | |



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| | | | | | |
|---|---|---|---|---|---|
| | Spilomelinae | *Polygrammodes* | 1 | 20 | |
| | | *Pycnarmon* | 2 | | |
| | | *Agrotera* | 2 | | |
| | | *Agrioglypta* | 1 | | |
| | | *Herpetogramma* | 6 | | |
| | | *Nausinoe* | 1 | | |
| | | *Pleuroptya* | 1 | | |
| | | *Bocchoris* | 1 | | |
| | | *Glyphodes* | 2 | | |
| | | *Spoladea* | 2 | | |
| | | *Eudocima* | 1 | | |
| | | *Omiodes* | 1 | | |
| | | *Prophantis* | 1 | | |
| | | *Maruca* | 1 | | |
| Noctuidae | Noctuinae | *Mythimna* | 2 | 5 | 5 |
| | | *Agrotis* | 2 | | |
| | | *Spodoptera* | 1 | | |
| Hepialidae | Hepialinae | *Endoclita* | 1 | 1 | 1 |



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From the study (Table: 2) 86 species which belong to 10 families were collected. The families include: Geometridae, Erebidae, Sphingidae, Cossidae, Pyralidae, Limacodidae, Thyrididae, Crambidae, Noctuidae, Hepialidae. There were collected 12 species of Geometridae belonging to its 3 subfamilies Ennominae, Geometrinae, Sterrhinae. From family Erebidae, 31 species were collected belonging to the sub families Erebinae, Hypeninae, Lymantriinae, Arctiinae, Boletobiinae, Catocalinae, Calpinae, Scoliopteryginae. 3 species of family Sphingidae were collected under its sub families Sphinginae, Macroglossinae. Also from family Cossidae 2 species were collected belonging to 2 subfamilies Zeuzerinae, Cossinae. From family Pyralidae 3 species where collected which are come under its sub families Pyralinae, Phycitinae. Only one species where collected from family Limacodidae (sub family: Limacodinae). From family Thyrididae, 2 species of its sub family Striglininae were collected from the site. 26 species of moths from family Crambidae were collected which are belonging to its subfamilies Crambinae, Limenitidinae, Schoenobiinae, Spilomelinae. From family Noctuidae 5 species were collected which come under its sub family Noctuinae. Only one species of family Hepialidae (sub family: Hepialinae) were collected from the agro ecosystem from malappuram district.

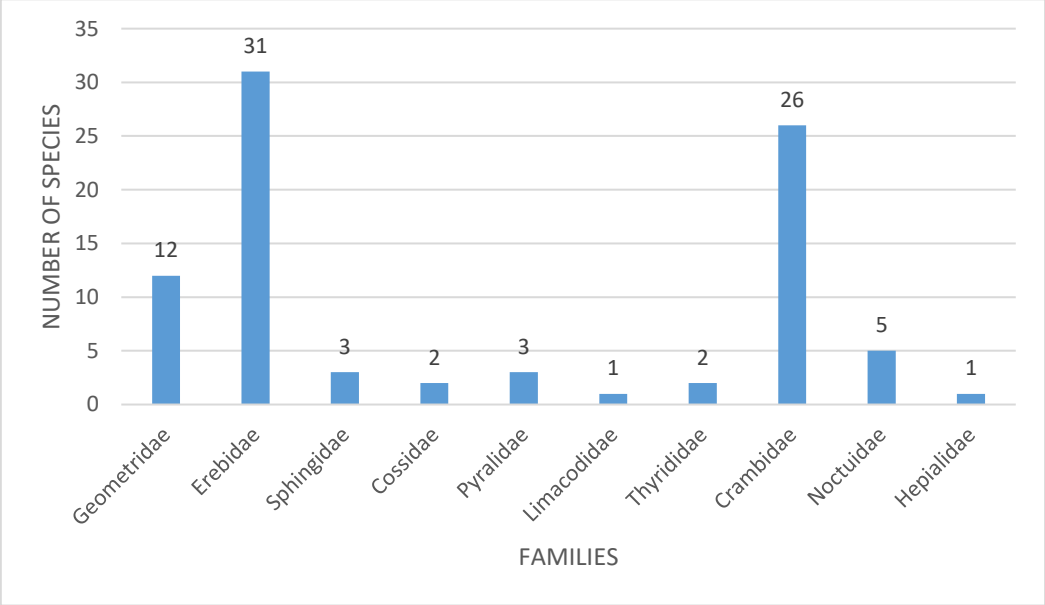


**Fig 2 – Bar diagram of different moth families**

When we analyse the relative number of species in teach families based on the bar diagram (fig. 2), we could find that relatively species from family Erbidae have dominace over other families. There were collected 31 species from it. The second dominant family in case of species number is family Crambidae (26 species). From family Geometridae 12 species were collected which make the third dominant family in the agro ecosystem of Malappuram district. Then comes from family Noctuidae with 5 species. Then, from each families - family Sphingidae and Pyralidae, 3 species were collected and from each family Cossidae and Thyrididae 2 species were collected. At last the family with least species is the family Limacodidae and Hepialidae with one species.



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**Table 3 – checklist-based pest status in mixed vegetable agro ecosystem**

| SPECIES IDENTIFIED | PEST STATUS (in mixed vegetable agro ecosystem) |
|---|---|
| *Psilalcis bisinuata* | Information deficient |
| *Pingasa alba* | Information deficient |
| *Artena dotata* | Information deficient |
| *Theretra nessus* | Minor pest of *Pongamia pinnata*, *Cinnamomum*, *Dioscorea* |
| *Phragmataecia parvipuncta* | Minor pest, particularly feeding on: Elephants Ear (*Alocasia macrorrhizos*, Araceae), and Yam *(Dioscorea bulbifera*, Dioscoreaceae). Many other food plants have been reported. |
| *Dervishiya* sp. | Information deficient |
| *Petelia medardaria* | Information deficient |
| *Calliteara grotei* | Information deficient |
| *Miresa* sp. | Information deficient |
| *Hyposidra talaca* | Major pest of *Ficus* spp. |
| *Endotricha* sp. | Information deficient |
| *Banisia* sp. | Major pest of sapota. |
| *Hypena sp.* | Information deficient |
| *Scopula opicata* | Information deficient |
| *Polygrammodes* sp. | Information deficient |
| *Ataboruza divisa* | Information deficient |
| *Scirpophaga incertulas* | Information deficient |



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| | |
|---|---|
| *Perina nuda* | Minor pest on mango, jack and several species of *Ficus* including *Ficus benjamina, F. benghalensis, F. racemosa, F. pumila, F. religiosa,* etc.<br>Commonly collected on *Ficus* spp. |
| *Comostola meritaria* | Information deficient |
| *Artaxa guttata* | Minor pest of Castor, jasmine, *shorea robusta etc.* |
| *Prophantis adjusta* | Information deficient |
| *Sonagara strigipennis* | Information deficient |
| *Pycnarmon cribrata* | Information deficient |
| *Ancylolomia* sp. | Information deficient |
| *Cnaphalocrocis medinalis* | Information deficient |
| *Agrotera basinotata* | Information deficient |
| *Agrotera* sp. | Information deficient |
| *Scopula* sp. | Information deficient |
| *Syntomoides imaon* | Minor pest. Larvae feeds on Sweet potato, sandalwood, etc. |
| *Mythimna* sp. | Information deficient |
| *Utetheisa pulchelloides* | Information deficient |
| *Agrioglypta zelimalis* | Information deficient |
| *Argyrocosma inductaria* | Information deficient |
| *Pareuchaetes pseudoinsulata* | Information deficient |
| *Hypena* sp. | Information deficient |
| *Agrius convolvuli* | Minor pest. Mainly Convolvulaceae, including cultivated hosts like sweet potato; Leguminosae like soyabean, *Phaseolus* sp. and beans; other hosts include sunflower, citrus, grapevine, groundnut, etc. |



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| | |
|---|---|
| *Hypena* sp. | Information deficient |
| *Herpetogramma* sp. | Minor pest Brinjal. Larvae feed on Brinjal |
| *Herpetogramma stultalis* | Information deficient |
| *Petelia medardaria* | Information deficient |
| *Scopula* sp. | Information deficient |
| *Nausinoe perspectata* | Information deficient |
| *Pleuroptya balteata* | Minor pest, more severe after monsoon months.<br>Larvae fold the margins of leaves or fold adjacent leaves together and feed from inside by scraping the tissues resulting in drying and shedding of leaves. |
| *Herpetogramma* sp. | Minor pest Brinjal. Larvae feed on Brinjal |
| *Pycnarmon cribrata* | Information deficient |
| *Scopula* sp. | Information deficient |
| *Ataboruza divisa* | Information deficient |
| *Agrotis* sp. | Polyphagous on several hosts including peas, tobacco etc. |
| *Bocchoris onychinalis* | Information deficient |
| *Lyclene* sp. | Information deficient |
| *Glyphodes caesalis* | Minor. An important pest of jack (*Artocarpus integrifolia*). The caterpillar is reddish brown with black spots and bores into the tender shoots and developing fruits, occasionally causing substantial damage. |
| *Semiothisa eleonora* | Information deficient |
| *Nephopterix* sp. | Information deficient |



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| | |
|---|---|
| *Spoladea recurvalis* | Minor Pest of bhendi. Feed on the flowers causes circular boreholes on fruits. Larva thrust only part of their body inside the fruit feed. |
| *Eudocima* sp. | Major pest of *Citrus* spp., *Tinospora cordifolia*, *Cocculus* sp., *Tiliacora acuminata*, *Cyclea peltata*, etc. |
| *Thyas honesta* | Information deficient |
| *Thyas coronate* | Information deficient |
| *Herpetogramma* sp. | Minor pest Brinjal. Larvae feed on Brinjal |
| *Hypena* sp. | Information deficient |
| *Mocis frugalis* | Major pest of rice, maize, ragi, green gram, and various grasses. |
| *Artena* sp. | Information deficient |
| *Hypospila bolinoides* | Information deficient |
| *Maruca vitrata* | Minor, occasionally serious. Pest of cowpea (*Vigna unguiculata*).The larvae damage flower buds, flowers and developing pods and also web the inflorescences of cow pea. |
| *Spodoptera mauritia* | Information deficient |
| *Hypena sp.* | Information deficient |
| *Lyclene goaensis* | Information deficient |
| *Cyana perornata* | Information deficient |
| *Lyclene kishidai* | Information deficient |
| *Glyphodes bicolor* | Information deficient |



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| | |
|---|---|
| *Eudocima homaena* | Major pest on Citrus, *Cocculus* sp., *Tiliacora acuminata*, *Tinospora cordifoila*, *Cyclea peltata*, etc. and many vegetables. |
| *Cyana peregrina* | Information deficient |
| *Rajendra biguttata* | Information deficient |
| *Anomis flava* | Pest of bhendi, hibiscus, black gram etc. Caterpillar fed on the leaves and cause Defoliation. |
| *Anomis* sp. | Pest of bhendi, hibiscus, black gram etc. Caterpillar fed on the leaves and cause Defoliation. |
| *Artaxa* sp. | Minor pest of Castor, jasmine, *shorea robusta etc.* |
| *Artaxa* sp. | Minor pest of Castor, jasmine, *shorea robusta etc.* |
| *Hyles livornica* | Information deficient |
| *Ectomyelois* sp. | Information deficient |
| *Endoclita* sp. | Information deficient |
| *Omiodes* sp. | Larvae feed on cowpea (*Vignaunguiculata*). |
| *Erebus macropus* | Information deficient |
| *Agrotis* sp. | Polyphagous on several hosts including peas, tobacco etc. |
| *Herpetogramma* sp. | Minor pest Brinjal. Larvae feed on Brinjal |
| *Mythimna* sp. | Information deficient |
| *Hypena* sp. | Information deficient |



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* The pest status of moths were studied based on the data provided by KAU, TNAU, NBAIR (Bangalore). Those species which cause damage below ETL are considered as minor pest and above ETL are major pest.

Based on this (Table: 3), 5 major pests and 20 minor pests were identified from the studied mixed vegetable ecosystems of Malappuram district. The major pests that collected from field which feed on mixed vegetable agro ecosystem are *Hyposidra talaca*, *Banisia* sp., *Eudocima* sp., *Mocis frugalis, Eudocima homaena. Hyposidra talaca* is a major pest of *Ficus* spp., *Banisia* sp. is a major pest in sapota and some vegtables. *Eudocima* sp. is a major pest of *Citrus* spp., *Tinospora cordifolia, Cocculus* sp., *Tiliacora acuminata, Cyclea peltata*, etc. *and Mocis frugalis* is a major pest of rice, maize, ragi, green gram, and various grasses and *Eudocima homaena* is a major pest on Citrus, *Cocculus* sp., *Tiliacora acuminata, Tinospora cordifoila, Cyclea peltata*, etc. and many vegetables.

The minor pests are *Theretra nessus* (minor pest of *Pongamia pinnata, Cinnamomum, Dioscorea*), *Phragmataecia parvipuncta* (minor pest, particularly feeding on: Elephants Ear (*Alocasia macrorrhizos*, Araceae), and Yam *(Dioscorea bulbifera*, Dioscoreaceae). Many other food plants have been reported.), *Perina nuda* (Minor pest on mango, jack and several species of *Ficus* including *Ficus benjamina, F. benghalensis, F. racemosa, F. pumila, F. religiosa*, etc.), *Artaxa guttata* (minor pest of Castor, jasmine, *shorea robusta etc.*), *Syntomoides imaon* (minor pest, larvae feeds on Sweet potato, sandalwood, etc.), *Agrius convolvuli* (minor pest . Mainly Convolvulaceae, including cultivated hosts like sweetpotato; Leguminosae like soyabean, *Phaseolus* sp. and beans; other hosts include sunflower, citrus, grapevine, groundnut, etc.), *Herpetogramma* sp. (minor pest Brinjal. Larvae feed on Brinjal), *Pleuroptya balteata* (minor pest, more severe after monsoon months), *Herpetogramma* sp. (minor pest Brinjal. Larvae feed on Brinjal), *Glyphodes caesalis* (an important minor pest of jack (*Artocarpus integrifolia*), *Spoladea recurvalis* (minor Pest of bhendi .Feed on the flowerscausesCircular boreholes on fruits.Larva thrust only part of their body inside the fruit feed), *Herpetogramma* sp. (minor pest Brinjal. Larvae feed on Brinjal), *Maruca vitrata* (minor, occasionally serious, pest of cowpea (*Vigna unguiculata*).The larvae damage flower buds, flowers and developing pods and also web the inflorescences of cow pea.), *Artaxa* sp. (minor pest of Castor, jasmine, *shorea robusta* etc.), *Artaxa* sp. (minor pest of Castor, jasmine, *shorea robusta* etc.), *Herpetogramma* sp. (minor pest Brinjal. Larvae feed on Brinjal), *Agrotis* sp. (polyphagous on several hosts including peas, tobacco etc.), *Anomis flava* (pest of bhendi, hibiscus, black gram etc.), *Anomis* sp. (pest of bhendi, hibiscus, black gram etc.) and *Agrotis* sp. (polyphagous on several hosts including peas, tobacco etc.)

The above analysis shows us the pest status of collected moth species in the mixed vegetable agro-ecosystem of Malappuram district. This data surely help in the further studies of moths of the



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Malappuram district, especially in its mixed vegetable agro-ecosystem. It is very important to know the status of every pest to get a good yield from agriculture.

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# "INTERWOVEN WORLDS: EXPLORING THE NEXUS OF TRANSLATION AND LITERATURE: UNVEILING THE CORE OF EMOTIONS THROUGH TRANSLATION: A LITERARY ANALYSIS OF 'SUGANDHI ENA ANDAL'

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**Abstract:**

"The synergy between Translation and Literature forms an intricate web of cross-cultural exchange and interpretation. This abstract illuminates the dynamic relationship between these disciplines, scrutinizing the intricate art of transmuting literary works across linguistic boundaries while safeguarding the essence, style, and cultural intricacies of the original text. It explores the challenges faced by translators in capturing the intended meaning and emotions of authors, navigating linguistic barriers, and preserving cultural nuances. Moreover, it underscores the transformative impact of translation, fostering global literary connectivity, enabling access to diverse literary landscapes, and preserving cultural heritage through the dissemination of multilingual literature."

**Keywords:** cross-cultural exchange, Linguistic fidelity, Multilingual language.

## Introduction

T D Ramakrishnan's novel Sugandhi alias Andal Devanayaki (translated by Priya K Nair) is a postmodern novel that can be marked as an engaging piece of work that discusses how violence connects both fascism and revolution. Sugandhi enna andal Devanayaki, the original work published in 2014 has won the 2016 Kerala Sahitya Award,2016 Malayatoor Award, and 2017 Vayalar Award. This novel explores the nuanced portrayal of emotions over language emphasizing, the challenge of conveying cultural and emotional nuances across linguistic boundaries. The book dwells on how emotions embedded in the source language are preserved, adapted, or transformed in the process of translation shedding light on the intricate interplay between words and feelings.

In the translation theory, the work Sugandhi enna andal Devanayaki with a translation theory considers the relevance of Eugene Nida's dynamic equivalence theory. nidas's approach emphasizes capturing the dynamic meaning and emotions of the source text rather than a word-for-word translation. This theory aligns well with the exploration of emotions in translation, as it recognizes the importance of converging the intended impact and cultural nuances across languages.



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**Analysis**

"Sugandhi Enna Andal" is a Malayalam novel written by T. D. Ramakrishnan and translated into English by Priya K. Nair. The novel delves into various themes and offers a complex portrayal of emotions. The translation of these emotions across languages adds an interesting layer to the narrative.

Sugandhi Enna Andal Devanayaki as a story the narrative moves smoothly despite its complex structure and penchant for fantasy. the backdrop of the book story is about Sri Lanka's civil war, the conflict between the majority Sinhalas and the minority Tamils, and within that, the war between the Sri Lankan army and militant groups like the Liberation Tigers of Tamil Elam(LTTE), but that is the only backdrop. The real story deals with our idea of womanhood, the culture of violence and violence against women all these active instruments used over centuries in the world of power and politics. A century ago, a king forced his queens to wear chastity belts. In the turbulent politics of later years, patriarchal interpretation of female anatomy and what womanhood means, remain the same right up to the present with its capacity for fascism.

In Eugene Nida's book The Theory and Practice of Translation, she quotes "Translating consists in reproducing in the receptor language the closest natural equivalent of the source language message, first in terms of meaning and secondly in terms of style"

Sugandhi alias Andal Devanayaki in the context of translation or literature, suggests adapting names or terms in a manner that resonates with the target culture while maintaining the essence of the original.

Dynamic Equivalence in translation theory is particularly relevant when it comesto portraying emotions across languages. This approach emphasizes not only the literal translation of words but also the translation of the emotional and cultural context. By adapting expressions; idioms, and cultural nuances, translators use Dynamic Equivalence to strive to evoke similar emotional responses in the target audiences as the original text does in the sourcelanguage. This ensures that the emotional impact of the context remains intact despite linguisticand cultural differences.

The portrayal of emotions in "Sugandhi Enna Andal" and their translation into English involves conveying the depth and nuances of the original work while considering the unique linguistic and cultural aspects of both Malayalam and English.

One of the primary themes in the novel is the exploration of deep emotions such as love, desire, and sacrifice. These emotions are depicted through the experiences and struggles of the characters. The translator's role in conveying these emotions across languages is crucial in maintaining the emotional authenticity and impact of the original work. Priya K. Nair must carefully navigate the linguistic differences and cultural contexts to effectively communicate the emotional depth and complexity present in the Malayalam text.

The portrayal of emotions across languages raises important questions about the cultural and



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linguistic nuances that influence our understanding and expression of emotions. Different languages may have unique ways of expressing certain emotions, and the translation process must navigate these differences to convey the full emotional spectrum of the original text without losing its nuances and cultural richness.

Furthermore, the translation also allows readers to explore how emotions are shaped and conveyed within different linguistic and cultural contexts. The translator's ability to capture the emotional weight of the narrative ensures that the rich emotional tapestry of the original work is not lost in translation, offering English-speaking readers a window into the emotionallandscape of the story that is told in Malayalam.

**Conclusion**

In conclusion, the portrayal of emotions across languages in "Sugandhi Enna Andal, Devanayaki" as translated by Priya K. Nair, is a compelling aspect of the novel. It provides an opportunity to examine how the depth and complexity of emotions are conveyed across diverse linguistic and cultural boundaries. The translator's skill in preserving the emotional authenticityof the original work while effectively communicating it in English is essential in allowing readers to engage with the emotional depth of the narrative.

Translation bridges different worlds, allowing the exchange of ideas, emotions, and experiences. It is through translation that the beauty and depth of a literary work can be sharedwith a global audience, offering a glimpse into the rich tapestry of human expression. Ultimately, "Sugandhi Ena Andal Devanayaki" serves as a testament to the enduring power ofliterature and the profound impact of translation in forging connections across the interwovenworlds of language and culture. It exemplifies the ability of literature to evoke universal emotions and transcend the limitations of linguistic boundaries, fostering a sense of common humanity and shared understanding.

As we continue to explore the nexus of translation and literature, we are reminded of the transformative potential of storytelling and the enduring resonance of human emotion. Throughthe art of translation, we have the opportunity to bridge divides, cultivate empathy, and celebrate the diversity of human expression, ultimately enriching our collective literary landscape and deepening our appreciation for the beauty of language and emotion.

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# NAVIGATING CULTURAL CROSSROADS: TRANSLATION DYNAMICS IN *MAPS FOR LOST LOVERS* BY NADEEM ASLAM

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**Abstract**

Translational studies in literature explore the challenges, strategies, and impact of translating literary works across languages and cultures. Translational studies explore instances where translators actively resist dominant cultural norms or political ideologies through their work. This resistance can manifest in the choice of words, the interpretation of cultural references, or other elements that challenge the status quo.

*Maps for Lost Lovers* is a novel by the British Pakistani writer Nadeem Aslam. It was first published by Faber and Faber in 2004. The novel centers on the murder of a pair of lovers, Jugnu and Chanda. However, the book also serves as commentary of working-class Pakistani immigrants in England and the religious traditions they firmly hold. This paper explores the intricate challenges faced by translators in navigating the cultural crossroads presented in Nadeem Aslam's novel, *Maps for Lost Lovers*.

Set in the fictional town of Dasht-e-Tanhaii, the narrative revolves around the lives of an immigrant Pakistani community in England. The themes of cultural struggles, forbidden love, religious identity, and the immigrant experience provide a rich tapestry for examination. The aim of this paper is to uncover how translators balance linguistic authenticity and cultural richness while maintaining the essence of the story. Through this exploration, we gain insights into the crucial role translators play in making multicultural narratives accessible and relatable to diverse readers.

*Keywords*: Translation, culture, cultural richness, narrative, traditions

## Introduction

*Maps for Lost Lovers* is a novel by the British Pakistani writer Nadeem Aslam. It was first published in 2004. The novel is set in a British Pakistani community in a fictional city in England. It explores themes of love, cultural identity, and the clash between traditional values and modern life. The name of the fictional city represented in this novel is Dashta-e-Tanhaii, as a multicultural place with residents like Muslims, Sikhs, Bengalis and British. The novel explores the cultural hybridity.



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Cultural hybridity refers to the blending and mixing of different cultural elements, often arising from the interactions between different cultures. In the novel, this theme is evident in various aspects of the characters' lives and experiences.

Nadeem Aslam is a well-known Pakistani writer. Most of his works were mainly about themes of identity, cultural clash, and political turmoil. His experiences as an immigrant and his background have significantly influenced his writing. Nadeem Aslam has authored several novels, including *Season of the Rainbirds* (1993), *Maps for Lost Lovers* (2004), *The Wasted Vigil* (2008), and *The Golden Legend* (2017) etc. *Maps for Lost Lovers* has shortlisted for or the Booker Prize and received the Kiriyama Prize.

He is known for his rich and lyrical prose. His novels are characterized by a careful attention to detail, intricate storytelling, and a deep exploration of characters' inner lives. Common themes in Aslam's works include the intersection of Eastern and Western cultures, the challenges faced by immigrants, the impact of political conflicts, and the human experience in the face of adversity. Aslam is known for addressing political and social issues in his novels. His works often touch on themes such as religious intolerance, the consequences of war, and the struggles of individuals caught in the midst of political turmoil.

The setting in Nadeem Aslam's novel *Maps for Lost Lovers* (2005) may at first easily deceive the reader into thinking that the story takes place in a small community in Pakistan. However, one soon realises that this is clearly not the case. Instead, the setting is an unnamed British city, inhabited almost solely by Pakistani immigrants. In spite of the fact that the setting is England, there are few white people present in the story, and the ones who are mentioned are banished to the margins by the Pakistani society and simply reduced to a stereotyped image of white racists who, moreover, suffer from moral decay. Not only are the stereotyped whites excluded, but everything they represent, i.e. Western society, is alienated and thought of as foreign, not belonging to the desirable traditions and properties of the Pakistani community. Owing to this, white society serves the purpose of defining the main characters and their society.

**Cultural Hybridization in *Maps for Lost Lovers***

Culture plays an important role in this novel. *Maps for Lost Lovers* is basically a story which is in first thought considered as an investigative story but later on it is realized or can be understood that there is a story of a couple who were killed at the very start. The main stream running through the book is the story of Jugnu and Chanda, they both decide to live together, and thus invite the ire of not just their relatives, but almost all the residents of their town Dasht-E-Tanhai. In a town near



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London known as the Desert of Loneliness, a man named Jugnu and a woman named Chanda mysteriously disappear, causing a commotion. Their decision to live together before marriage raises eyebrows. Police suspect Chanda's brothers of foul play, but lack evidence. Some speculate the couple is in hiding, deepening the mystery. Shamas, Jugnu's older brother, and his wife Kaukab offer their perspectives.

As the community awaits the trial, we delve into Shamas' background. In his sixties, he clashes with his strict wife Kaukab over his brother's disappearance. Despite their differing religious views, Shamas acts as a bridge between the community and the wider world. The book explores Shamas and Kaukab's lives before the disappearance, including Shamas' past affair and their three-year separation. The narrative reveals unsettling events in the town, narrated with Shamas' frustration towards what he perceives as a culture holding onto superstitions. The story introduces Shamas and Kaukab's three children, reflecting the growing influence of Western culture in the community. Kaukab feels she failed to instill strict Muslim values in them, leading to conflicts as her children reject these beliefs. A climactic moment occurs when Kaukab, in a heated argument, slaps her daughter. Despite a family dinner discussing Jugnu's murder, the profound rift within the family appears irreparable due to Kaukab's fear of societal judgment.

The term Hybridity common sense meaning is referred to a mixture. Cultural Hybridity is new transcultural forms within the contact zone produced by colonization and wants to show the maintenance of a sense of balance among values, customs and beliefs of two or more different cultures, but it is not a new cultural phenomenon.

Nadeem Aslam wants to depict realistic pictures of religion, nationalism and love relationships among the people of Dashta-e-Tanhaii (Desert of Loneliness). Dashtae- Tanhaii, as a multicultural place with residents like Muslims, Sikhs, Bengalis and British, occupies a central place in the novel. This place is intertwined with monuments such as mosques, temples and churches. People speak Hindi, Urdu, Bengali as well as English. In the social picture, Muslims, Hindus and Sikhs live with each other, united only because they are immigrants from other countries and surrounded by a Godless white society. The people of this city do not accept the culture and customs of the white people, because they do not want to adopt a living culture for themselves. Thus, the various nationalities of the Sub-continent as they changed the names according to the specific country, they had immigrated from various country such as Pakistani, Bangladeshi, Indian, and Sri Lankan.

The novel also portrays cultural clash existed in that location. The disappearance of Jugnu and Chanda, who defy societal norms by living together before marriage, highlights the clash between tradition and modernity within the immigrant community. This forbidden love becomes a focal point



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for cultural tensions and societal expectations. The concept of translating cultures is metaphorically explored throughout the novel. Characters grapple with the challenge of adapting to a new cultural environment, leading to a complex process of translation where cultural values and identities are interpreted, negotiated, and sometimes misunderstood.

Shamas, as the older brother, acts as a cultural bridge, being more open to the wider world and fluent in English. His clashes with Kaukab, who holds stricter religious views, offer readers insights into the diverse perspectives within the community and the tensions arising from differing interpretations of cultural norms. Shamas' critical view of cultural superstitions and practices within the community adds depth to the narrative. These elements, rooted in tradition, often clash with the changing world and contribute to the internal conflicts faced by the characters. The novel also addresses the complexities of communication in a multicultural environment. Linguistic challenges, cultural differences, and the struggle to express oneself effectively contribute to instances of miscommunication, leading to misunderstandings and conflicts among characters.

**Conclusion**

*Maps for Lost Lovers* is a novel which deals with human complex phenomenon such as identity and social hierarchy. The novel makes visible the forming of identity through the process of othering and consequently deals with the problems which concern this issue. Kaukab forms the core of the novel to some extent, and has created for herself an identity. In conclusion, *Maps for Lost Lovers* leaves us with a deep understanding of the struggles people face at the intersection of different cultures. Through the characters and their forbidden love, family conflicts, and clashes with societal expectations, the novel shows us how challenging it can be to find a balance between tradition and the ever-changing modern world.

By focusing on characters like Shamas and Kaukab, the author brings out the diverse perspectives within the community. This sheds light on the internal conflicts and tensions that arise as individuals try to make sense of cultural differences. The novel also highlights the ongoing battle against societal judgment, revealing the difficulty of preserving one's cultural identity in the face of evolving norms. Hybridization is not the only phenomenon in language but also a phenomenon in many cultural domains. Hybridization is referred to the separate and distinct entities or processes that produce another entity or process (hybrid), which shares certain characteristics with each of its sources, but which is not purely structural.



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In short, *Maps for Lost Lovers* encourages us to think about the complexities of cultural blending. It reminds us to consider the delicate dance between holding onto our cultural roots and adapting to the inevitable changes that come with living in a diverse and ever-evolving world.

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# POLICY MAKING AND SUSTAINABLE DEVELOPMENT IN KERALA

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**ABSTRACT**

Kerala State Environment Policy Vision stressed on the importance of maintaining fresh air, water, soil and food. The State Government is trying to implement several rules and regulations for protection of our ecosystem. For example, The Wildlife (Protection) Act, The Hazardous Waste Rules, The Biomedical Waste Management Rules and The Noise Pollution Rules 2000 are some of the rules and acts from the part of state governments, The Government implement all these rules and regulations through the Department of Environment Forests and Wildlife, Industries, Science and Technology, Mining and Geology and Groundwater and Health and Family Welfare, The Indian constitution is also emphasized the importance of the protection and conservation of nature The Indian Constitution states ,"State to take measures to protect and improve the environment and to safeguard the environmental quality''. If we can frame policies to protect the nature along with all the possible developments and can implement the same effectively, the first goal of sustainable development, that is eradication of poverty can be attained easily. Coastal erosion, lack of basic infrastructure such as toilets and sewage systems, pollution from urban areas, Conversion of paddy lands, deterioration of the rivers, use of chemical fertilizers in the agricultural fields, solid waste, growth of urbanization etc are the serious issues we face today. Thus, the government should make and implement effective policies to ensure the protection of our eco system.

**key words-**environment policy, rules, acts, regulations, protection and conservation, pollution, Eco system

## INTRODUCTION

Kerala's recognition as "God's Own Country" is attributed to its high standard of living and significant advancements in education. It owned high standard of living and progress in education. The impressive literacy rate of 96.2% reflects a commitment to educational advancement that surpasses the national average.

The Vision of Environment Policy of Kerala state focuses on protection and conservation of water, air and soil and sustainable development for a good standard of living of the people in Kerala. It also aims at conservation of natural resources and ecosystems. To maintain healthy



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condition, the State Government should implement several regulatory and promotional measures for environmental protection and conservation of eco system through various departments and agencies. We need effective policies to keep it up and continue for a better generation. It's our duty to save nature not only for the present generation but future generation too

## IMPORTANCE OF THE STUDY

Sustainable development is very relevant in the modern time as we live in the world of consumerism. E waste and factory waste are increasing day by day. People don't know how to manage all these things. And we are not aware about conditions future generation. In this juncture we have to study about sustainable development.

## OBJECTIVES

To know the importance sustainability and the value of natural resources to younger generation. And it helps us to know the dangerous aspects of pollution and other environmental problems. It also gives us correct knowledge about different rules and regulations are implemented by the government for this purpose. The study about government's environmental policies help the people to understand different rules and regulations. And also help them to follow all these rules without failure.

## RESEARCH METHODOLOGY

**For this study, collected Various** sources especially government publications and articles

## GEOGRAPHY OF KERALA

In Kerala there are 3 Geographical regions. 1) Highlands, 2) Midlands and 3) Low Lands. The High lands include Western Ghats, its average height is 900 m, with a number of peaks 1,800 m in height. Major plantations like tea, coffee, rubber, cardamom etc.are there in this region. The total area of Kerala is 38,863 km2, the long coastline with backwaters along the coast and tropical monsoon climate make the State a unique geographical entity. The Western Ghats also most important entity in the state.

## ENVIRONMENTAL CONDITION OF KERALA

The biophysical system and biodiversity of the State Is richest in the world, such as tropical rainforest and the coastal marine coral reefs, freshwater and brackish water and wetlands. The tropical moist forests on the Western Ghats is another important peculiarity of Kerala. The tropical monsoon climate also creates an unique climate in Kerala. The development measures



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such as road and building constructions resulted in the deforestation and degradation of natural resources .it disrupts the balance of ecology especially the floral and faunal life. This leads to the scarcity of water in the rivers and other water bodies. No place is secure in the matter fresh air and water. Even though the majority people are educated here in the state, they are not aware about the pollution and all. It is too dangerous not only to us but also to future generation; throwing wastes to rivers and ponds and road sides. The Biomedical Waste Management & Handling Rules 1998, 2000, 2003, The Environment (Setting for Industrial Projects) Rules 1999 and The Municipal Solid Wastes (Management & Handling) Rules 2000 are some of acts passed by government. The authority installed many CCTV cameras to monitor and trace all these evil practices. Many acts are passed by the Governments for this purpose, severe penalties and fines also enforced on the people those who are doing such ill practices in the society. The Wildlife Protection Act, 1972 was passed by the Government for the protection of forest and natural resources in the state.

## THREATS AND CHALLENGES IN KERALA

The state is on the way of the fast development in the field of infrastructure. It is a positive move towards the development and progress. But the exploitation of natural resources is a negative side of this development. It causes ecological degradation, natural disasters, climatic change and bad effects on plants, and animals in the State. Unlimited use of chemical fertilizers, pesticides and insecticides cause the bad effect on eco system. The state faces the following challenges in this field;

### Violation of Rules

People's tendency to violate rules is more dangerous than any other reasons. If we violate the rules ,it will badly affect not only the present generation and but also future generation. It's our duty to obey and follow the public rules and regulations. Then only we can achieve

### Deforestation,

The clearing of forests for agriculture, infrastructure development, and urbanization can lead to habitat loss, fragmentation, and a decline in biodiversity.

### Land Degradation

The unsustainable land use practices including improper agricultural practices and land conversion cause soil erosion and reduced fertility of soil.



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**Water Pollution**

pollution of rivers lakes and other water bodies can occur due to improper waste disposal and industrial effluents impacting aquatic eco system and species.

**Air Pollution**

Emissions from industries, vehicles, and other sources contribute to air pollution affecting the health of both aquatic and terrestrial eco system.

**Climate Change**

Temperature rise, Changes in climate patterns and altered precipitation patterns can have profound effects on ecosystems.

**Waste Management Issues**

Improper disposal of solid waste and plastic pollution can be affected both fauna and flora

**Exploitation of Natural Resources**

Unplanned and Unsustainable fishing, logging, and other resource extraction activities can lead to the depletion of natural resources and degradation.

**Loss of wetland**

The draining and conversion of wetlands negatively impact of the balance of ecosystem and biodiversity.

**Human –wild life conflict**

It affects both human community and wild life population. Encroachment into natural habitats can lead to increased conflicts between humans and wildlife.

**Invasive species**

The introduction of non-native species can disrupt local ecosystems and spreading diseases.

**REMEDIES FOR ACHIEVING SUSTAINABILITY**

**Responsible and accountable government**

The governing body must be responsible and accountable to keep the balance of eco system in a particular area.



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**People's effective participation**

This participation of the people is considered as precondition for the success of sustainable development. Without their participation and cooperation, it won't be successful. I f people violate the rules, it won't be implemented effectively.

**Decentralization of planning and implementation**

This means transferring decision-making authority and responsibilities to lower levels of government or local communities as part of grassroots approach to development. Then only the benefit reaches at the lowest level.

**Gandhian principle**

The Gandhian principle emphasizes the importance of inclusivity and needs of the last and least privileged citizens to ensure that the benefits of development reach all sections of society. It also stresses in the Directive Principles of state Policy of the constitution, it indicates the importance of environmental protection and conservation.

**PUBLIC POLICIES AND ACTS FOR SUSTAINABILE DEVELOPMENT**

**Kerala Conservation of Paddy Land and Wetland Act 2008**

This act aims to conserve paddy land and wetlands for agricultural practices

**Kerala State Land Use Board Act 2009**

The State Land Use Board Act was enacted to establish a State Land Use Board for the systematic planning and regulation of land use in the state, with an emphasis on sustainable land use in the state.

**Kerala Sustainable Urban Development Project**

The KSUDP focuses on sustainable urban development by improving infrastructure promoting environmental sustainability and improving the quality of life.

**Kerala State Electricity Regulatory Commission(KSERC)**

The KSERC plays an important role in promoting sustainable development by regulating the electricity sector and encouraging the integration of renewable energy sources into power grid.

**Haritha Keralam Mission**

It launched as a comprehensive program for waste management and environmental



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conservation. It aims to make the state clean, green, and sustainable.

**Kerala State Disaster Management Authority**

It aims to reduce the risk of disaster and management, emphasizing sustainable development and reduce natural disasters and calamities.

**Kerala Coastal Zone Management Authority**

It is responsible for managing and regulating activities in the coastal zone and ensuring sustainable development while protecting the coastal eco system.

**Kerala State Biodiversity Board**

It works towards the conservation of biological diversity and promoting sustainable utilization of biological resources in the state.

**Kerala State Industrial Policy**

The state's industrial policy may include provisions for promoting sustainable industrial development and encouraging eco-friendly practices and ensuring responsible use of natural resources.

**Kerala Sustainable Development Goals (SDGs) Action Plan**

The state government may have formulated specific action plans aligned with the United Nations' Sustainable Development Goals to maintain sustainable goals.

**References**


- ✓ The “New” Kerala Model: Lessons for Sustainable Development-Article
- ✓ April 2001 World Development 29(4):601-617
- ✓ Decentralisation, health and Sustainable Development Goal –Article
- ✓ Kerala Sustainable Urban Development Project (PPTA 4106 – IND) volume 8 – social and environmental safeguard frameworks


1. **Kerala Conservation of Paddy Land and Wetland Act (2008):**
    - ✓ This act aims to conserve paddy land and wetlands, recognizing their ecological significance and the need for sustainable agricultural practices.



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2. **Kerala State Land Use Board Act (2009):**
    - ✓ The State Land Use Board Act was enacted to establish a State Land Use Board for the systematic planning and regulation of land use in the state, with an emphasis on sustainable land management.
3. **Kerala Sustainable Urban Development Project (KSUDP):**
    - ✓ The KSUDP focuses on sustainable urban development by improving infrastructure, promoting environmental sustainability, and enhancing the quality of life in urban areas.
4. **Kerala State Electricity Regulatory Commission (KSERC):**
    - ✓ The KSERC plays a role in promoting sustainable development by regulating the electricity sector and encouraging the integration of renewable energy sources into the power grid.
5. **Haritha Keralam Mission:**
    - ✓ Launched as a comprehensive program for waste management and environmental conservation, the Haritha Keralam Mission aims to make Kerala clean, green, and sustainable.
6. **Kerala State Disaster Management Authority (KSDMA):**
    - ✓ KSDMA works towards disaster risk reduction and management, emphasizing sustainable and resilient development practices to reduce the impact of natural disasters.
7. **Kerala Coastal Zone Management Authority (KCZMA):**
    - ✓ KCZMA is responsible for managing and regulating activities in the coastal zone, ensuring sustainable development while protecting fragile coastal ecosystems.
8. **Kerala Forest (Vesting and Management of Ecologically Fragile Lands) Act (2003):**
    - ✓ This act addresses the management of ecologically fragile lands, with a focus on preserving biodiversity and maintaining ecological balance.
9. **Kerala State Biodiversity Board (KSBB):**
    - ✓ The KSBB works towards the conservation of biological diversity in the state, promoting sustainable utilization of biological resources and equitable sharing of benefits.
10. **Kerala State Industrial Policy:**
    - ✓ The state's industrial policy may include provisions for promoting sustainable industrial development, encouraging eco-friendly practices, and ensuring responsible use of



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natural resources.

11. **Kerala Sustainable Development Goals (SDGs) Action Plan:**
    - ✓ The state government may have formulated specific action plans aligned with the United Nations' Sustainable Development Goals (SDGs) to guide sustainable development efforts.
    - ✓ It's important to note that policies and initiatives may evolve, and new measures may be introduced after my last update in January 2022. For the latest information on governmental acts related to sustainable development in Kerala, it is recommended to refer to official government publications, websites, and announcements.



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## ABOUT THE CONFERENCE

The international conference at MES Kalladi college offers a captivating experience of academic rigor giving insights into different domains of knowledge. Scholars and experts from various fields will converge to explore the frontiers of research and innovation. With a diverse array of topics ranging from technology to humanities, the conference promises to be a melting pot of ideas. Renowned speakers are set to grace the event, imparting their wisdom and insights to the eager audience. The vibrant campus of MES Kalladi college will provide a welcoming backdrop, creating an environment conducive to intellectual exchange and collaboration. This conference is expected to contribute to the academic landscape and faster a sense of global camaraderie among participants.

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