



**CONFERENCE PROCEEDING
INTERNATIONAL CONFERENCE ON
SMART INNOVATION TECHNOLOGIES &
ARTIFICIAL INTELLIGENCE FOR
SUSTAINABLE DEVELOPMENT (ICSAS-2026)**

VOLUME - III

EDITORS

**Rev. Sr. Dr. M. BABY
Dr. R. RUBAN**

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INTERNATIONAL CONFERENCE ON

SMART INNOVATION TECHNOLOGIES

&

ARTIFICIAL INTELLIGENCE FOR SUSTAINABLE DEVELOPMENT
(ICSAS-2026)

ORGANIZED BY



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From the Chairman's Desk



Dear friends,

*It is with great joy and happiness that I present this “**International Conference on Smart Innovations and Artificial Intelligence for Sustainable Development**” organized by **St. Joseph Arts & Science College, Kovoov** - a unit of the **DMI Foundations**.*

In a rapidly evolving world, Artificial Intelligence (AI) offers tremendous opportunities to transform daily life, healthcare, agriculture, education and environmental sustainability. AI is going to become in the near future as important and inevitable as the internet to humanity. However, these innovations must be guided and guarded by respect for human dignity, social responsibility and ethical values.

***At St. Joseph's Kovoov**, we strongly believe that technology must basically serve human development, especially the development of the poor, needy and the marginalized. It must build a just, sustainable and inclusive society. I am happy that this conference organized by the college brings together researchers, scholars, innovators and scientists to find solutions to address global challenges with compassion and responsibility.*

I sincerely appreciate all the participants and organizers for your commitment to this important endeavour. May this conference inspire and ignite meaningful collaboration with lasting impact!

Best Wishes,

Rev. Fr. Dr. J.E. Arul Raj

*Chairman, St. Joseph Arts & Science College, Kovoov
Chancellor, St. Joseph University of the DMI Foundations*

Message from the Managing Trustee



With great joy and warm regards, I extend my heartfelt greetings to all the distinguished scholars, researchers, professionals, and delegates participating in the *International Conference on Smart Innovations and Artificial Intelligence for Sustainable Development*.

In today's rapidly evolving world, technology has become a defining force in shaping the future of societies and economies. Among these advancements, Artificial Intelligence stands out as one of the most transformative developments of our time. When guided by ethical responsibility and visionary thinking, AI has the potential to improve lives, strengthen communities, and contribute significantly to sustainable development.

The purpose of this conference is not only to explore technological advancements but also to reflect on how these innovations can be used wisely to address global challenges. Issues such as environmental conservation, climate change, resource management, and social equity require solutions that combine scientific knowledge with innovative technological approaches.

Institutions of higher learning play a crucial role in fostering such innovation by encouraging research, creativity, and collaboration among scholars from diverse disciplines. By bringing together experts and emerging researchers under one platform, this conference creates an environment where ideas can flourish and partnerships can grow.

I would like to express my sincere appreciation to the organizing team, faculty members, and contributors who have worked with dedication to organize this important academic gathering. Their efforts demonstrate a shared commitment to advancing knowledge and promoting responsible innovation.

May this conference inspire meaningful dialogue, encourage groundbreaking research, and guide us toward solutions that support a more sustainable and technologically progressive world.

With my blessings and best wishes for the success of this conference.

Best Wishes,

Rev. Sr. S. Gnanaselvam

Managing Trustee

DFT Group of Institutions

Administrator's Message



Esteemed Scholars, Researchers, Innovators, and Participants,

*It is my great pleasure to warmly welcome you all to the **International Conference on Smart Innovations and Artificial Intelligence for Sustainable Development**. This conference serves as a dynamic platform that brings together visionary thinkers, academicians, industry experts, and emerging researchers who are united in their commitment to shaping a sustainable and technologically advanced future.*

In an era where innovation is rapidly transforming every aspect of our lives, such gatherings play a crucial role in fostering intellectual exchange, collaboration, and progressive thinking. Artificial Intelligence and smart technologies have emerged as powerful tools capable of addressing some of the most pressing global challenges. From enhancing resource efficiency and environmental sustainability to advancing healthcare, agriculture, and education, these technologies are enabling solutions that were once beyond imagination.

As we explore these advancements, it is equally important to ensure that technological progress aligns with the principles of sustainability, ethical responsibility, and inclusiveness. This conference provides an excellent opportunity to examine how smart innovations can contribute to sustainable development across diverse sectors. Through research presentations, insightful discussions, and interdisciplinary collaborations, participants will be able to exchange knowledge, gain new perspectives, and develop ideas that promote responsible and sustainable technological growth.

I sincerely commend the dedicated efforts of the organizing committee, faculty members, researchers, and volunteers whose commitment and hard work have made this conference possible. Their contributions reflect the spirit of academic excellence and innovation that our institution upholds. I extend my best wishes to all participants for productive discussions, meaningful collaborations, and successful outcomes. May this conference inspire innovative ideas and lasting partnerships that contribute to building a sustainable and technologically empowered world.

Best Wishes,

Rev. Sr. Dr. M. Baby

Administrator

St. Joseph's College (Arts & Science)

Kovur, Chennai 128

Principal's Message



“Sustainable development begins where innovation meets responsibility.”

Dear Esteemed Scholars, Researchers, and Participants,

With the blessings of God Almighty and the visionary guidance of our Founder Chairman, Rev. Fr. Dr. J. E. Arul Raj, our institution continues to strive for excellence in education and holistic development. It is indeed a great privilege to convey my greetings on the International Conference on Smart Innovations and Artificial Intelligence for Sustainable Development, which reflects our commitment to promoting academic inquiry and meaningful research.

St. Joseph's College (Arts & Science) has consistently worked towards creating an environment that nurtures intellectual growth, ethical values, and holistic development. Guided by our vision of forming individuals who are “Fully Alive and Fully Human,” the institution remains dedicated to empowering students through quality education and social responsibility.

The focus of this conference on smart innovations and artificial intelligence highlights the growing importance of technology in addressing contemporary global challenges. As advancements continue to influence various sectors, it is essential to ensure that such developments are aligned with the principles of sustainability, inclusiveness, and responsible progress.

This conference offers a valuable platform for scholars, researchers, and professionals to exchange ideas, present their work, and engage in meaningful academic dialogue. Such interactions contribute to the advancement of knowledge and encourage innovative approaches toward sustainable development.

I appreciate the dedicated efforts of the organizing team, faculty members, and all those who have contributed to making this conference possible. I extend my best wishes for the success of this conference and for all participants to have a productive and enriching experience.

Best Wishes,

Dr. R. Ruban

Principal

*St. Joseph's College (Arts & Science)
Kovur, Chennai 128*

FULL PAPER INDEX – ICSAS - 2026

S. NO	PAPER TITLE	PAGE NO.
1.	ARTIFICIAL INTELLIGENCE IN LANGUAGE LEARNING: TRANSFORMING THE FUTURE OF LINGUISTIC EDUCATION	1
	R. RATHI PRIYA	
2.	FLUID MASCULINITIES: CHALLENGING WESTERN PARADIGMS IN MO XIANG TONG XIU’S MODAO ZUSHI	11
	AKSHAYA SANTHOSH	
3.	DESIGNING AI-ENHANCED WHOLE LANGUAGE TASKS: A PEDAGOGICAL MODEL FOR FUTURE-FOCUSED ELT.	21
	ALLAN MESHACK J	
4.	AI-DRIVEN APPROACHES TO SECOND LANGUAGE ACQUISITION IN THE DIGITAL LEARNING ERA	30
	DR. S. ANANDH RAJ, MRS. S. SARASANNA DEVI	
5.	“EXPLORING THE DEPTHS OF THE UNCONSCIOUS: HUMAN PSYCHE IN LITERARY NARRATIVES”	41
	MS. BHARATHICHELLAMMAL.A	
6.	MYTH AND ENVIRONMENTAL ETHICS IN JUNGLE NAMA: AN ECO- CRITICAL READING	49
	F. FEMINA	
7.	MODERNITY AND ITS DISCONTENTS: A CRITIQUE OF UNSUSTAINABLE SOCIAL PRACTICES IN VILE BODIES	54
	MRS JOSEPHINE SILVIYA	
8.	EXPLORING THE MIND: A COGNITIVE APPROACH TO THE DARK HOLDS NO TERRORS BY SHASHI DESHPANDE	60
	MRS.D.MUGUNTHAPRIYA, DR.R.ANNAM	

9.	CULTURAL NARRATIVE OF SUSTAINABILITY IN RANI MANICKA'S TOUCHING EARTH DR. NARMADA C	65
10.	ANCIENT GODS IN A MODERN WORLD: IDENTITY AND HEROISM IN THE TITAN'S CURSE P. PEARL FEMINA	68
11.	NEGOTIATING QUEER IDENTITIES IN MO DAO ZU SHI: TRADITION, MASCULINITY, AND SOCIAL LEGITIMACY IN CHINESE CONTEXTS G. SIVASHAKTHI	71
12.	A COMPARATIVE STUDY ON CARBON EMISSIONS ACROSS TRANSPORT MODES IN INDIA DR.A. PARIMALA , DR.J. RAJESH, , MRS.R. ISHWARYA, PRINCY SOFIYA J, AARTHI J, DURGA DEVI S	75
13.	JOINT MODEL FOR PREDICTING THE RISK FOR RECURRENCE IN COLORECTAL CANCER WITH A COMPETING EVENT IRFANA MOHAMMED , NAZEEMA BEEVI T , JAGATHNATH KRISHNA , AND AANAD HARI	80
14.	A STUDY ON DIFFERENT RANKING TECHNIQUES TO SOLVE THE TRAPEZOIDAL FUZZY TRANSPORTATION PROBLEM K MONISHA, R DEVI	88
15.	BUILDING NEUROETHICS-AI TOOLS GROUNDED IN MORAL PHILOSOPHY:A TIRUKKURAL - INSPIRED FRAMEWORK S. RAMAN	94
16.	MULTI-SPORT ATHLETES: ADVANCED YET ACCESSIBLE TRAINING METHODS TO MAXIMIZE SKILL TRANSFER AND MINIMIZE OVERUSE RISK FOR GENERAL ATHLETE MR.B.SELVANESAN	99
17.	ARTIFICIAL INTELLIGENCE AND ROBOTICS IN HOTEL OPERATIONS: TRANSFORMING THE FUTURE OF HOSPITALITY INDUSTRY MOHAMMED YASIR M	105

18.	SMART AI TECHNOLOGIES FOR VISUAL COMMUNICATION STUDENTS	109
	K.VELAYUTHAM	
19.	A STUDY ON THE INTEGRATION OF COMMUNITY DEVELOPMENT WITH SMART INNOVATION TECHNOLOGIES	112
	AISHWARYA MILLER	
20.	USING INNOVATIVE TECHNOLOGY TO SUPPORT THE HEALTH AND WELLBEING OF AUTISM CAREGIVERS	118
	AKSHAYA DHANESH, MRS. P. VINITHA	
21.	A STUDY ON THE DIVERSITY AND INCLUSION OF EMPLOYEES IN CONTEMPORARY ORGANISATIONS	125
	U AVANTIKA, DR. G F ALBAN NISHANTH LALU	
22.	EMPLOYEE JOB SATISFACTION AT DOMINOS PIZZA	132
	HALIMAA YASMIN S, DR. M. BABY	
23.	STUDY ON WOMEN EMPLOYEES' AWARENESS IN POSH POLICIES AND PROCEDURES IN ORGANIZATIONAL SETTINGS	138
	JOHN ANTONY L DR. G F ALBAN NISHANTH LALU	
24.	COMMUNITY DEVELOPMENT, SOCIAL INCLUSION AND SUSTAINABLE SOCIAL PRACTICE: PATHWAYS FOR TRANSFORMATIVE CHANGE IN UPPER NILE STATE, SOUTH SUDAN	145
	S. JUDIT, DR. K. EMMANUEL	
25.	COMMUNITY DEVELOPMENT, SOCIAL INCLUSION, AND SUSTAINABLE SOCIAL PRACTICES: GLOBAL PERSPECTIVES AND THE CASE OF SOUTH SUDAN	147
	S.RENGIS MARY, DR. JAMES MUMBASA	
26.	RECYCLING BEHAVIOR PREDICTION USING MACHINE LEARNING	153
	ANUSUYA ARUMUGAM	
27.	SOCIO-ECONOMIC STATUS OF TEACHING FACULTY IN MEN'S COLLEGES IN CHENNAI: A COMPREHENSIVE STUDY	161
	SANTHOSH KUMAR. S & DR.A.MALLIGA	

28.	CORPORATE GOVERNANCE, COMPLIANCE, AND SUSTAINABILITY: EMERGING TRENDS IN MODERN ORGANIZATIONS	173
	MS.HEMAVATHY. D , MS.DIVYADHARSHINI. M AND MS.MANJUSRI. S	
29.	GRAPH NEURAL NETWORK (GNN) BASED PREDICTION OF HER2, BRCA1/2, AND EGFR DRUG TARGETS IN HUMAN BREAST CANCER	181
	T. JERIN SALES	
30.	ADAPTIVE EXPLAINABLE GRAPH-ENSEMBLE DEEP LEARNING FRAMEWORK FOR REAL-TIME FINANCIAL FRAUD DETECTION	190
	BODA NIHARIKA¹, KASHA MAHALAXMI², SALMA BEGUM³	
31.	RELATIONSHIP MARKETING STRATEGIES AND CUSTOMER LOYALTY IN THE BANKING SECTOR	197
	MR. J. JABASTEEN, DR.M.JENIFER EZHILARASI	
32.	ANALYSIS OF CUSTOMER PERCEPTION ON ONLINE FOOD DELIVERY IN CHENNAI	214
	JOEL PREETHI F, ANUSHA T	
33.	AI FOR CULTURAL AND SOCIAL EMPOWERMENT: DRIVING BEHAVIOUR CHANGE FOR SUSTAINABLE DEVELOPMENT	226
	F. AMALA PUSHPAM Dr. T. MARIRAJAN Dr. M.BABY	
34.	SMART INNOVATION TECHNOLOGIES & ARTIFICIAL INTELLIGENCE FOR SUSTAINABLE DEVELOPMENT	233
	DR. N. SASIKALA	
35.	PRODUCTION AND CHARACTERIZATION OF BIODEGRADABLE PHA BIOPLASTIC FROM BANANA PEEL WASTE USING MIXED MICROBIAL FERMENTATION	240
	K.PRIYA	
36.	MARKETING MANAGEMENT AND AI-DRIVEN CONSUMER ANALYTICS IN SOCIAL MEDIA	254
	V. MATHARSI	
37.	STRATEGIC HUMAN RESOURCE MANAGEMENT PRACTICES FOR SUSTAINABLE ORGANIZATIONAL PERFORMANCE	265
	DR.P.PORSEZIYAN	

38.	MONSOON RAINFALL VARIABILITY IN CHENNAI: A TIME SERIES STUDY	271
	K. RENUGADEVI	
39.	A COMPARATIVE STUDY OF SUPERVISED AND UNSUPERVISED METHODS FOR SENTIMENT ANALYSIS AT THE DOCUMENT LEVEL	276
	Dr. W. SARADA, T.NANDINI, P.POOJA	
40.	சங்கஇலக்கியத்தில் சமூகவியல் நோக்கில் பெண்மொழி	282
	முனைவர். ச. பசுபதி	
41.	நவீன இலக்கியங்களில் பாரதியின் தாக்கம்	290
	முனைவர். செ. பரமேஸ்வரி	
42.	முக்கூடற்கண் மருத்துவம் செய்த காதையில் புலவர் காசுமானின் மருத்துவப் புலமைகள்	296
	முனைவர் .தே ஜெயசோபியா	
43.	சோளகர் பழங்குடி மக்களின் தொழில்கள்	301
	முனைவர் சு. பிரபாகரன்	
44.	HUMAN-LIKE EMOTIONAL INTELLIGENCE IN ARTIFICIAL INTELLIGENCE: EXPLORING FUTURE POSSIBILITIES, ETHICAL IMPLICATIONS, AND SOCIETAL CHALLENGES	306
	B.VASANTHAKUMAR	
45.	INNOVATION & TECHNOLOGY FOR EMPLOYEE PERFORMANCE IN CBSE SCHOOLS	312
	ALEYAMMA.A DR. JAYA SUNITHA PRABHAKARAN	

ARTIFICIAL INTELLIGENCE IN LANGUAGE LEARNING: TRANSFORMING THE FUTURE OF LINGUISTIC EDUCATION

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Abstract

Artificial Intelligence has emerged as one of the most influential technological developments in the field of education, especially in the teaching and learning of languages. In the modern digital era, language learning is no longer limited to traditional classroom instruction, but has expanded into flexible, technology-supported environments that allow learners to practice language skills in innovative ways. Artificial Intelligence based technologies such as Natural Language Processing, speech recognition, machine learning, neural networks, and intelligent tutoring systems provide new opportunities for improving linguistic competence. These technologies help learners develop listening, speaking, reading, and writing skills through personalized learning experiences and immediate feedback. Artificial Intelligence also supports adaptive learning environments where lessons are designed according to the learner's level, speed, and ability. At the same time, the use of Artificial Intelligence in language education raises important questions related to human interaction, ethical responsibility, data privacy, and the role of teachers. This paper discusses the concept of Artificial Intelligence, its application in language learning, pedagogical implications, classroom integration, research perspectives, and future possibilities. The study argues that Artificial Intelligence can greatly improve language education when it is used as a supportive tool along with traditional teaching methods rather than as a replacement for human teachers.

Keywords: *Artificial Intelligence, Language Learning, Educational Technology, Digital Education, Natural Language Processing, AI in Education*

Introduction

The development of science and technology has brought remarkable changes in every field of human life, and education is one of the areas that has experienced significant transformation. In earlier times, language learning mainly depended on classroom teaching, printed books, and direct communication between teachers and students. The traditional method of teaching languages focused on memorization, grammar rules, and written exercises. Although these methods were useful, they often lacked flexibility and did not provide equal attention to all

learners. With the advancement of digital technology, the process of language learning has become more interactive, learner-centered, and flexible.

Artificial Intelligence has played a major role in this transformation by introducing intelligent learning systems that can understand and respond to human language. Artificial Intelligence refers to the ability of machines to perform tasks that normally require human intelligence, such as understanding speech, recognizing patterns, solving problems, and making decisions. In language education, Artificial Intelligence allows learners to practice communication skills in a comfortable and supportive environment. Students can learn at their own pace, repeat lessons many times, and receive instant correction for their mistakes.

In the present educational environment, students are more interested in using digital tools such as mobile applications, online platforms, and virtual classrooms. Artificial Intelligence makes these tools more intelligent by providing personalized lessons and automatic feedback. As a result, language learning has become more effective and enjoyable. The integration of Artificial Intelligence in language education has created new possibilities for teachers and learners. Therefore, the study of Artificial Intelligence in language learning has become an important topic in modern educational research.

Literature Review

Many scholars have examined the use of Artificial Intelligence in education and have explained its importance in improving teaching and learning. Research studies show that Artificial Intelligence can support personalized learning, increase student motivation, and improve academic performance. Chen, Zou, Cheng, and Xie state that Artificial Intelligence helps in creating adaptive learning environments where the system analyzes the learner's performance and provides suitable lessons. Their research shows that students learn faster when they receive immediate feedback and personalized instruction.

Holmes, Bialik, and Fadel explain that Artificial Intelligence has the ability to support teachers by performing routine tasks such as evaluation, progress monitoring, and lesson planning. According to their study, Artificial Intelligence should not replace teachers, but it should help teachers make the learning process more effective and efficient. They also suggest that the future of education will depend on the proper integration of technology and human teaching.

Li and Lan conducted a systematic review of Artificial Intelligence in second language learning and found that speech recognition systems, chatbots, and automated writing evaluation tools are widely used in language education. These technologies allow learners to practice language skills without fear of making mistakes. The researchers also note that AI-based learning systems increase learner confidence and provide more opportunities for practice.

Zawacki-Richter and his colleagues studied the use of Artificial Intelligence in higher education and concluded that AI will become an essential part of modern learning systems. Their study shows that Artificial Intelligence is mainly used for personalized learning, student support, and administrative purposes. However, the researchers also warn that the use of Artificial Intelligence must be controlled carefully to avoid ethical problems.

The review of previous studies clearly shows that Artificial Intelligence has a positive influence on language learning, but it should be used in a balanced way to maintain the importance of human teaching.

Concept of Artificial Intelligence in Education

Artificial Intelligence is a branch of computer science that deals with the creation of intelligent machines that can perform tasks similar to human thinking. These tasks include understanding language, recognizing speech, learning from experience, and solving problems. Artificial Intelligence works with the help of algorithms, machine learning, and data analysis. Machine learning allows computers to learn from data and improve their performance without direct human instruction.

In education, Artificial Intelligence is used to create intelligent learning environments where students can interact with digital systems. These systems can analyze the learner's performance and provide lessons according to individual needs. Artificial Intelligence also supports multimedia learning, virtual classrooms, and online education platforms that make learning more interesting and effective.

The use of Artificial Intelligence in language learning is especially important because language requires continuous practice and feedback. AI-based systems provide opportunities for learners to practice communication skills in different situations. This makes learning more natural and meaningful.

Artificial Intelligence in Language Learning

Artificial Intelligence has become an important tool in modern language education. AI-based technologies such as chatbots, speech recognition software, translation tools, grammar correction systems, and intelligent tutoring programs help learners practice language skills in an effective way. These tools allow students to repeat exercises many times and learn without fear of making mistakes.

AI-based language learning applications provide instant feedback for pronunciation, grammar, and vocabulary. This helps learners correct their mistakes immediately and improve faster. Unlike traditional classroom teaching, Artificial Intelligence systems are available at any time, which makes learning more flexible.

Artificial Intelligence also creates interactive learning environments where students can participate in conversations, games, and quizzes. These activities increase motivation and make learning more enjoyable. Students feel more confident when they practice with AI because they are not afraid of being judged.

Another important advantage of Artificial Intelligence in language learning is that it supports self-learning. Students can learn independently without depending completely on the teacher. This makes learning more effective, especially for slow learners.

Natural Language Processing and Language Learning

Natural Language Processing is one of the most important technologies used in Artificial Intelligence. It allows computers to understand human language in both spoken and written form. NLP is used in translation systems, chatbots, grammar correction tools, and voice assistants.

In language learning, Natural Language Processing helps in analyzing the learner's speech and writing. The system can identify grammatical errors, pronunciation problems, and incorrect sentence structures. This helps learners improve their accuracy.

NLP also allows learners to communicate with AI-based systems as if they are talking to a real person. This improves speaking and listening skills and makes learning more natural.

Speech Recognition and Pronunciation Training

Speech recognition technology is very useful in language learning because it allows computers to understand spoken language. Students can speak into the system and receive immediate feedback. This helps learners improve pronunciation and fluency.

Many learners feel shy to speak in the classroom, but AI-based systems provide a comfortable environment where they can practice freely. Continuous practice helps learners gain confidence.

Speech recognition also reduces the workload of teachers because the system automatically checks pronunciation errors.

Intelligent Tutoring Systems and Personalized Learning

Intelligent tutoring systems are computer programs that act like virtual teachers. These systems analyze the learner's performance and provide lessons according to individual needs. If a student is weak in grammar, the system gives more grammar exercises. If the student is strong in vocabulary, the system provides advanced lessons.

Personalized learning is one of the biggest advantages of Artificial Intelligence. In traditional classrooms, it is difficult for teachers to give individual attention to every student. AI makes this possible.

Intelligent tutoring systems also store student performance records, which helps teachers understand the progress of each learner.

Psychological Impact of AI-Based Language Learning

Artificial Intelligence has also influenced the psychology of learners. Many students feel nervous while speaking in front of others, especially when learning a new language. AI-based learning systems reduce this fear because students can practice privately without feeling embarrassed. This creates a comfortable learning environment and increases self-confidence.

Another psychological benefit of AI-based learning is motivation. Interactive activities such as games, quizzes, and conversation simulations make learning enjoyable. When students enjoy the learning process, they show more interest and concentration. Artificial Intelligence also provides immediate feedback, which helps learners understand their mistakes quickly. This increases their confidence and encourages them to continue learning.

However, there are also some psychological challenges. Some learners may become too dependent on technology and may lose the habit of independent thinking. When students rely only on AI tools for correction, they may not develop the ability to analyze language by themselves. Therefore, teachers must guide students to use Artificial Intelligence in a balanced way so that technology supports learning without reducing creativity and critical thinking.

Classroom Integration of Artificial Intelligence

The integration of Artificial Intelligence into classroom teaching has changed the role of both teachers and students. In a traditional classroom, the teacher was the main source of knowledge, but in a technology-supported classroom, the teacher acts as a guide and facilitator. Artificial Intelligence provides additional support by offering digital lessons, interactive exercises, and automatic evaluation.

Teachers can use AI-based platforms to provide assignments, quizzes, and language practice activities. Students can complete these activities online and receive instant feedback. This saves time for teachers and allows them to focus on explaining difficult concepts and developing communication skills.

Artificial Intelligence also supports blended learning, where traditional classroom teaching is combined with online learning. This method gives better results because students can learn both from teachers and from digital systems. Classroom integration of Artificial Intelligence makes the learning process more flexible and effective.

Ethical Issues and Data Privacy

The use of Artificial Intelligence in education also raises ethical concerns. AI-based systems collect personal data such as student performance, learning habits, and communication patterns. This data must be protected carefully because misuse of personal information can create serious problems. Educational institutions must ensure that AI systems follow proper security rules.

Another ethical issue is the digital divide. Not all students have equal access to technology. Some learners may not have computers, internet connection, or smart devices. This creates inequality in education. Institutions must provide equal opportunities for all students so that technology can be used fairly.

There is also a concern that Artificial Intelligence may reduce human interaction in education. Language learning requires emotional understanding, cultural knowledge, and real communication. Machines cannot fully replace human teachers in these areas. Therefore, Artificial Intelligence should be used as a supportive tool rather than a complete replacement.

Research Methodology

This study is based on qualitative research using secondary sources such as books, research journals, academic articles, and educational reports related to Artificial Intelligence in language learning. The purpose of the study is to analyze the role of Artificial Intelligence in improving language education and to understand its advantages and limitations.

Information has been collected from previous studies that discuss the use of AI-based tools in second language learning. The study also examines classroom practices where Artificial Intelligence is used for teaching English as a second language. The collected data is analyzed to understand how AI influences student performance, motivation, and communication skills.

Qualitative analysis is suitable for this study because it allows detailed examination of ideas, opinions, and research findings related to Artificial Intelligence in education.

Future Scope of Artificial Intelligence in Language Education

The future of language learning will be strongly influenced by Artificial Intelligence. Advanced technologies such as virtual reality, augmented reality, and real-time translation will make learning more natural and interactive. Students may learn languages by entering virtual classrooms where they can communicate with digital characters.

Artificial Intelligence will also help teachers in automatic evaluation, lesson planning, and progress monitoring. Smart learning systems will be able to understand the learner's level and provide suitable lessons automatically. This will make education more personalized.

In the future, Artificial Intelligence may also help in multilingual communication by providing instant translation. This will make it easier for people from different countries to communicate. As technology continues to develop, Artificial Intelligence will become an essential part of language education.

1. Personalized Learning Experiences

AI systems analyze learners' proficiency levels, learning pace, and preferences to tailor content accordingly. This adaptive learning ensures that each student receives a unique learning path, improving efficiency and retention.

2. Instant Feedback and Error Correction

One of the most powerful features of AI is real-time feedback. Learners receive immediate corrections on grammar, pronunciation, and vocabulary, enabling faster improvement without waiting for instructor input.

3. Conversational Practice Through AI Chatbots

AI-driven chatbots simulate real-life conversations, allowing learners to practice speaking in a low-pressure environment. This builds confidence and fluency, especially for beginners who may feel hesitant speaking with native speakers.

4. Accessibility and Flexibility

AI enables 24/7 access to learning resources, making language education more inclusive and flexible. Learners can study at their own pace, regardless of location or schedule.

5. Gamification and Engagement

AI-powered apps incorporate game-like features such as rewards, levels, and challenges, transforming language learning into an engaging and enjoyable activity.

6. Contextual and Intelligent Vocabulary Learning

Instead of rote memorization, AI introduces vocabulary in meaningful contexts, improving understanding and long-term retention.

7. Emotional and Motivational Support

Advanced AI systems can detect learner emotions (e.g., frustration or boredom) and adjust content accordingly, maintaining motivation and improving learning outcomes.

Challenges and Limitations

Despite its advantages, AI in language learning faces several challenges:

- **Lack of cultural nuance:** AI may struggle to teach cultural context and pragmatic language use effectively.
- **Over-reliance on technology:** Excessive dependence on AI tools can hinder critical thinking and independent learning.
- **Bias in data:** AI systems may reflect biases present in their training data, limiting exposure to diverse linguistic forms.

- **Limited authenticity:** AI-generated language may lack real-world social and cultural depth.

The Future of AI in Language Education

The future of linguistic education lies in a hybrid model that combines AI with human instruction. AI will likely:

- Act as a **personal tutor available 24/7**
- Enable **immersive learning via AR/VR environments**
- Support **real-time multilingual communication and translation**
- Foster new skills like “**prompt literacy**”, where learners interact effectively with AI systems

Conclusion

Artificial Intelligence has brought a major transformation in the field of language learning by making education more interactive, flexible, and personalized. AI-based technologies such as Natural Language Processing, speech recognition, and intelligent tutoring systems help learners improve their language skills through continuous practice and immediate feedback. Artificial Intelligence supports personalized learning and allows students to learn according to their own speed and ability.

At the same time, the use of Artificial Intelligence also creates challenges such as lack of human interaction, over-dependence on technology, and ethical concerns related to privacy and equality. Therefore, Artificial Intelligence should not replace teachers, but it should be used as a supportive tool. A balanced approach that combines traditional teaching with modern technology can produce the best results.

The future of language education will depend on the proper use of Artificial Intelligence. If used responsibly, AI can improve the quality of education and help learners communicate effectively in the global world.

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FLUID MASCULINITIES: CHALLENGING WESTERN PARADIGMS**IN MO XIANG TONG XIU'S MODAO ZUSHI****Ms. AKSHAYA SANTHOSH**Assistant Professor, Department of English, St. Joseph's College (Arts & Science), Kovur

Abstract

Masculinity, as a culturally constructed concept, varies significantly across societies, challenging any universal definition of what it means to be “manly.” This paper explores the representation of masculinity in *Modao Zushi* by contrasting dominant Western ideals with the Chinese *wen-wu* paradigm. While Western frameworks emphasize physical strength, emotional restraint, and dominance, Chinese masculinity integrates both intellectual refinement (*wen*) and martial capability (*wu*) as complementary forces. Through an analysis of characters such as Wei Wuxian, Lan Wangji, and Nie Mingjue, the study demonstrates that masculinity in the narrative is fluid, balanced, and culturally rooted. It also highlights how traits like caregiving, emotional depth, and same-sex relationships do not diminish masculine identity but contribute to its complexity. Drawing on theoretical perspectives from masculinity studies and Chinese gender discourse, this paper argues that applying Western lenses to Eastern texts leads to reductive interpretations and obscures alternative models of masculine expression.

Keywords: *masculinity, Wen–Wu Paradigm, Chinese Gender Studies, Cultural Representation*

Introduction:

Stephen Whitehead and Frank Barrett define the term “Masculinity” in *The Masculinities Reader* (2001) as “those behaviours, languages and practices, existing in specific cultural and organizational locations, which are commonly associated with men, thus culturally defined as not feminine”. The concept of masculinity in the West is significantly different from that in the East. This is evident from the different kinds of warriors portrayed in historical or fantasy dramas on both sides. The heroes of *Vikings* (2013-2020) or *Game of Thrones* (2011- 2019) do not resemble the heroes of *Kingdom* (2019-2020) or *Ashes of Love* (2018). Popular actors, such as Marlon Brandon Jr., Jason Momoa, Clark Gable did not shoot

to fame solely based on their acting skills, instead the image of masculinity they maintained played a vital role which also influenced the audience.

The recent works on masculinity produced in the West describe “the Occidental male as forming his notion of the male self in terms of images of toughness, courage, and decisiveness, having an adventuresome spirit, a proclivity to violence, a tendency towards a physical rather than oral expression of thoughts and a callous attitude to sexual relations” (Louie and Edwards 138). A significant number of movies and television series represent the Western men as ‘popular’ and ‘desirable’, thus depicting ideal masculinity, while Eastern (especially Asian) men are shown as ‘geeky’ or ‘nerd’, pushing them to a subordinate position.

If readers from the West are to analyze the men in *Modao Zushi* under this lens of masculinity, then perhaps even the primary characters, Lan Wangji and Wei Wuxian, may not make into the list. The cultural practices, such as the use of fans, conversations over tea, even homosexuality, would be held as markers to question their masculinity. Therefore, “western paradigms of masculinity are inappropriate—their application could only serve to prove that [Eastern] men are “not quite real men” because they fail the Western test of masculinity” (Louie and Edwards 183). Before dwelling into the depiction of masculinity in the novel, it is essential to shed light into China’s perception of term.

Chinese masculinity consists of *wen* and *wu*. In simple terms, *wen* refers to the mental or civil while *wu* refers to the physical or the martial. In *Theorizing Chinese Masculinity: Society and Gender in China*, Kam Louie provides a comprehensive analysis of Chinese masculinity using these concepts. According to Louie, *Wen* referred to “those genteel, refined qualities that were associated with literary and artistic pursuits of the classical scholars and can thereby be partly analyzed as a leisure class masculine model” (Louie 14). He further expands that “this type of masculinity is perhaps best typified by the image of groups of men writing poetry for mutual amusement or to mark a memorable occasion” (Louie 14). *Wu*, according to the Great Chinese Dictionary, contains over two dozen meanings but “with the core meaning centering around martial, military, force and power” (Louie 10). Yet, Louie clarifies that:

Wu attributes of physical strength and military prowess were not the sole preserve of the masses since they were cultivated by large sections of male society. Wu was conceived as embodying seven virtues—'suppressed violence, gathered in arms, protected what was great,

established merit, gave peace to the people, harmonized the masses and propagated wealth'. Wu is therefore a concept which embodies the power of military strength but also the wisdom to know when and when not to deploy this strength. (Louie 14)

Additionally, he highlights the difference between the wuxia (the *wu* fighters), European knights, and Japanese samurai, where the former are depicted as fighters of righteousness displaying loyalty to their comrades while maintaining a certain distance from women. In contrast, European knights uphold aristocratic values, fighting for lofty ideals, often rooted in religion, and the samurai embody a military spirit and prioritize loyalty to their lord (Louie 10). However, neither *wen* nor *wu* are considered superior over the other, instead they are considered to be crucial for 'men of substance'. Thus, a scholar is no less masculine than a soldier.

Despite being a social construct, this wen-wu paradigm cannot be applied to women, unless they have managed to transform themselves into men (often through disguise as seen in Disney's *Mulan* or in the Chinese TV series *Oh My General*) because women have been denied access to these sections of society during the period of Imperial China. Similarly, the masculinity of non-Chinese men was not considered under the wen-wu paradigm, instead their "masculinity was sexualized to reveal their animal barbarism" (Louie 12).

In *Modao Zushi*, this blend of wen-wu is what must be considered when examining the masculinity portrayed. They are 'cultivators' who are trained to be equally proficient with wen and wu attributes irrespective of whether they chose to lean towards one later in their life. When Wei Wuxian and Lan Wangji are considered, their masculinity remains unchallenged. Wei Wuxian and Lan Wangji are described as the "Master of Six Arts"—Rites, Music, Archery, Charioteering, Literary, and Numeracy—talents that perfectly blend in Wen and Wu. They are both powerful cultivators of their generations, prodigies in their own way, and undefeated in battles. When Wei Wuxian abandoned his sword—an extremely important symbol in the cultivation society not only as a marker of their identity but also a symbol of propriety—he was greatly criticized. But the criticism was due to his deviation into the demonic arts and unorthodox practices. His decision to cultivate using his flute did not push him into a subordinate position when he was placed along with the other sword-wielders.

The only instance when Wei Wuxian's masculinity was questioned was during the post-revival period, during which he disguised himself as Mo Xuanyu, who was known to possess none of the Wen-Wu attributes. Even when he was suspected with proper evidence to

be hiding under a false identity, it was quickly dismissed because ‘Wei Wuxian’s’ masculinity is secure.

During the Sunshot Campaign, [Wei Wuxian] stood on the battlefield and played his flute throughout the whole night, controlling the ghost soldiers as if they were a living army. He swept away all obstacles—whether a human or god was standing in front of him, he had defeated them. The sound of his flute was as if it was played by an immortal, absolutely incomparable to the terrible moans made by the abandoned son of the Jin Clan. No matter how horrible Wei Wuxian’s character was, it was too insulting to compare them like this. (MXTX Chapter 10)

However, it must be noted that the kind of masculinity portrayed by Wei Wuxian and Lan Wangji is ‘ideal’ masculinity—the kind that women consider to be the correct kind of masculinity, or the one which they desire for men to possess. As explained in the previous pages, these characters were developed embodying the desires of women and therefore it must be understood that every aspect of the characters in the narrative will be affected by this desire. This is one of the accusations placed on Danmei novels. They are criticized for promoting a kind of masculinity which does not exist in real life. However, this allegation need not be seriously considered because the very existence of hegemonic masculinity in almost every society proves that Danmei is not unique in its promotion of one kind of superior masculinity.

The ideal masculinity that Wei Wuxian and Lan Wangji promote is a mixture of both masculine and feminine attributes. During the period when he was living in the Burial Mounds, Wei Wuxian was both the protector and nurturer for the War survivors. As their protector, Wei Wuxian “embodies masculine power through his use of demonic cultivation to defend the survivors from political persecution—yet [his] daily life is embedded in the practices of female nurturance, as *Modao Zushi* depicts scenes in which he takes responsibility for the health and wellbeing of the young and elderly Wen Sect survivors” (Hu). Similarly, MXTX portrayed Lan Wangji to take up the roles of the masculine protector and feminine nurturer. He is considered to be one of the most powerful cultivators of his time, yet his role as Lan Sizhui’s devoted parent after Wei Wuxian’s death reveals his role as the caretaker.

Even within their relationship Wei Wuxian and Lan Wangji are shown to be secure about their masculinity. Irrespective of the duties they carry out within their household—

cooking, cleaning, washing, weaving, farming—they are not considered to be inferior to one another. One of the frequently committed misunderstandings while examining stories revolving around homosexual relationships is that such relationships jeopardize the individual's masculinity or femininity. Such misunderstandings led to the Chinese government imposing ban on literature and media portrayal of homosexual contents that might influence the population and therefore pose a risk to the national security. But this misunderstanding is due to the writers' tendency to fall back into the heterosexual gender roles even when writing about homosexual relationships. This wouldn't be an issue with most Danmei novels, especially with *Modao Zushi*, as explained in the previous pages.

Nie Mingjue could be considered to be the ideal embodiment of Western masculinity. Apart from being the Commander of the Sunshot Campaign and the Nie Sect leader, he is aggressive, refuses to display his emotions, unflinching in the face of danger, prefers death over humiliation, is not inclined towards Arts, and resorts to violence before attempting for peace. However, this interpretation of his masculinity is inaccurate because he is the perfect example of *wu* masculinity.

Nie Mingjue places great importance on loyalty from among comrades, forbidding any form of discrimination on the basis of social status or origin. When Jin Guangyao (who was then known as Meng Yao) was insulted by the soldiers for his origins, Nie Mingjue fiercely defended him, approving him for his hard work and determination. His support only ended when the latter murdered one of his soldiers due to a personal grudge. Nie Mingjue, one of the most powerful cultivators, wielded his saber only for causes that he believed to be righteous and moral. During his period as the leader of the Nie Sect, the crime rates in Qinghe along with the number of attacks from non-human entities were significantly low. He was known to readily answer the plight of anyone living in his dominion.

As mentioned before, *wu* focuses on attributes related to physical strength and military powers. But *wu* hero also displays his masculinity differently from the *wen* through their relationship with women. The *wu* hero “shows his strength and masculinity by resisting the lure of feminine charm—a *wu* hero must contain his sexual and romantic desires” (Louie and Edwards 146). Unlike other characters, Nie Mingjue and his brother, Nie Huaisang, stand out as characters who have minimal interaction with women, and the Nie women are neither included into the narrative nor noted by the characters. Unlike the Lan, Jin, Jiang, or Wen, the Nie Sect is depicted as a sect that leans more towards martial skills over civil practices. Even

their choice of weapon is in contrast with the rest of the cultivation—while the other sects prefer swords which is considered to be elegant and gentlemanly, the Nies prefer sabers, a less elegant weapon comparatively.

Throughout the narrative, Nie Mingjue (true to *wu* qualities) only once shows interests in the opposite sex. When Wei Wuxian was being falsely accused of plotting for a mutiny with the Wen Sect war survivors he rescued, Luo Qingyang comments on the lack of credibility of the accusation, thus incurring disrespect and insults from her sect and others as well. Unwilling to bend her morals, she decided to leave her sect—an act unthinkable for most cultivators. Nie Mingjue praises her bravery for having “much more backbone than the mob of her sect” (MXTX Chapter 73). Apart from this instance, any meaningful interaction Nie Mingjue has with women is next to none. Despite being the head of his sect, thus bearing the responsibility to procreate and continue the bloodline, he pushes the responsibility onto his brother.

Nie Huaisang, unlike his brother, does not display *wu* attributes. If his brother was considered to be one of the most powerful cultivators of his time, he is the weakest Nie from his clan’s history. A cowardly character, he relied on his brother and others for protection. He was nicknamed ‘Head-shaker’ due to his inability to solve the issues that plagued his people after he was made the Sect leader following his brother’s death. While a brilliant strategist, as he proved from the plan he crafted that led to Jin Guangyao’s downfall, he did not use his brilliance for occasions that would put him in the spotlight. As Wei Wuxian described, Nie Huaisang’s interests leaned more on bird watching, paintings, and general merrymaking.

While not entirely dismissive of his brother’s interest, the majority of the interactions between them recounted by Nie Huaisang involves Nie Mingjue’s insistence that he gives equal importance to saber practice as he gives to birdwatching or fan painting. Nie Mingjue believed that for his brother to become worthy of eventually taking over the role of the Head of Nie Clan, he must be skilled in using his weapon. This desire is not unique to Nie Mingjue.

Presenting opportunities for male bonding since colonial times, firearms cemented father-son, as well as other, parental relationship. Placing boys at the threshold of manhood, game hunting conferred responsibility, maturity, and autonomy, working as a rite of passage and preparing them for their eventual role as protector and provider. (Kimmel and Aronson 364)

Thus, the saber practice was the connecting factor between the two brothers who otherwise led different lives and followed varying interests. Even when the war was at its peak, Nie Mingjue insisted his brother to not neglecting his saber practice—“Even though he’s safe there with you, he shouldn’t neglect his studies either—Next time we meet, I’ll examine his saber and heart scriptures” (MXTX Chapter 48). He believed that if his brother mastered the saber he would successfully cross the threshold to adulthood—becoming a reliable Clan Leader.

Nie Huaisang’s interest did not reduce his masculinity instead shows that it leaned more towards scholarly pursuits—wen attributes. Even if the cultivation society does not recognize him as masculine or a respectable figure (due to the disguise he skillfully crafted over years), Wei Wuxian perhaps might be the only person in the narrative who knows his true identity. While Nie Mingjue could not instill masculine qualities within his brother in his desired manner, ironically, he did become the reason why the latter was able to assert his masculinity.

Analyzing the timeline in *Modao Zushi* chronologically would reveal that specific characters, especially Wei Wuxian, Jiang Wanyin, Nie Huaisang, and Nie Mingjue, had transitioned into adulthood through acts of violence and their desire for vengeance for the murder of their family. Until such a transition, they led lives that were peaceful and sheltered. From Wei Wuxian’s memories before the massacre of Lotus Pier, it is evident that irrespective of the life he lived, it was marked with simplicity and innocence. This is the same for the Nie brothers. In *Revenge and Gender: In Classical, Medieval, and Renaissance Literature* (2018), Lesel Dawson highlights the expression of masculinity through revenge:

Revenge narratives represent manliness as a highly prized commodity that individuals acquire through retaliatory acts of violence, exposing the performative nature of gender in which, in Judith Butler’s words, ‘identity is . . . constituted by the very “expressions” that are said to be its results’. The revenger, in his role as an artist-figure enacting mimetic violence, draws attention to his self-fashioning: just as he devises plots, so too does he fabricate his masculinity. (Dawson 3)

When reading the novel from Nie Huaisang’s perspective, it appears as a complex revenge narrative detailing his quest for justice for his brother’s murder and retribution against the murderer. Aware of his enemy’s strength and his own powerlessness, he crafted an elaborate plan for other characters to extract revenge for him without realizing until the very

last moment. Thus, Mo Xuanyu's sacrifice, massacre of the Mo Family, journey to the Yi City, timely appearance of the two women in Lotus Pier are all part of his carefully laid trap that eventually led to the political downfall and death of Jin Guangyao.

Extracting vengeance also benefited these characters in raising their social standing. Apart from the psychological benefits attached to it, vengeance "can enhance status and frequently 'coincides admirably with calculations of expediency', serving a man's financial and political self-interests" (Dawson 3). Apart from Wei Wuxian, the other characters solidified their position as the Sect Leader only after they had extracted revenge. Both Jiang Wanyin and Nie Mingjue gained respect and support as Sect Leaders once they proved themselves by avenging their parents' death. Towards the end of the novel, Nie Huaisang is able to shed his disguise as the clueless 'Head-Shaker' and reveal his sharpness, as noted by Wei Wuxian.

The discussion continued, "Speaking of it, the ceremony impressed me indeed. Nie Huaisang did quite a good job, didn't he? When he volunteered in the first place, I thought he was definitely gonna mess things up. He's the head-shaker, after all." Hearing their astonishment, Wei Wuxian commented in silence, What's so special about this? After all, in the next few decades, perhaps this leader of the Qinghe Nie Sect's would gradually begin to show his edges, bringing the world even more surprises. (MXTX Chapter 113)

Thus, Nie Huaisang successfully establishes his masculinity, a fact that often goes unnoticed by both Western and many Asian readers because they perceive him through the lens of Western masculine attributes. This is a common mistake made by readers of Danmei novels who are unfamiliar with the wen-wu paradigm, and therefore, assume that since these novels are written by women for women, the characters would only embody traits desired by women, ignoring the traditional qualities that have historically defined masculinity. This misinterpretation pushed researchers to examine the impact such novels would have on the male population and the pressure they would experience to adopt the qualities embodied by these characters in order to appear attractive to their partners.

The characters whose masculinity remains unquestioned by both local and overseas readers include Jin Guangshan, Jin Zixuan, Wen Ruhan, and Wen Chao. These characters' masculinity requires no in-depth research. Jin Zixuan's masculinity is secure because he fulfills the expectation associated with the traditional gender roles and the wen-wu paradigm. His father, Jin Guangshan's masculinity is, however, secured through his promiscuity, greed,

and a lack of empathy. Both he and Wen Chao epitomize men who feel entitled due to their gender and wealth, asserting their masculinity through multiple relationships and violence. Wen Ruhan, Wen Chao's father and the novel's initial antagonist, establishes his masculinity through his martial prowess and violence. With two sons, leadership of his sect, and unmatched cultivation power, Wen Ruhan's masculinity remains unquestioned by readers. The strongest cultivator of his time, it required a collective effort from the cultivation world to overthrow him.

Modao Zushi challenges the notion of sexual relations are a requirement to assert and defend one's manhood. In many patriarchal societies, engaging in sex is perceived as a rite of passage for boys to transition into adulthood. The number of such relations they indulged in is directly proportional to their masculinity. However, characters like Jiang Wanyin, Lan Xichen, and Lan Qiren are respected and admired in the cultivation society despite refraining interactions with women, unless necessary. Their masculinity is secured through the wen-wu paradigm in the cultivation society, and through their respectful behavior towards women for the audience. For instance, while Jiang Wanyin may be blacklisted by the female cultivators, it's due to the high standards he sets for his spouse, who would be the co-leader, rather than a general lack of respect. Women, whether commoners or cultivators, hold respect and trust for these characters based on their personality and actions.

To reiterate, Danmei novels were banned by the government and heavy censored over concerns that they could jeopardize national security and challenge traditional values. This also contributed to the misconception that effeminate Chinese men are the norm in China, and their masculinity is therefore inferior to Western ideals. However, these allegations are inaccurate, particularly in the case of Danmei novels like *Modao Zushi*. Contrary to the belief that these novels aim to portray effeminate men or dismantle traditional masculine images, they actually work within the traditional values. The characters in these novels are depicted as genuinely masculine, not relying only on external factors or sexual relationships to justify their masculinity. Their masculinity is not under any crisis nor would threaten the social order. Instead, they promote values such as valor, compassion, righteousness, confidence, etc., that would strengthen it.

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DESIGNING AI-ENHANCED WHOLE LANGUAGE TASKS: A PEDAGOGICAL MODEL FOR FUTURE-FOCUSED ELT.

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Abstract

This study proposes a pedagogical model for designing AI-enhanced whole language tasks within the framework of future-focused English Language Teaching (ELT). Rooted in the principles of constructivism and communicative language teaching, the model emphasizes meaningful, authentic language use by integrating artificial intelligence (AI) tools to facilitate reading, writing, speaking, and listening as interconnected skills. The research adopts a qualitative design-based methodology, involving iterative task development, classroom implementation, and feedback analysis from both teachers and learners across secondary and tertiary levels. The model leverages AI platforms including natural language processors, speech recognition tools, and adaptive learning systems to personalize learning, foster collaboration, and enhance learner autonomy. Findings suggest that AI-supported whole language tasks improve learner engagement, scaffold language production, and promote critical thinking. The study contributes a flexible, replicable framework for ELT practitioners aiming to align their practices with 21st-century competencies such as digital literacy, creativity, and global communication. The pedagogical implications underscore the importance of teacher training in AI literacy and task design. This model not only addresses evolving learner needs but also positions ELT as an adaptive, innovation-driven discipline.

***Keywords:** Whole Language Approach, Artificial Intelligence, English Language Teaching, Task Design, Future Skills, Constructivism, AI Literacy, Pedagogical Innovation.*

1. Introduction

The global educational landscape is currently witnessing a paradigm shift, driven by the dual forces of rapid technological advancement and an urgent need for sustainable pedagogical practices. At the center of this transformation lies the challenge of linguistic equity. For students in semi-urban colleges, particularly those in the critical late-adolescence transition of 17–19 years, English proficiency is often the primary barrier to social mobility and global participation. While urban centers benefit from immersive environments and high-resource institutions, semi-urban learners are frequently confined to "Grammar-Translation"

models—a relic of industrial-age education that prioritizes rote memorization over functional communication. This creates a "linguistic divide" that hinders the realization of Sustainable Development Goal 4 (Quality Education) and Goal 10 (Reduced Inequalities).

To bridge this gap, this paper proposes a synthesis of Whole Language Learning (WLL) and Smart Innovation. WLL is a holistic pedagogical philosophy that posits language is best acquired when it is kept "whole"—integrated, contextualized, and focused on meaning-making rather than fragmented drills (Goodman, 1986). However, the historical critique of WLL in resource-constrained environments has been its high demand for individualized teacher attention and a constant supply of authentic, diverse reading materials. In a semi-urban classroom with high student-to-teacher ratios, implementing a pure WLL approach has traditionally been perceived as an "elite" luxury.

The emergence of Artificial Intelligence (AI) and Smart Innovation technologies changes this equation. By utilizing Large Language Models (LLMs) and Natural Language Processing (NLP), we can now provide "synthetic immersion" at scale. For the 17–19 age group, who are digitally native yet linguistically marginalized, AI-driven tools can act as non-judgmental conversational partners, real-time scaffolds for complex texts, and generators of localized, interest-based content. This integration does not merely "digitize" the classroom; it "humanizes" the technology by using it to facilitate deep, meaningful human communication.

This study explores the theoretical and practical framework of Smart-WLL, examining how AI-enhanced contextual learning can transform the semi-urban college experience. By focusing on sustainable educational equity, this paper argues that the marriage of smart technology and holistic pedagogy is the essential catalyst for turning language acquisition from a hurdle into a tool for empowerment. Through this lens, we move away from viewing AI as a replacement for the educator and instead see it as the infrastructure required to make student-centered, whole-language education a sustainable reality for all.

2. Literature Review

The theoretical foundation for this study is built upon three converging pillars: the holistic philosophy of Whole Language Learning (WLL), the psychological framework of Second Language Acquisition (SLA) in late adolescence, and the disruptive potential of Smart Innovation and Artificial Intelligence in educational equity.

2.1 The Philosophy of Whole Language Learning (WLL)

Whole Language Learning emerged as a grassroots educational movement challenging the "sub-skill" approach to literacy, which fragmented language into isolated sounds, letters, and grammar rules. Ken Goodman (1986) famously argued that language should be kept "whole," asserting that "when language is broken into bits and pieces... it isn't language anymore." In a WLL framework, the focus shifts from form (grammar and syntax) to function (meaning and communication). For semi-urban college students, who have often spent a decade memorizing rules without achieving fluency, WLL offers a transition toward "authentic" literacy—using language to read, write, and speak about real-world issues relevant to their lives (Watson, 1989).

2.2 Socio-Psychological Factors in Late Adolescence (Ages 17–19)

The age group of 17–19 represents a critical developmental juncture. According to Vygotsky's (1978) Zone of Proximal Development (ZPD), learning occurs best when students are challenged just beyond their current ability with the help of a "More Knowledgeable Other" (MKO). However, in semi-urban colleges, the MKO (the teacher) is often overwhelmed by high student-to-teacher ratios. Furthermore, Stephen Krashen's (1982) Affective Filter Hypothesis suggests that high anxiety, low self-esteem, and a lack of motivation can form a mental block that prevents language acquisition. Late adolescents are particularly sensitive to peer judgment; the fear of "sounding wrong" in a second language is a significant barrier to the immersion required by WLL.

2.3 Smart Innovation and AI as Pedagogical Scaffolding

The "Smart Innovation" aspect of this study refers to the use of Generative AI (GenAI) and Natural Language Processing (NLP) to provide the individualized scaffolding that WLL requires. Recent research into Large Language Models (LLMs) like GPT-4 and Claude suggests that AI can act as a "tutor-in-the-pocket," providing instant feedback and contextualized vocabulary (Annamalai, 2025). Unlike traditional Software-Assisted Language Learning (SALL) which relied on repetitive drills, modern Smart Innovation allows for "Synthetic Immersion"—a simulated environment where the AI adapts to the student's unique socio-cultural context. This is particularly vital for Sustainable Development Goal 4, as it democratizes access to high-quality, personalized instruction that was previously an urban privilege.

2.4 Bridging the "Semi-Urban" Gap

Research by Norton and Toohey (2011) emphasizes that language learning is deeply tied to identity and investment. Students in semi-urban areas often view English as an "alien"

language belonging to an urban elite. Smart Innovation allows for the localization of content; AI can instantly generate "whole" texts—such as news articles or case studies—that reflect semi-urban realities (e.g., local agriculture, regional entrepreneurship). This makes the "Whole Language" not just linguistically whole, but culturally relevant, fostering a sense of ownership over the learning process.

3. Methodology: The Smart-WLL Framework

To investigate the efficacy of Smart Innovation in Whole Language Learning (WLL), this study employs an exploratory sequential mixed-methods design. This approach is specifically chosen to capture both the quantitative shifts in linguistic competence and the qualitative shifts in student "affective filters" within the semi-urban college context. The methodology is structured around the implementation of a "Smart-WLL" intervention over a 12-week semester for students aged 17–19.

3.1 Participants and Setting

The study focuses on a cohort of 120 undergraduate students from a semi-urban college. These participants represent the "linguistically marginalized" demographic: they have consistent access to smartphones (digital inclusion) but lack immersion-based English environments (linguistic exclusion). Participants are divided into an Experimental Group (Smart-WLL) and a Control Group (Traditional Rote Learning).

3.2 The Smart-WLL Intervention Model

The intervention replaces fragmented grammar worksheets with a three-tier smart pedagogical framework:

1. **Selection of Authentic "Whole" Digital Texts:** Instead of standardized textbooks, students utilize AI-curated "interest-feeds." Using Natural Language Processing (NLP) tools, the curriculum dynamically fetches real-world content (e.g., global tech news, digital storytelling, or environmental case studies) based on the students' career aspirations.
2. **AI-Driven Scaffolding:** Students interact with Large Language Models (LLMs) to engage with these texts. The methodology utilizes "Adaptive Reading Scaffolds" where the AI provides instant, context-aware simplifications of complex sentences without removing the "whole" meaning of the text. This aligns with Vygotsky's Zone of Proximal Development by providing support that is uniquely tailored to each student's current proficiency level.
3. **Synthetic Immersion via Conversational AI:**

To address the lack of speaking partners in semi-urban areas, students engage in 20-minute daily "Low-Anxiety Dialogues" with AI personas. These sessions are designed as goal-

oriented tasks (e.g., "Negotiate a business deal" or "Explain a local environmental issue to a global visitor") to foster communicative competence.

3.3 Data Collection and Analysis

- **Quantitative Phase:** Pre- and post-tests are administered to measure gains in Communicative Confidence and Contextual Vocabulary Retention. Unlike traditional tests, these assessments focus on the ability to derive meaning from "whole" unfamiliar texts and the fluidity of spoken responses.
- **Qualitative Phase:** Semi-structured interviews and "Digital Learning Journals" are used to assess changes in the Affective Filter. This phase seeks to understand if the non-judgmental nature of AI reduces the "speaking anxiety" typically found in 17–19 year old learners in public classroom settings.
- **Triangulation:** By correlating AI usage logs (frequency of interaction) with performance gains, the study identifies the "Optimal Immersion Threshold" required for sustainable language growth in resource-constrained environments.

3.4 Ethical Considerations and Sustainability

In line with the conference theme of Sustainable Development, the methodology prioritizes "Low-Data/High-Impact" AI tools that can operate on older smartphone models and limited data plans. This ensures that the Smart-WLL framework is not just an experimental success but a scalable, sustainable model for educational equity in semi-urban regions.

4. Alignment with Sustainable Development Goals (SDGs)

The integration of Smart Innovation into the Whole Language Learning (WLL) framework is more than a pedagogical shift; it is a strategic alignment with the United Nations' 2030 Agenda for Sustainable Development. For semi-urban colleges, language proficiency is a gatekeeper to economic and social participation.

- **SDG 4: Quality Education:** Traditional rote-learning models in resource-constrained areas often result in "schooling without learning." Smart-WLL ensures that students (ages 17–19) receive high-quality, personalized instruction that mimics elite 1-on-1 tutoring. By using AI to provide scaffolding and real-time feedback, we democratize access to sophisticated language acquisition methods that were previously geographically and economically restricted.
- **SDG 10: Reduced Inequalities:** The "Linguistic Divide" is a primary driver of inequality. Graduates from urban elite colleges often secure high-paying roles in the global digital

economy due to superior English fluency, while their semi-urban counterparts—despite having equal technical skills—are sidelined. Smart Innovation acts as a leveling tool, providing semi-urban students with the "cultural capital" of language fluency, thereby reducing the employability gap.

- **SDG 8: Decent Work and Economic Growth:** By moving from fragmented grammar drills to "Whole Language" competence, this framework prepares the 17–19 age group for the modern workforce. Sustainable economic growth in semi-urban regions depends on a workforce that can engage with global markets, use international digital platforms, and participate in the remote work revolution.

5. Discussion & Case Study: The "Smart-WLL" Pilot

5.1 Case Study: A Semi-Urban College Implementation

To illustrate the framework, we examine a pilot study conducted at a vocational degree college in a semi-urban cluster. The student population (n=60, ages 17–19) primarily consisted of first-generation learners. Prior to the intervention, 85% of students reported "high anxiety" regarding English communication, despite having passed ten years of formal English schooling.

The Intervention: Students were given access to a localized AI platform that bypassed standard textbooks. Instead, the "Whole Language" input consisted of AI-curated transcripts of successful young entrepreneurs from their own region, translated into accessible yet challenging English. Students used an AI "Contextual Assistant" to navigate these texts.

Key Findings:

- **The "Safety" of Silicon:** The most significant qualitative finding was the "non-judgmental" nature of the AI. Unlike a classroom setting where 17–19 year olds are acutely aware of peer scrutiny, the AI provided a "psychologically safe space." This lowered the Affective Filter, allowing students to experiment with "whole" sentences rather than giving one-word answers.
- **Contextual Mastery over Rote Memory:** Post-intervention assessments showed that while the experimental group did not perform significantly better on isolated grammar tests, they outperformed the control group by 52% in "Situational Fluency"—the ability to explain a complex process (e.g., how to set up a small business) using cohesive, natural language.

5.2 Discussion: Scaling the Human-AI Hybrid

The discussion centers on the "Sustainability of Innovation." A common critique of AI in education is that it might replace the teacher. However, in this case study, the teacher's role shifted from a "grammar corrector" to a "literacy mentor."

In the semi-urban context, "Smart Innovation" is not about expensive VR headsets or high-end labs; it is about the intelligent use of existing mobile infrastructure. By using Large Language Models to handle the repetitive, individualized scaffolding tasks (correcting basic syntax, providing synonyms, practicing pronunciation), the human teacher is freed to focus on the "Whole" part of the language—encouraging critical thinking, debate, and social application.

The case study proves that when technology is used to support a meaning-based philosophy like WLL, it creates a sustainable educational ecosystem where students are no longer passive recipients of information, but active participants in their own linguistic development.

6. Conclusion

The integration of Smart Innovation within the Whole Language Learning (WLL) framework represents a critical evolutionary step for education in semi-urban colleges. This paper has demonstrated that the linguistic divide—long a barrier for students aged 17–19—is not an insurmountable consequence of geography, but rather a byproduct of outdated, fragmented pedagogical models. By shifting the focus from isolated grammar drills to holistic, meaning-centered communication facilitated by Artificial Intelligence, we provide semi-urban learners with the immersive environments once reserved for elite urban institutions.

The "Smart-WLL" model successfully addresses the historical challenges of resource scarcity and high affective filters. Through AI-driven scaffolding and synthetic immersion, technology performs the labor-intensive task of personalization, allowing the "whole" language to remain at the forefront of the curriculum. This approach does more than improve test scores; it fosters communicative agency, enabling young adults to transition from passive observers of the digital economy to active, fluent participants.

From the perspective of Sustainable Development, this framework is a vital tool for achieving SDG 4 (Quality Education) and SDG 10 (Reduced Inequalities). It proves that sustainability in education is not just about environmental factors, but about creating scalable, equitable systems that survive beyond the experimental phase. By leveraging the existing mobile

infrastructure of semi-urban students, Smart-WLL offers a cost-effective, high-impact solution that empowers the next generation of the global workforce.

Ultimately, the marriage of AI and WLL confirms that technology is at its best when it serves human-centric goals. For the 17–19-year-old student in a semi-urban college, this innovation is the bridge between local potential and global opportunity. As we look toward the future of smart education, our priority must remain the democratization of fluency, ensuring that every learner, regardless of their location, has the linguistic tools to script their own sustainable future.

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AI-DRIVEN APPROACHES TO SECOND LANGUAGE ACQUISITION IN THE DIGITAL LEARNING ERA

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Abstract

The rapid development of Artificial Intelligence has significantly influenced modern education, particularly in the field of second language acquisition. AI-driven technologies such as intelligent tutoring systems, natural language processing, speech recognition, and adaptive learning platforms provide learners with personalized and interactive learning experiences. These tools help students improve their listening, speaking, reading, and writing skills through continuous practice and instant feedback. AI also promotes learner autonomy by allowing students to study at their own pace in flexible learning environments. In addition, modern AI applications support multilingual communication, automated assessment, and real-time error correction, which were not possible in traditional classroom settings.

This paper examines various AI-driven approaches used in second language acquisition and discusses their benefits, limitations, and future possibilities in the digital learning era. The study also highlights the importance of combining AI-based learning with traditional teaching methods to achieve better learning outcomes. The paper concludes that Artificial Intelligence can effectively support second language learning when it is used as a complementary tool under proper teacher guidance.

Keywords: *Artificial Intelligence, Second Language Acquisition, Digital Learning, AI in Education, Language Technology, Adaptive Learning, NLP*

Introduction

The digital learning era has brought remarkable changes in the field of education, especially in language teaching and learning. Second language acquisition requires continuous practice, feedback, interaction, and exposure to real-life communication. In traditional classrooms, teachers often face difficulties in giving individual attention to every learner because students have different levels of understanding and learning speed. As a result, some learners fail to develop confidence in using the target language.

The introduction of Artificial Intelligence has created new opportunities for learners to improve their language skills through smart and adaptive learning systems. AI-driven applications provide interactive environments where learners can practice language skills without hesitation. Unlike traditional methods, AI-based learning systems can analyse learner performance, identify mistakes, and provide immediate correction. This makes language learning more effective and learner-centered.

With the help of machine learning and natural language processing, computers can understand human language and respond intelligently. Modern AI tools such as chatbots, speech recognition software, grammar correction systems, and virtual tutors help learners practice language skills in a realistic manner. These technologies create a flexible learning environment where students can learn anytime and anywhere. Because of these advancements, Artificial Intelligence has become an important part of modern second language education in schools, colleges, and online learning platforms.

In recent years, the use of AI in education has increased rapidly due to the growth of digital technology, internet access, and online learning systems. During the pandemic period, many educational institutions depended on digital platforms, which increased the importance of AI-based learning tools. Therefore, it is necessary to study how AI-driven approaches influence second language acquisition in the digital learning era.

Concept of Second Language Acquisition in the Digital Age

Second language acquisition refers to the process of learning a language other than one's native language. This process involves developing skills in listening, speaking, reading, and writing. Language learning also includes understanding grammar, vocabulary, pronunciation, and cultural context. Traditionally, second language learning depended mainly on classroom teaching, textbooks, and teacher guidance. However, modern learners require more interactive and flexible learning methods.

In the digital age, language learning has moved from teacher-centered classrooms to learner-centered environments. Students can now use online platforms, mobile applications, and AI-based tools to practice language skills independently. Digital learning allows students to repeat lessons, listen to audio materials, watch videos, and communicate with speakers from different countries. This increased exposure helps learners develop language fluency faster than before.

Artificial Intelligence plays a major role in this transformation because it can provide customized learning experiences. AI systems can analyse learner performance and suggest suitable exercises according to the learner's level. This type of adaptive learning makes second language acquisition more effective and enjoyable.

AI-Driven Technologies in Second Language Learning

Artificial Intelligence includes various technologies that support language learning in the digital environment. One of the most important technologies is Natural Language Processing, which allows computers to understand and generate human language. NLP helps learners practice grammar, vocabulary, translation, and sentence formation. Many language learning applications use NLP to check writing errors and provide suggestions for improvement.

Speech recognition technology is another important AI tool used in second language learning. This technology allows learners to practice pronunciation by speaking into the system. The software compares the learner's speech with the correct pronunciation and provides feedback. Continuous practice with speech recognition improves fluency and confidence in speaking.

Intelligent tutoring systems are also widely used in AI-based language learning. These systems provide exercises based on the learner's performance. If a learner makes mistakes, the system gives additional practice until the learner understands the concept. This personalized approach helps students learn at their own speed without pressure.

Chatbots and virtual assistants create real-time conversation practice, which is very useful for developing communication skills. Learners can ask questions, answer prompts, and participate in dialogues with AI-based programs. This type of interaction helps students overcome fear and hesitation in speaking a new language.

Adaptive learning platforms use machine learning algorithms to track learner progress and adjust the difficulty level of lessons. These platforms ensure that learners receive suitable content according to their ability. Because of these features, AI-driven tools create a learner-centered environment where students can practice repeatedly until they gain confidence in using the language.

Advantages of AI-Driven Language Learning

One of the major advantages of AI-driven approaches in second language acquisition is personalized learning. Each learner has a different level of understanding, and AI systems can adjust the content according to individual needs. This makes learning more effective compared to traditional methods where the same lesson is given to all students. Personalized learning increases student confidence and reduces fear of making mistakes.

Another important benefit is instant feedback. In language learning, correcting mistakes at the right time is very important. AI systems can immediately identify errors in pronunciation, grammar, and writing, and provide suggestions for correction. Continuous feedback helps learners improve accuracy and fluency.

AI-based learning also increases student motivation. Many digital platforms use games, quizzes, and interactive activities to make learning enjoyable. When students feel interested, they spend more time practicing the language. Increased practice leads to better learning results.

Flexibility is another major advantage. Digital learning platforms allow students to access lessons anytime and anywhere. Learners can practice language skills at home, in college, or while travelling. This flexibility is especially useful for working students and distance learners.

AI also supports self-learning. Students can learn independently without depending completely on teachers. This develops learner autonomy, which is very important in second language acquisition. When students take responsibility for their own learning, they become more confident and motivated.

Challenges in AI-Based Second Language Acquisition

Although AI offers many benefits, it also has certain limitations in language learning. One of the major challenges is the lack of human interaction. Language learning is not only about grammar and vocabulary but also about emotions, expressions, and cultural understanding. Machines cannot fully understand human feelings, so learners may miss emotional connection in communication.

Another problem is over-dependence on technology. When students use AI tools continuously, they may become dependent on software for correction. This may reduce their

ability to think independently and solve problems without help. Teachers must guide students to use technology in a balanced way.

Technical problems also affect AI-based learning. Internet connection, software errors, and device problems may disturb the learning process. In some educational institutions, lack of proper infrastructure makes it difficult to use advanced AI tools.

Data privacy is another serious concern. Many AI applications collect personal information from users to analyse learning behaviour. Without proper security, this data may be misused. Educational institutions must ensure safe use of technology.

High cost of AI implementation is also a challenge for many schools and colleges. Advanced software, training programs, and digital devices require financial support. Without proper funding, it may be difficult to introduce AI-based learning systems.

Role of Teachers in the Digital Learning Era

Even in the digital learning era, teachers play an important role in second language acquisition. Artificial Intelligence can provide exercises and feedback, but teachers provide guidance, motivation, and emotional support. A teacher understands the learner's needs better than a machine. Teachers can explain complex grammar, correct pronunciation, and guide students in real communication situations.

Teachers also help learners understand cultural meanings, idioms, and expressions that cannot be easily learned through software. Language learning requires social interaction, and teachers create opportunities for group discussion, role play, and communication activities.

In AI-supported classrooms, the role of the teacher changes from information provider to facilitator. Teachers guide students in using digital tools effectively. They also monitor learner progress and give personal support when necessary.

Therefore, the best learning results can be achieved when AI technology is used together with traditional teaching methods. A balanced approach helps students gain both technical knowledge and real communication ability.

Future of AI in Second Language Education

The future of second language acquisition will be strongly influenced by Artificial Intelligence. New technologies such as virtual reality classrooms, augmented reality learning,

and intelligent conversation partners will make language learning more realistic. Students may be able to enter virtual environments where they can communicate with people from different countries.

Real-time translation technology will also improve communication between speakers of different languages. AI systems may act as personal tutors who guide learners throughout their learning journey. These developments will make language learning easier and more accessible to everyone.

In the future, AI may also help teachers by reducing workload. Automated assessment, attendance tracking, and performance analysis will save time for teachers. They can use this time to focus on creative teaching and student interaction.

As technology continues to develop, AI-driven learning systems will become an essential part of education in schools, colleges, and online platforms. However, human guidance will always remain important in language learning.

AI and Learner Autonomy in Second Language Acquisition

Learner autonomy is an important concept in modern education, especially in second language acquisition. It refers to the ability of learners to take responsibility for their own learning. In traditional classrooms, students depend mainly on teachers for instruction, correction, and guidance. However, in the digital learning era, Artificial Intelligence allows learners to practice language skills independently without waiting for teacher support.

AI-based learning platforms provide self-paced learning opportunities where students can choose lessons according to their needs. For example, if a learner finds difficulty in pronunciation, the system can provide more speaking exercises. If the learner needs improvement in grammar, the software can give additional practice. This type of personalized learning helps students understand their strengths and weaknesses.

Another advantage of AI in learner autonomy is continuous availability. Unlike classroom teaching, AI-based applications can be used at any time. Students can practice language skills whenever they feel comfortable. This increases the amount of exposure to the language, which is very important in second language acquisition.

AI also supports independent evaluation. Many digital learning systems provide tests, quizzes, and performance reports. Learners can check their progress without waiting for teacher evaluation. When students see their improvement, they become more motivated to learn.

However, complete independence may not always be beneficial. Some learners may feel confused without teacher guidance. Therefore, learner autonomy should be supported by proper instruction and supervision. Artificial Intelligence should be used as a tool to support learning, not as a replacement for teachers.

AI in Developing Listening and Speaking Skills

Listening and speaking are essential skills in second language acquisition. Traditional classroom methods often give limited time for practice, especially when the number of students is high. Artificial Intelligence provides new ways to improve these skills through interactive technology.

Speech recognition software helps learners practice pronunciation by comparing their speech with the correct model. The system identifies errors and gives suggestions for improvement. Repeated practice with instant feedback helps students develop correct pronunciation and fluency.

AI-based audio learning programs also help learners improve listening skills. Students can listen to conversations, stories, and lectures spoken by native speakers. Some applications allow learners to slow down the speed of speech, repeat sentences, and check meanings. This helps learners understand the language more clearly.

Virtual assistants and chatbots create conversation practice without fear. Many students feel shy to speak in front of others, but they feel comfortable speaking with a computer program. AI chatbots can ask questions, give responses, and continue conversation like a real person. This type of practice increases confidence.

Advanced AI systems are now able to analyse tone, stress, and intonation. These features help learners sound more natural while speaking. Because of these developments, AI plays an important role in improving listening and speaking skills in second language learning.

AI in Reading and Writing Skill Development

Artificial Intelligence also supports the development of reading and writing skills in second language acquisition. Reading requires understanding vocabulary, grammar, and sentence

structure. AI-based reading platforms provide texts according to the learner's level. If the text is too easy or too difficult, the system adjusts the difficulty automatically. This adaptive learning method improves comprehension. Many digital tools also provide instant meaning for difficult words. When learners click on a word, the system shows the meaning, pronunciation, and example sentence. This helps learners understand the text without stopping their reading.

Writing skill development is also improved through AI-based grammar correction systems. These tools check spelling, punctuation, and sentence structure. They also suggest better words and expressions. Continuous correction helps learners write more accurately.

Automated essay evaluation is another important feature of AI. Some platforms analyse writing and give feedback on grammar, vocabulary, and organization. This saves time for teachers and allows students to practice writing more frequently.

However, students should not depend completely on AI correction tools. Writing skill requires creativity and critical thinking, which cannot be fully developed by machines. Teachers should guide students to use AI as a support system while still practicing independent writing.

Cultural Learning through Artificial Intelligence

Language learning is closely connected with culture. Understanding a language also means understanding the customs, traditions, and social behaviour of the people who speak that language. Traditional textbooks provide limited cultural information, but Artificial Intelligence can provide real-life cultural exposure.

AI-based learning platforms can show videos, conversations, and real-life situations from different countries. Learners can watch how people speak in different contexts such as formal meetings, casual conversations, and public speeches. This helps learners understand the correct use of language. Virtual reality and simulation technology can create cultural learning environments. Students may enter a virtual classroom, market, or airport where they must communicate using the target language. This type of learning makes language practice more realistic.

AI translation tools also help learners understand cultural expressions that cannot be translated directly. Idioms, proverbs, and slang words often have cultural meaning. AI systems with advanced language models can explain these meanings clearly.

By providing real-life communication examples, Artificial Intelligence helps learners develop not only language skills but also cultural awareness. This makes second language acquisition more meaningful and practical.

Teacher Training for AI-Based Language Teaching

The successful use of Artificial Intelligence in language learning depends not only on students but also on teachers. Many teachers may not be familiar with advanced technology. Without proper training, it is difficult to use AI tools effectively in the classroom. Therefore, teacher training is necessary in the digital learning era.

Training programs should help teachers understand how AI-based applications work. Teachers must learn how to select suitable software, design digital activities, and monitor student progress. They should also know how to combine traditional teaching with AI-based learning.

Teachers should also be trained to solve technical problems that may occur during digital learning. Basic knowledge of computers, internet, and software is necessary for modern educators. Educational institutions should provide workshops and training programs for teachers.

Another important aspect of teacher training is ethical awareness. Teachers must understand the importance of data privacy and responsible use of technology. They should guide students to use AI tools safely.

When teachers are properly trained, AI can be used effectively in second language classrooms. Teacher knowledge and technology together can create a powerful learning environment.

Limitations of Artificial Intelligence in Language Education

Even though Artificial Intelligence offers many advantages, it has certain limitations that cannot be ignored. One of the main limitations is the lack of emotional intelligence. Human communication includes feelings, humour, and expressions, which machines cannot fully understand. Because of this, AI cannot replace real human interaction in language learning.

Another limitation is the dependence on electricity and internet connection. In many rural areas, students may not have access to digital devices or stable internet. This creates inequality in education. Only students with good technology access can benefit from AI-based learning.

AI systems also depend on the quality of programming. If the software is not designed properly, it may give incorrect feedback. Wrong correction may confuse learners instead of helping them. Therefore, the quality of AI tools must be carefully checked before using them in education.

Privacy and security are also important issues. AI applications often collect personal data such as voice recordings, writing samples, and learning behaviour. Without proper protection, this data may be misused. Educational institutions must follow strict rules to protect student information.

Because of these limitations, Artificial Intelligence should not be used alone. It should always be combined with human teaching and proper supervision.

Integration of AI with Traditional Teaching Methods

The best results in second language acquisition can be achieved when Artificial Intelligence is combined with traditional teaching methods. Technology can provide practice and feedback, while teachers provide explanation and emotional support. This combination creates a balanced learning environment.

In a modern classroom, teachers can use AI tools for exercises, pronunciation practice, and grammar correction. After that, they can conduct group discussions, role play, and communication activities. This allows students to use the language in real situations.

Blended learning is an effective method where students learn partly through digital platforms and partly through classroom teaching. AI can be used for homework, revision, and self-learning, while teachers focus on interaction and communication in the classroom.

This integration also reduces teacher workload. Automated correction and online tests save time, so teachers can spend more time helping students individually.

Therefore, the future of second language acquisition depends on the proper integration of Artificial Intelligence and traditional teaching.

Conclusion

AI-driven approaches have transformed second language acquisition in the digital learning era by providing personalized, flexible, and interactive learning experiences. These technologies help learners improve their language skills through continuous practice, instant feedback, and adaptive learning methods. AI makes language learning more interesting and accessible for students of different levels.

However, Artificial Intelligence cannot completely replace human teachers because language learning requires emotional understanding, cultural awareness, and real communication. Over-dependence on technology may also create problems if it is not properly guided. Therefore, the most effective method is to combine Artificial Intelligence with traditional teaching methods.

When used carefully, AI can improve the quality of language education and prepare learners for global communication in the modern world. The future of second language acquisition will depend on the balanced use of technology and human teaching.

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EXPLORING THE DEPTHS OF THE UNCONSCIOUS: HUMAN PSYCHE IN LITERARY NARRATIVES

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Abstract:

This paper explores the representation of the unconscious mind in literary narratives and examines how writers dramatize the hidden dimensions of human psychology. Drawing upon psychoanalytic theory, the study investigates how literature becomes a powerful medium for articulating suppressed desires, internal conflicts, trauma, and fragmented identities. The unconscious, often concealed beneath social behavior and rational thought, emerges vividly in narrative structures, character development, and symbolic imagery. Through close reading of selected texts from classical and modern literature, the paper demonstrates how literary characters embody psychological struggles that mirror the complexities of the human mind. Internal conflict, guilt, repression, memory, and identity crisis are analyzed as recurring themes that reveal the depth of human experience. Narrative techniques such as soliloquy, stream of consciousness, symbolism, and interior monologue are examined as artistic strategies that bring subconscious processes to the surface. The study argues that literature does not merely narrate events but penetrates psychological depths, transforming inner turmoil into artistic expression. Ultimately, literary narratives function as reflective spaces where the invisible workings of the human psyche become visible, enabling readers to engage empathetically with the complexities of mental and emotional life.

Key Words: *Unconscious Mind, Psychoanalytic Criticism, Human Psyche, Repression, Internal Conflict, Freud, Jung, Trauma Studies*

Introduction:

Literature has always served as a profound reflection of human life, capturing not only the visible realities of society but also the intricate psychological experiences that define individual existence. From ancient epics to modern narratives, writers have consistently sought to represent the complexities of human emotions, relationships, and inner struggles. While early literary works often emphasized external action and moral lessons, the evolution of literary thought has gradually shifted focus toward the exploration of the inner world of the human mind. This transition marks a significant development in the history of literature, where psychological depth becomes as important as plot and character.

One of the most influential intellectual movements that contributed to this shift is psychoanalysis, particularly through the groundbreaking work of Sigmund Freud and Carl Jung. Their theories revolutionized the understanding of human behavior by introducing the idea that much of what individuals think, feel, and do is shaped by unconscious forces rather than conscious intention. Freud's emphasis on repression, desire, and internal conflict, along with Jung's exploration of archetypes and the collective unconscious, provided new frameworks through which both writers and critics could interpret human psychology. These theoretical insights opened up new possibilities for literary representation, allowing authors to delve deeper into the hidden dimensions of the human psyche.

The concept of the unconscious mind lies at the heart of this psychological exploration. The unconscious encompasses thoughts, emotions, memories, and desires that exist beyond the realm of conscious awareness yet exert a powerful influence on behavior. Unlike conscious thought, which is logical and controlled, the unconscious operates in subtle and often indirect ways. It manifests itself through dreams, slips of the tongue, emotional reactions, and creative expression. According to Freud, the unconscious plays a crucial role in shaping human experience, influencing everything from fears and anxieties to imagination and artistic creation. This understanding transforms literature into a meaningful space where these concealed aspects of the mind can be expressed, symbolized, and critically examined.

In this context, literature becomes more than a mere reflection of reality; it becomes a medium of psychological revelation. Authors use narrative to give form to the intangible and often contradictory elements of human thought. Characters in literary works are frequently portrayed as complex individuals whose actions are not always rational or fully understood, even by themselves. Their behavior is often driven by internal conflicts, suppressed desires, and unresolved emotional tensions. These psychological struggles add depth and realism to literary narratives, making them resonate with readers on a deeply personal level.

To effectively represent such complexity, writers employ a variety of narrative techniques that bring the unconscious mind to the forefront. Techniques such as symbolism allow authors to convey hidden meanings through objects, settings, and imagery. Stream of consciousness provides direct access to the continuous flow of a character's thoughts, reflecting the fragmented and non-linear nature of the mind. Dream imagery reveals repressed desires and fears in symbolic form, while internal monologue exposes the private thoughts and emotional conflicts of characters. Together, these techniques enable literature to capture the dynamic and often elusive processes of the human psyche.

Furthermore, the exploration of the unconscious in literature is not limited to individual psychology; it also reflects broader cultural and social dimensions. Human behavior is shaped not only by personal experiences but also by collective beliefs, traditions, and historical contexts. In this sense, literary narratives serve as a bridge between the individual and the collective, revealing how personal identity is influenced by larger psychological and cultural forces.

Thus, literature emerges as an effective and insightful medium for exploring the unconscious mind. It allows readers to engage with complex psychological realities, offering a deeper understanding of the motivations, conflicts, and emotions that shape human behavior. By bringing hidden thoughts and feelings to light, literary narratives encourage reflection, empathy, and self-awareness. In doing so, they not only enrich our understanding of literature but also provide valuable insights into the nature of human existence itself.

Psychoanalysis and Literary Interpretation:

Psychoanalytic criticism has become one of the most influential approaches in literary studies. Sigmund Freud's theories about the human psyche introduced a new way of interpreting literary texts. Freud divided the human mind into three components: the id, the ego, and the superego. The id represents instinctual desires and primitive impulses, the ego acts as the rational mediator, and the superego represents moral values and societal expectations (Freud 45).

These psychological elements often appear in literary characters who struggle between desire and morality. Many narratives depict individuals torn between personal ambitions and social restrictions, revealing the tension between unconscious impulses and conscious control.

Carl Jung expanded Freud's ideas by introducing the concept of the collective unconscious. Jung argued that human beings share universal psychological patterns known as archetypes. These archetypes appear frequently in myths, folklore, and literary narratives. Characters such as the hero, the shadow, and the wise guide represent these archetypal structures within the collective unconscious (Jung 60).

By applying psychoanalytic theories to literature, critics can analyse how characters reflect deeper psychological realities. Literature thus becomes a mirror of the human psyche, revealing hidden desires, fears, and conflicts.

Representation of the Unconscious in Literary Narratives:

Authors employ various narrative techniques to portray the unconscious mind. Symbolism is one of the most common techniques used in literature. Symbols often represent hidden

psychological meanings that go beyond the literal interpretation of events or objects. For instance, dark settings, mysterious spaces, or recurring objects in narratives may symbolize suppressed emotions or fears.

Another important narrative technique is stream of consciousness. This method allows writers to present the continuous flow of a character's thoughts and emotions. Through this technique, readers are able to observe the spontaneous and fragmented nature of the human mind.

Dream sequences also play a crucial role in revealing unconscious desires. Freud believed that dreams represent disguised forms of suppressed wishes and psychological conflicts (Freud 67). Many literary works incorporate dream imagery to expose the hidden emotions of characters.

Internal monologue is another powerful technique used by writers to reveal a character's private thoughts. By presenting the inner voice of characters, authors allow readers to understand the emotional and psychological struggles that shape their behaviour.

Through these literary techniques, narratives reveal the complex workings of the unconscious mind and its influence on human actions.

Psychological Conflict and Character Development:

Psychological conflict is a central element in many literary narratives. Characters often experience inner struggles that arise from conflicting desires, moral dilemmas, or suppressed emotions. These internal conflicts make characters more realistic and psychologically complex.

For example, characters may struggle between their personal desires and social responsibilities. Such conflicts often reflect the tension between the id and the superego, as described in Freudian psychology. These internal struggles drive the narrative forward and contribute to character development.

Repressed memories and past experiences frequently influence a character's actions. These memories may remain hidden in the unconscious mind but eventually surface through emotional crises or self-reflection. As characters confront these hidden emotions, they often undergo significant psychological transformation.

Thus, literary narratives portray characters who must confront their unconscious fears and desires in order to achieve personal understanding and growth.

Memory, Trauma, and the Unconscious:

Memory plays a vital role in shaping the unconscious mind. Many experiences, particularly traumatic ones, are stored in the unconscious and continue to influence human behaviour. Literature often portrays characters who struggle with painful memories or unresolved emotional conflicts.

Trauma can deeply affect an individual's psychological state. Writers frequently depict characters who attempt to suppress traumatic memories but eventually confront them through dreams, flashbacks, or emotional breakdowns. These narrative elements reveal how past experiences remain embedded within the unconscious mind.

By representing trauma and memory, literature highlights the long-term psychological effects of personal and historical events. Such narratives encourage readers to reflect on the emotional impact of war, loss, and social oppression.

Identity and the Fragmented Self:

Another significant theme related to the unconscious mind is the exploration of identity. Many literary works depict characters who experience confusion or fragmentation in their sense of self. The unconscious mind often contains conflicting emotions and hidden desires that challenge a stable identity.

Modern and postmodern literature particularly emphasize the instability of identity. Characters may struggle to understand their true selves while confronting social expectations and internal psychological conflicts.

This fragmentation reflects the complexity of human psychology. Literature thus portrays identity as a dynamic and evolving process shaped by unconscious thoughts, memories, and experiences.

Literature as Psychological Exploration:

Literature serves not only as artistic expression but also as a form of psychological inquiry. Through narrative, writers explore universal human emotions such as fear, desire, guilt, and love. By portraying the inner lives of characters, literature invites readers to reflect on their own psychological experiences.

Freud suggested that creative writing often emerges from unconscious desires and fantasies (Freud 90). In this sense, literature becomes a symbolic expression of the author's inner world. At the same time, readers engage with these narratives and interpret them through their own psychological perspectives.

Thus, literature functions as a bridge between imagination and psychology, offering deeper insights into the complexities of the human mind.

Conclusion:

The exploration of the unconscious mind remains one of the most compelling and intellectually enriching dimensions of literary study. Literature, in its capacity to transcend surface realities, provides a unique and powerful medium through which the hidden layers of human experience are revealed and examined. Through the integration of psychological themes and sophisticated narrative techniques, authors are able to bring to light the otherwise inaccessible regions of the human psyche. These representations do not merely serve artistic purposes; they offer profound insights into the complexities of thought, emotion, and behavior that define human existence.

Psychoanalytic theories, particularly those developed by Freud and Jung, have significantly enhanced our understanding of literary narratives by offering structured frameworks through which the unconscious can be interpreted. Freud's model of the psyche, with its emphasis on repression, desire, and internal conflict, enables readers to recognize the underlying motivations that drive characters beyond their conscious intentions. Similarly, Jung's concept of the collective unconscious and archetypes broadens this understanding by situating individual experiences within universal psychological patterns. Together, these theoretical perspectives reveal that literature is not only a reflection of individual consciousness but also a manifestation of shared human experiences embedded within the unconscious.

One of the most striking aspects of literary narratives is the portrayal of characters who grapple with internal conflicts, suppressed memories, and fragmented identities. These elements are not incidental but central to the development of psychological realism in literature. Characters often find themselves caught between opposing forces—desire and duty, memory and forgetting, self and society. Such tensions mirror the internal struggles that individuals face in real life, thereby enhancing the relatability and emotional depth of literary works. The unconscious mind, in this context, emerges as a powerful force that shapes decisions, influences behavior, and ultimately defines the trajectory of a character's life.

The presence of repressed emotions and unresolved trauma further underscores the significance of the unconscious in literature. Many narratives illustrate how past experiences, particularly those that are painful or disturbing, continue to exert influence long after they have been consciously forgotten. These buried memories often resurface in symbolic forms—through dreams, flashbacks, or seemingly irrational actions—demonstrating the persistence of

the unconscious in shaping human experience. By portraying such phenomena, literature not only reflects psychological truths but also fosters a deeper awareness of the emotional and mental processes that govern human life.

Moreover, the theme of fragmented identity highlights the instability and fluidity of the self. In many modern and postmodern narratives, characters struggle to construct a coherent sense of identity amidst conflicting internal and external pressures. The unconscious plays a crucial role in this fragmentation, as hidden desires, fears, and memories challenge the notion of a unified self. This portrayal resonates strongly with contemporary understandings of identity as dynamic and multifaceted, shaped by a complex interplay of psychological, social, and cultural factors.

In addition to its thematic richness, literature employs a wide range of narrative techniques to represent the unconscious. Techniques such as stream of consciousness, symbolism, and interior monologue allow readers to access the inner worlds of characters in ways that traditional narrative forms cannot achieve. These techniques mirror the non-linear and often chaotic nature of human thought, thereby providing a more authentic representation of psychological reality. Through such innovations, literature transcends mere storytelling and becomes an immersive exploration of the mind itself.

Another significant dimension of literary engagement with the unconscious lies in its impact on readers. Literature invites readers to enter the psychological spaces of characters, encouraging empathy and introspection. As readers encounter narratives shaped by unconscious forces, they are often prompted to reflect on their own inner experiences. This process of identification and self-reflection transforms reading into an *ulunhul* psychological engagement, where the boundaries between the text and the reader begin to blur. In this sense, literature functions not only as a representation of the unconscious but also as a catalyst for its exploration.

Furthermore, literature serves as a bridge between imagination and psychological inquiry. Writers, consciously or unconsciously, draw upon their own inner worlds to create narratives that resonate with universal human concerns. The act of writing itself can be viewed as a process of externalizing the unconscious, transforming intangible thoughts and emotions into tangible forms. At the same time, readers interpret these narratives through their own psychological frameworks, creating a dynamic interaction that enriches both the text and its reception.

Ultimately, literature stands as a profound medium for exploring the mysteries of the human psyche. It illuminates the depths of the unconscious mind, revealing the intricate and often hidden forces that shape human existence. Through imaginative storytelling and psychological insight, literary narratives continue to expand our understanding of what it means to be human. They challenge us to confront the unknown aspects of ourselves, to acknowledge the complexities of our emotions, and to embrace the contradictions that define our inner lives.

In conclusion, the study of the unconscious in literature is not merely an academic exercise but a deeply meaningful exploration of human nature. It underscores the enduring relevance of literary narratives in a world increasingly shaped by psychological awareness. By engaging with these narratives, we gain not only intellectual insight but also emotional and existential understanding. Literature, therefore, remains an indispensable tool for uncovering the depths of the human mind and for navigating the complexities of human experience with greater clarity, sensitivity, and awareness.

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MYTH AND ENVIRONMENTAL ETHICS IN JUNGLE NAMA: AN ECO-CRITICAL READING.

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Abstract:

This paper examines *Jungle Nama* by Amitav Ghosh through the lens of Ecocriticism, exploring how myth and folklore are used to articulate environmental ethics in the fragile ecosystem of the Sundarbans. The text reimagines the traditional legend of Bon Bibi, presenting the forest as a sacred ecological space governed by moral codes that regulate human interaction with nature. By revisiting this indigenous narrative, the work highlights the consequences of greed, ecological imbalance, and the violation of natural boundaries.

Drawing on ecocritical theory, the study analyzes how the narrative structure, verse form, and symbolic imagery in *Jungle Nama* foreground the interconnectedness of humans, animals, and the environment. The tiger figure and the dense mangrove landscape function as powerful metaphors for nature's agency and its resistance to exploitation. The paper argues that the retelling of the Bon Bibi myth not only preserves a cultural memory embedded in local ecological knowledge but also offers an ethical framework that critiques modern attitudes toward environmental exploitation.

Ultimately, this study demonstrates that *Jungle Nama* bridges folklore and contemporary environmental discourse, positioning myth as a powerful narrative strategy for communicating ecological awareness. By integrating traditional belief systems with modern ecological concerns, the text contributes to broader conversations about climate crisis, sustainability, and the need for ethical coexistence between humans and the natural world.

Keywords: Ecocriticism, Environmental Ethics, Myth and Folklore, Human–Nature Relationship, Eco-literature, Indigenous Ecological Knowledge

Introduction

In recent decades, literature has increasingly engaged with environmental concerns, reflecting the growing urgency of ecological crises. Ecocriticism, as a literary theory, examines the relationship between literature and the physical environment, emphasizing how texts represent nature and human interaction with it. One of the significant contemporary voices in this field is Amitav Ghosh, whose works often address climate change, environmental degradation, and the cultural dimensions of ecological awareness.

Jungle Nama is a unique poetic retelling of the Bon Bibi legend, rooted in the cultural traditions of the Sundarbans. The narrative explores the delicate balance between humans and nature, presenting the forest not merely as a physical space but as a sacred entity governed by ethical principles. Through this retelling, Ghosh emphasizes the importance of respecting ecological boundaries and highlights the consequences of human greed and exploitation.

This paper aims to analyze Jungle Nama through an ecocritical lens, focusing on how myth and folklore function as vehicles for environmental ethics. By examining the symbolic elements, narrative structure, and cultural context of the text, the study demonstrates how indigenous narratives contribute to contemporary environmental discourse.

Ecocriticism and Environmental Ethics

Ecocriticism emerged as a response to the increasing environmental concerns of the modern world. According to Cheryll Glotfelty, ecocriticism is “the study of the relationship between literature and the physical environment” (Glotfelty xix). It seeks to understand how literary texts reflect and shape human attitudes toward nature.

Environmental ethics, a key aspect of ecocriticism, deals with the moral relationship between humans and the natural world. Traditional Western perspectives often place humans at the center, viewing nature as a resource to be exploited. In contrast, ecocritical approaches emphasize interconnectedness, sustainability, and respect for non-human life.

In Jungle Nama, environmental ethics are embedded within the narrative through the moral framework of the Bon Bibi legend. The story illustrates that survival in the forest depends on adherence to ethical codes that respect the natural order. Violating these codes leads to destruction, highlighting the consequences of ecological imbalance.

Myth, Folklore, and Indigenous Ecological Knowledge

Myths and folklore play a crucial role in preserving cultural values and ecological knowledge. The legend of Bon Bibi, central to Jungle Nama, is an indigenous narrative that reflects the lived experiences of the people of the Sundarbans. Bon Bibi is revered as the guardian of the forest, protecting those who respect its rules while punishing those driven by greed.

By retelling this myth, Ghosh not only preserves a cultural tradition but also reinterprets it for contemporary audiences. The narrative emphasizes that the forest is a shared space where humans, animals, and supernatural forces coexist. This perspective challenges modern notions of domination and control over nature.

Indigenous ecological knowledge, embedded in such myths, offers valuable insights into sustainable living. These narratives promote harmony with nature, emphasizing balance rather than exploitation. As Lawrence Buell suggests, environmental texts often highlight “the interdependence of human and non-human systems” (Buell 7).

The Sundarbans as a Sacred Ecological Space

The Sundarbans, a unique mangrove ecosystem, plays a central role in *Jungle Nama*. The landscape is portrayed not merely as a setting but as a living entity with its own agency. The dense forests, tidal rivers, and unpredictable environment create a sense of mystery and danger, reinforcing the idea that nature cannot be controlled.

In the narrative, the forest is governed by moral laws that regulate human behavior. Those who respect these laws are protected, while those who violate them face consequences. This portrayal reflects an ecological worldview in which nature is not subordinate to humans but exists as an equal and powerful force.

The sacredness of the forest is a recurring theme in the text. By presenting the Sundarbans as a spiritual space, Ghosh challenges modern attitudes that view nature as merely a resource. Instead, the narrative calls for reverence, responsibility, and ethical coexistence.

Symbolism and the Representation of Nature

Symbolism plays a significant role in *Jungle Nama*, particularly in the representation of the tiger and the forest. The tiger, often associated with danger and fear, symbolizes the power and unpredictability of nature. It represents the consequences of ecological imbalance and the enforcement of natural laws.

The mangrove forest itself serves as a symbol of interconnectedness. Its complex network of roots and waterways reflects the intricate relationships between humans, animals, and the environment. This imagery reinforces the idea that all forms of life are interdependent.

Through these symbols, Ghosh highlights the agency of nature. The environment is not passive but actively responds to human actions. This perspective aligns with ecocritical theories that emphasize the dynamic relationship between humans and the natural world.

Narrative Form and Poetic Structure

One of the distinctive features of *Jungle Nama* is its verse form. The use of rhythm and rhyme makes the narrative accessible and engaging, echoing the oral traditions of folklore. This stylistic choice reinforces the connection between the text and its cultural roots.

The poetic structure also enhances the thematic elements of the narrative. The rhythmic flow mirrors the natural cycles of the environment, while the repetition of motifs emphasizes key ecological messages. By adopting a traditional storytelling style, Ghosh bridges the gap between past and present, making the narrative relevant to contemporary readers.

Furthermore, the simplicity of the language allows the text to reach a wider audience, including those outside academic circles. This accessibility is crucial for promoting environmental awareness and encouraging ethical reflection.

Critique of Modern Environmental Exploitation

Jungle Nama can be read as a critique of modern attitudes toward nature. In contemporary society, rapid industrialization and consumerism have led to environmental degradation and climate crisis. The narrative contrasts these destructive practices with the sustainable values embedded in the Bon Bibi myth.

The character driven by greed represents the dangers of unchecked exploitation. His actions disrupt the balance of the ecosystem, leading to conflict and suffering. This portrayal serves as a warning against the consequences of prioritizing profit over ecological sustainability.

As Amitav Ghosh argues in his broader works, modern narratives often fail to adequately address environmental issues. Jungle Nama attempts to fill this gap by using myth as a powerful tool for ecological storytelling.

Literature and Ecological Consciousness

Literature plays a vital role in shaping environmental consciousness. Through storytelling, writers can influence how readers perceive and interact with the natural world. Jungle Nama demonstrates how myth and folklore can be used to communicate complex ecological ideas in an accessible and meaningful way.

By engaging with indigenous narratives, the text encourages readers to reconsider their relationship with nature. It emphasizes the importance of ethical coexistence and the need to respect ecological boundaries.

In this context, literature becomes a form of environmental activism. It raises awareness about ecological issues and inspires readers to adopt more sustainable practices. As Greg Garrard notes, ecocriticism seeks to explore “the ways in which culture shapes our understanding of nature” (Garrard 5).

Conclusion

An ecocritical reading of *Jungle Nama* reveals the profound connection between myth, culture, and environmental ethics. Through the retelling of the Bon Bibi legend, Amitav Ghosh highlights the importance of respecting ecological boundaries and preserving the balance of the natural world.

The text demonstrates that indigenous narratives contain valuable ecological knowledge that remains relevant in the context of modern environmental challenges. By integrating folklore with contemporary concerns, *Jungle Nama* offers a powerful critique of environmental exploitation and advocates for sustainable coexistence.

Ultimately, the study shows that literature can serve as a bridge between tradition and modernity, using storytelling to promote ecological awareness and ethical responsibility. In an era of climate crisis, such narratives play a crucial role in shaping a more sustainable and harmonious relationship between humans and the natural world.

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MODERNITY AND ITS DISCONTENTS: A CRITIQUE OF UNSUSTAINABLE SOCIAL PRACTICES IN VILE BODIES

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Abstract:

Evelyn Waugh's *Vile Bodies* offers a sharp satirical portrait of interwar British society, exposing the fragile foundations of modernity through the lives of the so-called "Bright Young Things." This paper examines how Waugh critiques the unsustainable social practices that define this generation: excessive consumption, emotional detachment, and a relentless pursuit of pleasure devoid of purpose. Modernity, as represented in the novel, is not a progressive force but a destabilising condition that erodes ethical values, meaningful relationships, and social responsibility. The novel foregrounds a culture driven by spectacle and immediacy, where media sensationalism and social performance replace authenticity and stability. Through fragmented narrative structures and episodic events, Waugh reflects the disjointed consciousness of a society unable to sustain coherence or continuity. The characters' lives, marked by financial instability, romantic disillusionment, and moral ambiguity, reveal the deeper consequences of a culture that prioritises appearance over substance. This study argues that *Vile Bodies* anticipates contemporary concerns about social unsustainability, particularly in its depiction of a society trapped in cycles of excess and emptiness. Waugh's satire not only critiques the cultural practices of his time but also exposes the long-term consequences of a value system rooted in superficiality and transience. Ultimately, the novel presents modernity as a paradox, promising liberation while fostering disintegration, thereby questioning the viability of a society that lacks enduring ethical and social foundations.

Keywords: *Modernity; Unsustainability; Satire; Social Decay; Media Culture*

1. Introduction

Evelyn Waugh's *Vile Bodies* (1930) offers a compelling satirical exploration of interwar British society, portraying a generation that appears liberated from traditional constraints yet is deeply entangled in instability, excess, and moral ambiguity. Set in the aftermath of the First World War, the novel captures the cultural disorientation of a society attempting to redefine itself amidst rapid social and economic change. The "Bright Young Things," who dominate the narrative, exemplify this transition through their indulgence in parties, gossip, and fleeting pleasures, reflecting a broader shift toward immediacy and spectacle.

While modernity is often associated with progress, autonomy, and innovation, Waugh interrogates these assumptions by revealing the underlying fragility of such transformations. This paper argues that *Vile Bodies* critiques modernity as an unsustainable social condition, characterized by excessive consumption, emotional detachment, performative identities shaped by media, and the erosion of ethical frameworks, ultimately presenting a society unable to sustain coherence or meaning.

2. Review of Literature

Critical scholarship on *Vile Bodies* has consistently emphasized its modernist features, particularly its fragmented narrative form and its reflection of post-war cultural disillusionment. Scholars have argued that Waugh's episodic structure mirrors the instability of interwar society, where traditional values were rapidly dissolving without being replaced by stable alternatives. The portrayal of the "Bright Young Things" has been widely interpreted as a satirical representation of a generation marked by moral decline and existential emptiness. Additionally, critics have highlighted Waugh's engagement with media culture, noting how gossip columns and sensational journalism contribute to the construction of identity and the commodification of personal experience.

More recent critical approaches have begun to examine *Vile Bodies* through the lens of sustainability, focusing on how the novel exposes the long-term consequences of socially and ethically unstable practices. This perspective suggests that Waugh's satire extends beyond individual behavior to critique systemic issues, including economic precariousness, the erosion of meaningful relationships, and the collapse of moral authority. This paper builds on these insights by offering a comprehensive analysis of unsustainability as a central theme that connects the novel's formal, thematic, and social dimensions.

3. Methodology

This study employs a qualitative, interpretative methodology grounded in close textual analysis. The approach focuses on examining key narrative elements, including characterization, thematic patterns, and stylistic techniques, to identify how Waugh constructs his critique of modernity. Drawing on theoretical frameworks related to modernity, satire, and cultural criticism, the analysis seeks to uncover the interconnected dimensions of unsustainability within the novel.

The methodology also incorporates a contextual reading of the novel, situating it within the socio-historical conditions of interwar Britain. This allows for a deeper understanding of how Waugh's satire responds to contemporary anxieties while also offering

insights that extend beyond its immediate context. By combining textual analysis with contextual interpretation, the study aims to provide a nuanced and comprehensive account of how *Vile Bodies* articulates the discontents of modernity.

4. Analysis

4.1 Excessive Consumption and Economic Instability

One of the central dimensions of unsustainability in *Vile Bodies* is the pervasive culture of excessive consumption, which is closely linked to economic instability. The characters are engaged in a continuous cycle of social activities — parties, travel, and extravagant gatherings — that demand financial resources they often do not possess. Adam Fenwick-Symes serves as a representative figure of this condition, as his financial difficulties repeatedly undermine his attempts to establish stability. His inability to secure consistent income reflects a broader societal pattern in which consumption is not merely a choice but a necessity for maintaining social identity, even when it is economically unsustainable.

This contradiction reveals a fundamental flaw in the structure of modern society as depicted by Waugh. The emphasis on display and performance creates a system in which individuals are compelled to prioritize short-term gratification over long-term stability, leading to cycles of dependency and insecurity. Waugh's satire thus exposes the economic fragility underlying the apparent glamour of the "Bright Young Things," suggesting that their lifestyle is built on unstable foundations that cannot endure.

4.2 Emotional Detachment and Fragile Relationships

The unsustainability of modernity in *Vile Bodies* is further reflected in the nature of interpersonal relationships, which are characterized by emotional detachment and instability. The relationship between Adam and Nina Blount, while central to the narrative, lacks depth and continuity, as it is repeatedly disrupted by financial concerns and shifting circumstances. Their interactions often rely on wit and surface-level engagement rather than genuine emotional connection, indicating a broader cultural tendency to avoid intimacy and commitment.

Such emotional detachment can be understood as a response to the uncertainties of modern life, where rapid change and instability make long-term commitments difficult to sustain. However, this avoidance of emotional depth ultimately contributes to a sense of isolation and dissatisfaction. Waugh's portrayal of these fragile relationships highlights the psychological consequences of a culture that prioritizes immediacy and convenience over stability and responsibility.

4.3 Media, Spectacle, and Performative Identity

Waugh's critique of modernity is also evident in his portrayal of media culture and its role in shaping identity. The novel depicts a society in which gossip columns, sensational journalism, and public visibility play a central role in defining social status and personal identity. Characters are often recognized not for their intrinsic qualities but for their presence within the public sphere, creating a culture in which individuals are constantly engaged in self-presentation, adapting their behavior to align with the expectations of an audience.

The resulting emphasis on performative identity undermines authenticity and fosters a sense of disconnection between the individual and their true self. Waugh's depiction of this phenomenon anticipates contemporary concerns about media and identity, suggesting that the pressures of visibility and performance contribute to the erosion of meaningful selfhood.

4.4 Fragmentation and Narrative Form

The fragmented narrative structure of *Vile Bodies* serves as a formal reflection of the instability and disorientation that characterize modern life. The novel's episodic form, marked by abrupt transitions and a lack of linear continuity, mirrors the fragmented experiences of its characters, who struggle to find coherence in their lives. This stylistic choice disrupts traditional narrative expectations, emphasizing the absence of clear progression or resolution and reinforcing the sense of unpredictability that defines the modern condition.

Waugh's use of fragmentation can be interpreted as both a representation and a critique of modernity, highlighting the inadequacy of conventional frameworks for understanding a rapidly changing world. By rejecting narrative coherence, the novel underscores the disintegration of social and cultural structures, suggesting that modern life itself resists stability and order.

4.5 Moral Disintegration and Ethical Vacuum

A significant aspect of Waugh's critique lies in his depiction of moral disintegration, as the characters in *Vile Bodies* operate within a landscape largely devoid of ethical guidance. Traditional sources of moral authority, such as religion and established social norms, are either absent or ineffective, leaving individuals to navigate their actions based on personal desire and social convenience. This absence of a stable moral framework results in a condition of ethical ambiguity, where actions are rarely evaluated in terms of their consequences or broader implications.

The lack of moral accountability contributes to the overall instability of the society depicted in the novel. Waugh's satire thus exposes the dangers of a society that has abandoned its moral

foundations without developing new ones, highlighting the need for a more stable and coherent system of values.

4.6 War and the Collapse of Illusion

The abrupt introduction of war at the conclusion of *Vile Bodies* serves as a powerful culmination of Waugh's critique, exposing the fragility of the social world he has depicted. The transition from frivolity to conflict underscores the instability of a society built on excess and avoidance, revealing the limitations of a lifestyle centered on immediate pleasure. War functions as both a literal event and a symbolic rupture, dismantling the illusions that sustain the characters' existence and forcing a confrontation with reality.

This shift highlights the broader implications of Waugh's critique, suggesting that the unsustainable practices of modern society are not merely superficial but indicative of deeper structural weaknesses. In this sense, the novel presents war not only as a historical event but as an inevitable outcome of a society that has failed to sustain itself.

5. Conclusion

Vile Bodies presents a nuanced and incisive critique of modernity, revealing the unsustainable social practices that define interwar British society while also offering insights that remain relevant in contemporary contexts. Through its exploration of excessive consumption, emotional detachment, media-driven identities, fragmented experience, and moral disintegration, the novel exposes the contradictions inherent in modern life and challenges the assumption that progress necessarily leads to stability or fulfillment.

Waugh's use of satire and formal experimentation enhances the depth of this critique, capturing the complexity and instability of a society in transition. Ultimately, the novel suggests that modernity, in the absence of stable ethical and social foundations, is inherently prone to disintegration. By highlighting the consequences of unsustainable practices, *Vile Bodies* invites a reconsideration of the values and structures that underpin contemporary life, emphasising the importance of balance, responsibility, and coherence. In doing so, Waugh's work remains a significant contribution to the study of literature and modern society, offering a timeless reflection on the challenges and contradictions of the modern condition.

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EXPLORING THE MIND: A COGNITIVE APPROACH TO THE DARK HOLDS NO TERRORS BY SHASHI DESHPANDE

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Abstract:

This paper examines *The Dark Holds No Terrors* through the lens of cognitive literary theory, focusing on the psychological experiences and mental processes of the protagonist Sarita (Saru). Cognitive theory in literature explores how thoughts, memories, emotions, and perceptions shape human behavior and identity. The novel presents a deep psychological portrayal of Saru's inner conflicts, childhood trauma, guilt, and marital distress. Her memories of her mother's discrimination and the tragic death of her brother create a lasting impact on her mental state, influencing her self-perception and emotional responses. The study analyzes how Saru's past experiences construct negative cognitive patterns that affect her relationships and her sense of self. Through introspection and recollection, the narrative reveals the complexity of her psychological struggle and the gradual process of self-realization. By applying a cognitive approach, this paper highlights how Deshpande effectively portrays the workings of the human mind and the role of memory and perception in shaping identity. Ultimately, the novel demonstrates Saru's journey from fear, guilt, and confusion toward self-awareness and emotional strength, offering a significant exploration of psychological conflict and cognitive transformation within the framework of contemporary Indian feminist writing.

Keywords: *Cognitive Theory, Psychological Conflict, Memory and Trauma, Self-Identity, Gender Discrimination, Marital Conflict and Inner Consciousness*

1. Introduction

Indian English literature has significantly explored the psychological and social experiences of individuals, particularly the inner lives of women. Among the prominent writers in this field, Shashi Deshpande occupies an important place for her realistic portrayal of women's struggles, identity crises, and emotional conflicts within a patriarchal society. Her novel *The Dark Holds No Terrors* presents a profound psychological exploration of the life of its protagonist, Sarita (Saru), whose experiences reveal the complex interaction between memory, emotion, and personal identity.

Cognitive literary theory provides an effective framework for analyzing such psychological narratives. This theoretical approach focuses on how individuals process experiences through thoughts, memories, perceptions, and emotions. It emphasizes the role of mental patterns in shaping behavior, relationships, and self-understanding. In *The Dark Holds No Terrors*, Deshpande portrays Saru's life as deeply influenced by childhood discrimination, guilt over her brother's death, and the emotional turmoil of her marriage. This paper aims to explore the cognitive dimensions of the novel by analyzing Saru's mental processes, memories, and emotional struggles, ultimately illustrating her journey from fear, guilt, and confusion toward awareness and inner strength.

2. Concept of Cognitive Theory in Literature

Cognitive theory in literature focuses on the study of how the human mind processes experiences, emotions, memories, and perceptions, and how these mental activities influence behavior and identity. It draws its foundation from the field of Cognitive Psychology, which examines the ways in which people think, learn, remember, and interpret the world around them. When applied to literary studies, cognitive theory helps scholars understand how characters perceive their experiences and how their mental processes shape their actions and decisions. Cognitive literary criticism also explores how narratives represent the functioning of the human mind, examining elements such as memory, imagination, emotions, trauma, and self-reflection within literary texts. The approach emphasizes that human identity and personality are not fixed but are formed through continuous mental processing and interpretation of experiences. In *The Dark Holds No Terrors*, the protagonist Sarita's life is deeply influenced by her memories, childhood experiences, and emotional conflicts. Her introspective reflections and recollections reveal how the mind interprets trauma and constructs personal identity.

3. Overview of the Novel

The Dark Holds No Terrors, written by Shashi Deshpande, is a psychological novel that explores the inner conflicts and emotional struggles of its protagonist, Sarita (Saru). The novel presents the life of a modern, educated woman who faces both personal and social challenges within a patriarchal society. Through Saru's experiences, the novel highlights themes such as gender discrimination, marital conflict, guilt, and the search for self-identity.

The story begins with Saru returning to her father's house after a period of distress in her marriage, allowing her to reflect on her past and confront the memories that have shaped her personality. Her strained relationship with her mother, who showed greater affection toward her brother Dhruva, created deep emotional wounds and contributed to her feelings of rejection and

insecurity. The tragic death of her brother, for which she feels a sense of guilt, continues to influence her thoughts and emotional state even in adulthood. The novel is largely introspective and focuses on Saru's mental journey rather than external events. By the end of the novel, Saru reaches a stage of self-awareness and gains the courage to confront her problems rather than escape from them.

4. Childhood Trauma and Cognitive Formation of Saru

The childhood experiences of the protagonist Sarita (Saru) play a crucial role in shaping her psychological development and cognitive patterns. Cognitive theory emphasizes that early experiences significantly influence the formation of an individual's beliefs, emotions, and self-perception. In Saru's case, the emotional neglect and discrimination she faced during her childhood created deep psychological scars that affected her personality and outlook on life.

Saru's mother openly favors her younger brother Dhruva and constantly reminds Saru that she is less valuable because she is a girl. This gender discrimination instills feelings of rejection and inferiority in Saru's mind, developing negative cognitive patterns and causing her to believe she is unwanted and responsible for the problems in her family. The tragic death of her brother Dhruva further intensifies her guilt — the memory of Dhruva's death repeatedly appears in her thoughts and becomes a source of emotional pain and self-blame. According to cognitive theory, such recurring memories can form persistent mental schemas that influence how individuals interpret their experiences and relationships. These childhood experiences continue to affect Saru even in adulthood, influencing her decisions and relationships, including her marriage.

5. Memory, Guilt, and Psychological Conflict

Memory plays a crucial role in shaping the psychological state of the protagonist, Sarita (Saru). The narrative unfolds largely through Saru's recollections of her past, revealing how memories influence her emotions, decisions, and self-perception. From a cognitive perspective, memories are not merely recollections of past events but active mental processes that shape an individual's understanding of reality and identity.

One of the most significant memories affecting Saru is the tragic death of her younger brother Dhruva. Although the incident was accidental, Saru carries a deep sense of guilt, intensified by her mother's harsh accusation that Saru was responsible. As a result, Saru internalizes the blame and develops a persistent feeling of self-condemnation. These painful memories create an ongoing psychological conflict within Saru — she struggles between her desire to move forward in life and the haunting memories of her past. Cognitive theory suggests that such recurring memories can shape an individual's mental framework, influencing how they

interpret their relationships and experiences. The psychological conflict between her past and present leads to feelings of confusion, anxiety, and emotional distress.

6. Gender Discrimination and Mental Conditioning

Shashi Deshpande portrays gender discrimination as a key factor in shaping Sarita's psychological and cognitive development. From childhood, Saru experiences the preferential treatment of her brother Dhruva by her mother and other family members, which reinforces the notion that being a girl is a disadvantage. This persistent bias conditions Saru's mind to internalize feelings of inadequacy, guilt, and inferiority, influencing her self-concept and emotional responses throughout her life.

Cognitive theory explains that such repeated experiences of discrimination can form deep-seated mental schemas — patterns of thought that shape how individuals perceive themselves and interpret social interactions. Saru grows up believing that her worth is linked to her ability to conform to societal expectations of women, creating an internalized sense of limitation despite her intelligence and achievements. This mental conditioning manifests later in her personal and professional life, particularly in her marriage, where societal and cultural expectations exacerbate conflicts between her ambition and traditional gender roles. Through Saru's experiences, Deshpande illustrates that gender discrimination is not just a social issue but also a cognitive one, shaping mental patterns, beliefs, and emotional responses that define her perception of self.

7. Cognitive Transformation and Self-Realization

In *The Dark Holds No Terrors*, Shashi Deshpande presents Sarita's journey as one of profound cognitive transformation leading to self-realization. Cognitive theory emphasizes that human beings continuously process experiences, memories, and emotions, and through reflection, they can reconstruct their understanding of self and reality. Saru's introspection and confrontation with her past allow her to recognize how childhood trauma, guilt, and societal pressures have shaped her thoughts, feelings, and behavior.

Throughout the novel, Saru undergoes a gradual shift in mental patterns. She begins to differentiate between past conditioning and present reality, understanding that her guilt over her brother's death and her mother's favoritism should not define her identity. She also reassesses her marriage, recognizing that Manu's emotional abuse stems from his insecurities rather than her shortcomings. This process of self-analysis demonstrates cognitive restructuring, where Saru actively reevaluates her beliefs and interpretations to achieve a healthier and more autonomous mindset. By the end of the novel, Saru attains self-awareness and emotional maturity, no longer allowing fear, guilt, or societal expectations to dominate her actions, exemplifying how cognitive

processes, reflection, and mental reorganization enable a person to overcome trauma and reclaim agency.

8. Conclusion

The *Dark Holds No Terrors* offers a rich exploration of the human mind, emotions, and identity, making it an ideal text for analysis through cognitive theory. The novel vividly portrays Sarita's psychological struggles, including childhood trauma, gender discrimination, guilt, and marital conflict, showing how these experiences shape her thoughts, beliefs, and self-perception. Through introspection and memory, Saru navigates the complex interplay of past experiences and present reality, revealing the intricate workings of the human mind.

Cognitive theory helps us understand how Saru's early experiences created persistent mental patterns that influenced her emotional responses and decisions throughout life. Her journey from fear, guilt, and internalized societal expectations to self-awareness, emotional resilience, and autonomy exemplifies cognitive transformation. Ultimately, Deshpande's novel highlights the power of the mind in shaping human experience, demonstrating that while external circumstances and social pressures affect individuals, it is the cognitive processes — thoughts, memories, and perceptions — that determine how one understands oneself and interacts with the world. Through Saru's story, the novel offers a compelling insight into the psychological and emotional journey toward self-understanding, making it a significant contribution to both Indian literature and studies in cognitive literary criticism.

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CULTURAL NARRATIVE OF SUSTAINABILITY IN RANI MANICKA'S TOUCHING EARTH

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Abstract:

A shared story, belief system or values within a community defines the choices we make that has an impact on the environment and society. Rani Manicka's novel *Touching Earth* embeds cultural narrative of sustainability in the Balinese twin's upbringing, portraying Bali as a heaven of innocence where lives are intertwined with nature. Their traditional practices and spiritual rituals are connected with nature in Bali and that contrasts sharply with the urbanized city of London in the novel. *Touching Earth* evokes power and magic through the portrayal of the daily life rhythms, unseen spirits and family customs. This highlights the unknown spiritual world beyond human understanding that are designed for the protection of nature and environment. The novel also points out the importance of sustainable ecotourism that's essential for protecting biodiversity, preserving the cultural heritage and ensuring long-term safety of the earth. Manicka describes Bali with authentic, intoxicating imagery that captures its untouched power and cultural essence far beyond the clichés of tourist imagery of Bali. The novel's polyphonic structure amplifies these narratives through multiple voices, highlighting Bali's natural beauty and the underworld of London that is corrupted and addicted to drugs. This paper brings in how literature plays a significant part in presenting the cultural narrative of a community which paves way of ecological sustainability.

Keywords: *cultural narrative, traditional practices, spiritual world, polyphonic structure, ecological sustainability*

1. Introduction

Rani Manicka's *Touching Earth* intricately weaves Balinese cultural narratives with themes of harmony and disconnection from the earth, contrasting spiritual rootedness against modern exploitation. While not overtly an eco-novel, the story uses Bali's traditions to narrate sustainability as a lost ideal, corrupted by urban vice.

2. Bali's Spiritual Harmony

Balinese culture in the novel embodies sustainability through deep interconnectedness with nature, where daily life follows natural rhythms. The twins Nutan and Zeenat grow up in an "Edenic" paradise, tied to rituals, herbal healing, and ancestral land. Their grandmother Nenek, a

reported witch, feeds them herbal remedies from the earth, symbolizing a narrative of reciprocity—humans as stewards drawing sustenance without depletion.

This mirrors Balinese Hinduism's Tri Hita Karana, balancing humans, nature (palemahan), and spirit (utama), though Manicka fictionalizes it poetically. Sustainability here is cultural narrative: not as policy, but as banjar (community) ethos, where greed is taboo, and excess invites imbalance.

3. Corruption in Urban Exile

London's "Spider Temple" inverts Bali's narrative, depicting unsustainability as predatory materialism and addiction devouring souls. Ricky Delgado's bargain with the Spider Goddess echoes exploitative capitalism, contrasting Bali's harmony. The twins exchange "island paradise for shabby squalor," purity for corruption, heroin veins replacing herbal veins. This diaspora narrative critiques globalization: Balinese innocence lured by Ricky's charm, mirroring colonial or modern lures stripping cultural sustainability.

4. Nenek's Earthbound Wisdom

Nenek anchors the cultural narrative, her witchcraft a sustainable praxis of earth-touching. Tied to soil, she heals with "herbal combinations," embodying indigenous knowledge systems where medicine grows locally, minimizing extraction. In dialogic polyphony, Nenek's voice unfinalizes truth—characters debate her influence, like Zeenat's guilt over smack, rooted in lost Bali nurture. Her presence warns against "sorcerer" omens, symbolizing earth's retribution for hubris.

5. Polyphonic Voices of Loss

Manicka's polyphonic structure—multiple first-person confessions—mirrors Bakhtinian dialogue, each voice narrating sustainability's erosion. Anis paints "broken people," his rage outlet capturing earth's alienation. Cultural narrative emerges when Bali's multi-voiced gotong royong (mutual aid) contrasts with London's solipsism, where false modernity is unmasked.

6. Spider Goddess as Unsustainability

The Spider Goddess personifies anti-sustainability, her "weakest dwelling" a web trapping souls in addiction. Ricky's pact parodies Balinese offerings, twisted to blood sacrifice amid drugs and prostitution. Her temple in London devours, unlike Bali's temples nurturing life. This myth critiques consumer culture: Bali's animism (talking to earth) vs. London's commodified spirits.

7. Artist's Vision and Reclamation

Anis's gallery "knows subjects before they know themselves," paintings as sustainable narrative—immortalizing brokenness to heal. His Zeenat in golden headdress, "serene but

blazing," reclaims Bali's dance, defying death or drugs. Sustainability via art: canvas touches earth, unlike veins or webs.

8. Conclusion

Cultural narrative as sustainability is a dialogic choice in the novel which portrays Bali's ethos persisting in memory. Novel warns: lose cultural roots, become rats; reclaim via narrative touch. Ultimately, *Touching Earth* demonstrates that severing Balinese roots invites depletion, but cultural narratives persist—unfinalized, resilient, calling diaspora souls home to sustainable harmony.

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ANCIENT GODS IN A MODERN WORLD: IDENTITY AND HEROISM IN THE TITAN'S CURSE

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Abstract:

This paper examines how the novel transforms traditional mythological motifs into a framework for understanding contemporary adolescent struggles. By focusing on characters such as Percy Jackson, Thalia Grace, and Zoë Nightshade, the study argues that Riordan redefines heroism as an ethical and relational concept grounded in courage, loyalty, and self-sacrifice. Ultimately, the novel demonstrates that ancient myths continue to function as powerful cultural narratives capable of illuminating modern questions of identity and moral responsibility. The resurgence of mythological narratives in contemporary literature reflects an enduring fascination with ancient cultural traditions and their relevance to modern life. In *The Titan's Curse*, Rick Riordan reimagines the rich heritage of Greek mythology within a distinctly modern setting, exploring themes of identity, destiny, and heroism.

Keywords: *Greek mythology, modern adaptation, identity formation, heroism, Rick Riordan, Percy Jackson, young adult literature*

1. Introduction

Mythology has long served as a cultural reservoir through which societies articulate their values, fears, and aspirations. Authors revisit classical myths not merely to retell them, but to interrogate contemporary issues such as identity, morality, and belonging. Rick Riordan's *The Titan's Curse* exemplifies this dynamic interplay between ancient myth and modern storytelling. At the center of Riordan's narrative is the redefinition of heroism—in *The Titan's Curse*, heroism is less about individual triumph and more about moral responsibility, self-sacrifice, and cooperation.

2. Mythological Heritage in a Contemporary Narrative

One of the most compelling aspects of *The Titan's Curse* is its seamless integration of mythological tradition with contemporary settings. Mythological figures such as Artemis and Atlas retain their classical significance while actively participating in the unfolding narrative. Through this reinterpretation, Riordan demonstrates that mythological narratives are not static remnants of the past but living traditions capable of adaptation and renewal. The presence of

ancient gods within a modern world underscores the enduring relevance of myth as a means of interpreting human experience and moral struggle.

3. Identity and the Formation of the Modern Hero

At the heart of the novel lies a profound exploration of identity. Percy Jackson occupies a liminal position between the mortal and divine realms as the son of Poseidon, serving as a metaphor for the broader human quest for self-understanding and belonging. Thalia Grace, the daughter of Zeus, confronts the burden of prophecy and leadership—her decision to join the Hunters of Artemis reflects an assertion of personal agency, challenging the deterministic nature of classical myth. Zoë Nightshade further enriches the novel's exploration of identity, embodying a profound sense of loyalty and resilience forged through centuries of experience.

4. Reconfiguring the Meaning of Heroism

In classical mythology, heroism often revolves around the pursuit of glory and immortality. In *The Titan's Curse*, heroism emerges not through the assertion of power but through acts of empathy, loyalty, and self-sacrifice. Percy Jackson's courage is defined less by his supernatural abilities than by his willingness to protect his friends and confront danger for the sake of others. The narrative also emphasizes collective action—the success of the quest depends upon the collaboration of multiple characters, each contributing their unique strengths and perspectives.

5. Myth and Contemporary Cultural Perspectives

Beyond its exploration of identity and heroism, *The Titan's Curse* engages with broader cultural themes relevant to contemporary society. The novel offers a nuanced portrayal of gender dynamics through the presence of the Hunters of Artemis, a community of independent and powerful female warriors. This representation challenges traditional patriarchal narratives often associated with classical mythology. By granting significant agency and authority to female characters, Riordan reinterprets mythological tradition in ways that resonate with modern discussions about equality and empowerment.

6. Conclusion

The Titan's Curse stands as a compelling example of how ancient mythological traditions can be revitalized within contemporary literature. By shifting the focus from physical prowess to ethical responsibility and emotional growth, Riordan redefines what it means to be a hero in the modern world. Characters in the story are symbolic representations of real-world struggles—through their journeys, readers are encouraged to explore questions about identity, moral values, and how they relate to others in a complex world. His work demonstrates that mythology is not a

static relic of the past, but a living tradition that continues to evolve, offering new insights into the human condition.

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NEGOTIATING QUEER IDENTITIES IN MO DAO ZU SHI: TRADITION, MASCULINITY, AND SOCIAL LEGITIMACY IN CHINESE CONTEXTS

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Abstract:

This paper examines the authenticity of queer representation in *Mo Dao Zu Shi* by situating its characters within the historical, cultural, and philosophical frameworks of Chinese society. It argues that the contrasting fates of Wei Wuxian, Lan Wangji, and Mo Xuanyu are not merely narrative choices but reflections of deeply rooted socio-cultural norms. Drawing on historical accounts of homosexuality in Imperial China and Confucian principles of family, lineage, and masculinity, the study highlights how acceptance of queer relationships was conditional rather than absolute. Wei Wuxian and Lan Wangji's relationship aligns with these expectations through their social status, adherence to masculine ideals, and fulfillment of familial duties, enabling their acceptance. In contrast, Mo Xuanyu's marginalization reflects the consequences of failing to meet these norms, compounded by taboo desires. Ultimately, the paper contends that the novel presents a nuanced and contextually grounded portrayal of queer identities rather than an idealized or purely fictional narrative.

Keywords: *Queer Representation; Mo Dao Zu Shi; Confucianism; Masculinity; Chinese Cultural History; Homosexuality*

1. Introduction

Acceptance and tolerance towards the queer community is a slowly developing phenomenon. According to recent research on homosexuality conducted by the Pew Research Center, despite major changes in laws and norms surrounding the issue of same-sex marriage and the rights of LGBT people around the world, public opinion on the acceptance of homosexuality in society remains sharply divided by country, region, and economic development (Poushter and Kent). Based on the data collected, a country's attitude towards homosexuality depends on varying factors, including age, education, wealth, gender, social status, and most importantly the dominant religion and philosophy practiced in the country.

Examining the social atmosphere in Eastern countries such as China and India reveals a very low number on the acceptance scale, which stands in stark contrast with the country's history. Contrary to popular belief, China is home to one of the largest queer communities in the world, although this large population lives fairly invisible in society (Wang et al.). While laws pertaining

to homosexuality have been altered by the Chinese government and it is no longer considered a psychiatric disorder, complete acceptance of homosexuality remains a reality for the distant future. Historian Bret Hinsch, in the Introduction to *Passions of the Cut Sleeve* (1990), notes that in many periods homosexuality was widely accepted and even respected in Imperial China, having its own formal history and a role in shaping Chinese political institutions. He argues that despite the denouement of the homosexual tradition in modern times, the historical record is one of general tolerance (Hinsch 4).

This is echoed in *Men and Masculinity: A Social, Cultural, and Historical Encyclopedia*, which states that despite the varying nature of acceptance of homosexuality in Chinese society during different eras, it "on the whole was not condemned" (Kimmel and Aronson 393). The change in perception was brought about by the Communist Revolution, which introduced a moralizing denunciation of homosexuality as perverse (Kang 231). Unlike Western religions, there is no real evidence of homosexuality interdiction in Taoism, and Confucianism and Buddhism showed very little interest in sexual practices.

2. Contrasting Fates: Wei Wuxian, Lan Wangji, and Mo Xuanyu

When the queer characters in *Mo Dao Zu Shi* are considered, Lan Wangji and Wei Wuxian are treated far better than Mo Xuanyu. Their queer identities are accepted by the cultivation society without any qualms, while Mo Xuanyu was driven out of his Sect in disgrace for the same fact. Fans of *Mo Dao Zu Shi* agree that Lan Wangji and Wei Wuxian's story appears unrealistic, purely fictional, and a manifestation of the author's desires. Despite the traumatic events and trials they faced, their story culminates on a happy note — with the mystery solved and truths from the past revealed, the false accusations against Wei Wuxian are cleared, they marry and settle in Cloud Recess, and are depicted in domestic bliss and harmony.

This happy ending stands in glaring contrast to Mo Xuanyu's tragic fate, whose life ended in despair and sacrifice that did not benefit him in any manner. Both Wei Wuxian and Mo Xuanyu were accepted into prominent cultivation clans by the clan heads, share similar childhood trauma and abuse, and both end their lives through violent means driven by false accusations. These similarities do not, however, hide the fact that there are various ways in which they differ, and it is this difference that explains why the acceptance extended to Wei Wuxian as a homosexual would not be given to Mo Xuanyu.

3. Masculinity and the Wen-Wu Paradigm

One of the predominant reasons for Mo Xuanyu's inability to gain society's acceptance is his lack of masculine qualities. Chinese society judged masculinity based on the Wen-Wu paradigm.

Irrespective of their physical prowess, if the individual fulfilled either of the criteria, they were accepted in society as masculine men. While Wei Wuxian and Lan Wangji fulfilled both, Mo Xuanyu failed in both criteria — neither scholarly (wen) nor a warrior (wu), he was weak, unremarkable, and mediocre in every aspect. He also had an inclination toward covering his face in make-up, which would not have gained him disapproval had he fulfilled the wu paradigm, since wearing make-up was accepted for men in Ancient China to a certain extent.

Furthermore, Mo Xuanyu was claimed to have developed romantic feelings for his half-brother, Jin Guangyao, which eventually led to him being driven out from the Jin Clan in disgrace. It was this incestuous relationship — criminalized in China — that caused the greatest trouble. Therefore, when compared with Lan Wangji and Wei Wuxian whose masculinity was established and whose relationship was acknowledged by the cultivation society, Mo Xuanyu's existence and desires as a queer individual subverted social norms, posing a threat to the social order.

4. Confucianism, Lineage, and Familial Duty

Another factor rooted deeply in Asian philosophy of family life contributed to the acceptance of Lan Wangji and Wei Wuxian's relationship. Based on various examples from Chinese history of renowned individuals forming homosexual bonds, it becomes apparent that certain criteria must be fulfilled to gain societal acceptance — one such criterion being the progression of one's bloodline and lineage. Most Asian countries emphasize lineage continuation, a reason why importance is placed on a man to have children to continue his father's lineage (Watts 4).

Confucianism as a predominant philosophy in China dictated various aspects of Chinese society, including family structure and marriage. Within family structure, emphasis was placed on sons having children in order to participate in ancestor worship. The Chinese believed in the old saying that "there are three kinds of unfilial piety, the greatest is not having children" (Wei 568). Thus, homosexual relationships were accepted and tolerated in Imperial China as long as they did not hinder these Confucian principles. The most renowned figures who were in same-sex relationships — Emperor Ai of Han, Emperor Wen of Chen, Wei Ling of Wey province — were all married despite their passionate relationships with men, leading to the creation of euphemisms for homosexuality such as "passion of the cut sleeve" and "bitten peach."

It must also be noted that all these renowned individuals were either part of the nobility or belonged to the Imperial family. Lan Wangji was the only heir to one of the four prominent clans in the cultivation society, essentially part of the nobility. With the wealth and social privilege associated with this position, he was free to be part of any kind of relationship — a privilege denied to Mo Xuanyu, who was born as the illegitimate son to an illegitimate daughter of the Mo

Clan. Additionally, having adopted Lan Sizhui as his ward, Lan Wangji had essentially established the advancement of his lineage, thereby fulfilling his duty to his family.

5. Conclusion

Unlike Mo Xuanyu, Lan Wangji and Wei Wuxian neither subverted the familial structure dictated by Confucianism nor did they threaten societal norms. This facilitated them in gaining the tolerance of the cultivation society regarding their relationship. If there were any objections from the Lan Clan, it was predominantly due to Wei Wuxian cultivating using Demonic energy, rather than their queer identities.

To reiterate, Lan Wangji and Wei Wuxian might appear to lead a life far-fetched from reality where they are accepted for who they are and get their happily-ever-after. However, this does not mean that the novel used an inauthentic depiction of homosexuality for the sake of providing its protagonists with a happy life. Through careful considerations, Mo Xiang Tong Xiu utilized various means to make their relationship appear as close to reality as possible. Lan Wangji and Wei Wuxian's relationship conformed to the norms laid by Chinese society. The portrayal of homosexuality in *Mo Dao Zu Shi* is not an impact of globalization, but rather a product of the already existing societal practice. Mo Xiang Tong Xiu portrayed both the ancient and modern attitudes toward the queer community through the characters Lan Wangji, Wei Wuxian, and Mo Xuanyu.

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A COMPARATIVE STUDY ON CARBON EMISSIONS ACROSS TRANSPORT MODES IN INDIA

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Abstract:

The transport sector is one of the major contributors to carbon emissions globally and in India. Understanding the variation in emission levels across different transport modes is important for promoting sustainable mobility. This study compares carbon dioxide emissions per passenger-kilometre among major transport modes including private cars, two-wheelers, buses, metro rail, and conventional rail transport. Secondary data were obtained from internationally recognised transport emission studies and policy reports. Emissions were standardised for a fixed travel distance to ensure comparability. Descriptive statistics and one-way ANOVA were used to analyse differences in emission levels across transport modes. The results show substantial variation in emission intensity, with private vehicles producing considerably higher emissions compared to public transport systems. The findings highlight the environmental advantages of mass transit and support the promotion of sustainable transportation policies.

Keywords: *Carbon emissions, Passenger-kilometre, Transport modes, One-way ANOVA, Sustainable mobility*

1. Introduction

Transportation plays an essential role in economic development and daily mobility. However, it is also a major contributor to greenhouse gas emissions. Globally, the transport sector accounts for nearly one quarter of energy-related carbon dioxide emissions. Rapid urbanisation, population growth and increased private vehicle ownership have significantly increased emissions from transportation systems.

In developing countries such as India, the demand for mobility has risen sharply over the last two decades. Private vehicles, especially cars and two-wheelers, have grown rapidly due to rising incomes and urban expansion. While these vehicles provide convenience and flexibility, they generally produce higher emissions per passenger compared to public transportation systems. Public transport systems such as buses, metro rail, and trains are generally more energy efficient because they carry large numbers of passengers at once, reducing emissions per passenger-kilometre.

Statistical comparison of emissions across transport modes can help identify more sustainable mobility options. By analysing emission intensity per passenger-kilometre, policymakers and planners can understand which transport systems have lower environmental impact. This study focuses on comparing carbon emissions across major transport modes using emission factors reported in recognised transport emission studies.

2. Objectives of the Study

The main objectives of this study are:

- To compare carbon emissions per passenger-kilometre across major transport modes.
- To estimate emissions for a standardised travel distance.
- To examine whether statistically significant differences exist between transport modes using one-way ANOVA.
- To identify relatively more sustainable transport options based on emission levels.

3. Review of Literature

Several studies have analysed the environmental impact of transportation systems. According to the International Energy Agency, the transport sector contributes a large share of global carbon dioxide emissions due to fossil fuel consumption. Research comparing transport modes commonly measures emissions in grams of carbon dioxide per passenger-kilometre, allowing fair comparison between different transport systems while accounting for passenger occupancy.

The Intergovernmental Panel on Climate Change (IPCC) and the International Council on Clean Transportation (ICCT) report that private cars generally produce significantly higher emissions per passenger than mass transit systems. The International Energy Agency (IEA) notes that rail and metro systems typically have lower emission intensity due to higher passenger capacity and electrified operations. Several urban sustainability studies emphasise that shifting from private vehicles to public transport is one of the most effective strategies for reducing transport-related emissions.

4. Data and Methodology

4.1 Data Source

This study uses secondary data obtained from established transport emission studies and policy reports, including the International Energy Agency (IEA) transport emission statistics, Intergovernmental Panel on Climate Change (IPCC) emission factor guidelines, and International Council on Clean Transportation (ICCT) transport emission research. These sources provide widely accepted estimates of carbon emissions per passenger-kilometre for different transport modes: Private Car, Two-Wheeler, Bus, Metro Rail, and Rail Transport.

4.2 Emission Factors

Table 1 shows average emission factors compiled from the above studies.

Table 1: Emission Factors by Transport Mode

Transport Mode	Emission (g CO ₂ per passenger-km)
Car	171
Two-Wheeler	84
Bus	27
Metro	41
Train	14

4.3 Standardisation of Distance

To allow easy comparison across transport modes, emissions were calculated for a fixed travel distance of 10 kilometres using the formula: Emission = Emission factor × Distance.

4.4 Statistical Tools

The following statistical tools were used: Mean, Standard deviation, and One-way Analysis of Variance (ANOVA). Descriptive statistics were used to summarise emission levels. One-way ANOVA was applied to test whether differences between transport modes are statistically significant.

5. Data Analysis

5.1 Emission Estimation for 10 km Travel

Using the emission factors listed earlier, emissions for a 10 km trip were estimated as follows:

Table 2: Emission Estimation for 10 km Travel

Transport Mode	Emission for 10 km (g CO ₂)
Car	1710
Two-Wheeler	840
Bus	270
Metro	410
Train	140

The results show that private cars produce the highest emissions for the same travel distance, while rail transport produces the lowest emissions among the modes considered.

5.2 Descriptive Statistics

Mean emission across transport modes: Mean = $(1710 + 840 + 270 + 410 + 140) / 5 = 674$ grams of CO₂. This indicates that the average emission for a 10 km trip across the transport modes is approximately 674 grams of carbon dioxide.

5.3 Standard Deviation

Standard deviation measures variation among emission values. The calculated value indicates large variation between transport modes, mainly due to the high emission levels associated with private vehicles.

5.4 One-Way ANOVA

Hypothesis: H₀: Mean emission levels are equal across transport modes. H₁: At least one transport mode has a different mean emission level. ANOVA analysis indicates that differences in emission levels across transport modes are statistically significant.

Table 3: ANOVA Table

Source of Variation	Sum of Squares (SS)	df	Mean Square (MS)	F Value
Between Groups	1,821,640	4	455,410	10.94
Within Groups	208,100	5	41,620	
Total	2,029,740	9		

Since the calculated F value is greater than the critical value at the 5% significance level, the null hypothesis is rejected. This indicates that emission levels differ significantly across transport modes.

6. Results and Discussion

The results clearly demonstrate substantial variation in emissions among transport modes. Private cars produce the highest emissions per passenger-kilometre, followed by two-wheelers. Public transport systems such as buses, metro rail, and trains produce significantly lower emissions. These differences are primarily due to passenger capacity — public transport systems carry many passengers simultaneously, distributing emissions across a larger number of individuals.

The findings highlight the environmental advantages of mass transit systems. Encouraging the use of buses, metro systems, and trains could significantly reduce the carbon footprint of urban transportation. Statistical analysis confirms that emission differences across transport modes are not random but represent meaningful variation. Therefore, transportation policy and planning can play a critical role in reducing environmental impacts.

7. Conclusion

Transportation is essential for modern society but contributes significantly to carbon emissions. This study compared carbon emissions across major transport modes using standardised travel distances and statistical analysis. The results show that private vehicles generate considerably higher emissions compared to public transportation systems. Rail transport and buses show the lowest emissions due to higher passenger capacity and operational efficiency.

Promoting sustainable transportation systems and encouraging greater use of public transport can help reduce overall carbon emissions. Improved transit infrastructure and policies supporting mass transportation may contribute significantly to environmental sustainability. Future research may incorporate larger datasets, city-level comparisons and long-term emission trends to provide deeper insights into sustainable transportation planning.

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**JOINT MODEL FOR PREDICTING THE RISK FOR RECURRENCE IN
COLORECTAL CANCER WITH A COMPETING EVENT**
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Abstract:

In this paper, we study the relationship between longitudinal biomarker trajectories and time-to-event outcomes in colorectal cancer patients using a joint modeling framework with competing risks. Carcinoembryonic antigen (CEA) is an important biomarker used in monitoring disease progression and recurrence in colorectal cancer. Traditional approaches often analyze longitudinal biomarker measurements and survival outcomes separately, which may lead to biased or inefficient estimates. Joint modeling provides a unified framework that simultaneously analyzes longitudinal and survival data through shared random effects, allowing a better understanding of the association between biomarker evolution and event risk. In colorectal cancer follow-up studies, patients may experience recurrence or death, where death acts as a competing risk for recurrence. This study investigates the association between longitudinal CEA trajectories and the risks of recurrence and death using joint modeling with competing risks. Furthermore, the joint modeling framework also supports dynamic prediction, enabling updated individualized risk estimates as new biomarker information becomes available during follow-up.

Keywords: *CEA Biomarker, Colorectal Cancer, Competing Risks, Dynamic Prediction, Joint Modeling.*

1. Introduction

Colorectal cancer is the third most common cancer in developed countries and the second leading cause of cancer-related mortality worldwide (GLOBOCAN 2022). Carcinoembryonic antigen (CEA) is a widely used tumor biomarker in colorectal cancer. Traditionally, longitudinal outcomes such as repeated CEA measurements have been analyzed using linear mixed-effects models (Laird and Ware, 1982), and time-to-event outcomes such as recurrence or death have been modeled using survival analysis techniques such as the Cox proportional hazard model.

However, analyzing longitudinal and survival processes independently can lead to biased or inefficient estimates.

To address these limitations, Wulfsohn and Tsiatis (1997) introduced the joint modeling framework for longitudinal and survival data, proposing a shared-parameter approach in which both processes are linked through common latent random effects. In the context of colorectal cancer, joint models are particularly useful for understanding how evolving CEA levels influence the risks of recurrence and death. Furthermore, such models enable dynamic prediction, whereby individual risk estimates are updated as new biomarker information becomes available.

In cancer research, patients are at risk of experiencing multiple possible events, giving rise to a competing risks setting. A competing risk is an event whose occurrence precludes the occurrence of the primary event of interest. In colorectal cancer follow-up, patients may experience recurrence or death where death may act as a competing risk for recurrence. Extending joint models to incorporate competing risks enables the simultaneous evaluation of longitudinal biomarker trajectories, recurrence, and death, while accounting for their interdependence (Teixeira et al., 2019). The objective of this study is to investigate the association between longitudinal CEA trajectories and the risks of recurrence and death in colorectal cancer patients using joint modeling with competing events, and to evaluate the use of joint models for individualized dynamic prediction.

2. Methodology

In the present study, data on colorectal cancer patients were obtained from the Regional Cancer Centre, Thiruvananthapuram. The study included 357 colorectal cancer patients. Repeated measurements of carcinoembryonic antigen (CEA) values were collected during follow-up, resulting in multiple observations per patient. The event of interest was cancer recurrence, while death was treated as a competing event.

2.1 Longitudinal Sub-Model

A longitudinal sub-model is a statistical model used to analyze longitudinal data over time. Longitudinal data consist of repeated measurements collected from the same individuals over time, and these measurements are correlated within each patient. To properly account for this correlation, linear mixed-effects models are used which include both fixed effects and random effects. The longitudinal model can be expressed as: $y_i(t) = x_i(t)\beta + z_i(t)b_i + \varepsilon_i(t)$, where y_i is the vector of longitudinal responses for subject i , β is a vector of fixed effects, b_i is a vector of random effects with $b_i \sim N(0, D)$, and ε_i is a random error.

2.2 Survival Sub-Model

Let T_i^* denote the true event time for the i th subject, T_i the observed event time, and C_i the potential censoring time, where $T_i = \min(C_i, T_i^*)$. The hazard function, also referred to as the instantaneous risk function, represents the instantaneous risk of experiencing an event. The Cox proportional hazards model is the most widely used multivariable approach for analyzing survival data, relating the hazard function at time t to a set of covariates: $\lambda_i(t) = \lambda_0(t) \exp(w_i^T \gamma)$, where $\lambda_0(t)$ denotes the baseline hazard function, w_i is the vector of covariates, and γ is the vector of regression coefficients.

2.3 Joint Model for Longitudinal Biomarker and Competing Risk Survival Outcome

Joint models for longitudinal and time-to-event data bring these longitudinal and survival data simultaneously into a single model so that one can infer the dependence and association between the longitudinal biomarker and time to event. This approach jointly models the repeated measurements of biomarker values and the time-to-event outcome (recurrence) in the presence of competing risk (death). For each of the K causes, a standard relative risk model that jointly accounts for the longitudinal outcome and competing risks survival events is given by: $\lambda_{ik}(t | w_i, M_i(t)) = \lambda_{0k}(t) \exp(w_i \gamma_k + \alpha_k m_i(t))$, where $M_i(t)$ denotes the longitudinal history, γ_k represents the cause-specific regression coefficients, and α_k quantifies the strength of the association between the longitudinal biomarker and the risk of the event.

2.4 Joint Likelihood Formulation

The main estimation method proposed for the joint model is maximum likelihood. The joint density of the observed event time, censoring indicator, and longitudinal responses for subject i , conditional on the random effects b_i , is given by $P(T_i, \delta_i, y_i | b_i; \theta) = P(T_i, \delta_i | b_i; \theta) P(y_i | b_i; \theta)$, where $\theta = (\theta_t, \theta_y, \theta_b)$ denotes the full parameter vector. Since the random effects b_i are unobserved, the likelihood based on the observed data is obtained by marginalizing over b_i . Maximization of the log-likelihood function is computationally challenging because the integrals over the random effects and the survival function do not have closed-form solutions. Therefore, standard numerical integration techniques such as Gaussian quadrature are employed. A flexible parametric model for the baseline hazard function using B-splines was proposed by Rizopoulos (2010). All statistical analyses were performed using R version 4.3.1 with the package JM for joint modeling with competing risks.

2.5 Dynamic Prediction in Joint Model

Dynamic prediction refers to the estimation of an individual's future risk of experiencing an event, conditional on all information available up to a given prediction time. In the context of

joint modeling of longitudinal and time-to-event data, dynamic prediction takes advantage of the association between the longitudinal biomarker process and the survival process to continuously update risk estimates as new biomarker measurements become available. Let $y_j(t) = \{y_j(s) : 0 \leq s \leq t\}$ denote the observed longitudinal biomarker history for subject j up to time t . These measurements summarize the patient's biomarker trajectory available up to time t .

3. Results

This section presents the results of the joint modeling analysis conducted to evaluate the relationship between longitudinal CEA measurements and competing risk survival outcomes in colorectal cancer patients. The results for joint modeling with competing risk suggest that the longitudinal CEA trajectory showed a strong association with both recurrence and death, indicating that CEA acts as an important dynamic prognostic biomarker.

The association parameter for recurrence was positive and highly statistically significant (HR = 1.437, 95% CI: 1.279–1.615, $p < 0.0001$). This indicates that higher underlying CEA levels were strongly associated with an increased risk of cancer recurrence. Specifically, a one-unit increase in the latent log-CEA trajectory was associated with approximately a 44% increase in the hazard of recurrence, after adjusting for baseline covariates and individual-level variability.

The association parameter for death was positive and highly statistically significant (HR = 1.733, 95% CI: 1.523–1.973, $p < 0.0001$), with each one-unit increase in log-transformed CEA associated with approximately a 73% increase in mortality risk. Overall, disease stage was the most influential factor affecting both longitudinal CEA trajectories and event outcomes. Advanced-stage disease was associated with higher longitudinal CEA levels and a significantly increased risk of death.

Table 1: Parameter Estimates of Joint Model with Competing Risks for Longitudinal and Event Process

Variables	Estimates	95% CI	P value
Longitudinal Process			
Age	-0.013	-0.030 – 0.003	0.1292
Sex (Male vs Female)	0.217	-0.170 – 0.604	0.2724
Stage (Advanced vs Early)	1.291	0.812 – 1.771	< 0.0001
Family History (Yes vs No)	-0.345	-0.881 – 0.191	0.2066
Comorbidity (Yes vs No)	-0.036	-0.437 – 0.364	0.8591

Event Process			
Variables	Hazard Ratio	95% CI	P value
Recurrence			
Age	0.991	0.974 – 1.008	0.3177
Sex (Male vs Female)	1.233	0.837 – 1.817	0.2876
Stage (Advanced vs Early)	1.340	0.839 – 2.170	0.2166
Family History (Yes vs No)	0.992	0.594 – 1.657	0.9746
Comorbidity (Yes vs No)	1.203	0.813 – 1.779	0.3543
Association (Recurrence)	1.441	1.279 – 1.623	< 0.0001
Death			
Age	1.015	0.989 – 1.041	0.2476
Sex (Male vs Female)	0.972	0.548 – 1.725	0.9236
Stage (Advanced vs Early)	1.784	0.799 – 3.979	0.1573
Family History (Yes vs No)	0.759	0.335 – 1.717	0.5081
Comorbidity (Yes vs No)	0.601	0.339 – 1.066	0.0820

Table 2: Parameter Estimates of Joint Model for Longitudinal Process and Recurrence as Event

Variables	Estimates	95% CI	P-value
Longitudinal Process			
Age	-0.013	-0.030–0.003	0.1257
Sex (Male vs Female)	0.219	-0.168–0.607	0.2671
Stage (Advanced vs Early)	1.285	0.805–1.765	< 0.0001
Family History (Yes vs No)	-0.342	-0.878–0.193	0.2107
Comorbidity (Yes vs No)	-0.025	-0.425–0.375	0.9023
Event Process (Recurrence)			
Variables	Hazard Ratio	95% CI	P-value

Age	0.991	0.974–1.008	0.3266
Sex (Male vs Female)	1.227	0.833–1.807	0.2996
Stage (Advanced vs Early)	1.336	0.831–2.149	0.2313
Family History (Yes vs No)	0.995	0.595–1.662	0.9847
Comorbidity (Yes vs No)	1.208	0.817–1.788	0.3423
Association (Recurrence)	1.437	1.279–1.615	< 0.0001

Table 3: Parameter Estimates of Joint Model for Longitudinal Process and Death as Event

Variables	Estimates	95% CI	P-value
Longitudinal Process			
Age	−0.013	−0.030–0.003	0.1283
Sex (Male vs Female)	0.220	−0.168–0.609	0.2671
Stage (Advanced vs Early)	1.295	0.813–1.777	< 0.0001
Family History (Yes vs No)	−0.343	−0.881–0.194	0.2108
Comorbidity (Yes vs No)	−0.035	−0.437–0.366	0.8630
Event Process (Death)			
Variables	Hazard Ratio	95% CI	P-value
Age	1.008	0.989–1.028	0.3773
Sex (Male vs Female)	1.227	0.793–1.899	0.3563
Stage (Advanced vs Early)	2.541	1.304–4.950	0.0061
Family History (Yes vs No)	0.753	0.393–1.441	0.3922
Comorbidity (Yes vs No)	0.728	0.473–1.121	0.1501
Association (Death)	1.733	1.523–1.973	< 0.0001

Figures 1, 2, and 3 present individualized dynamic predictions for three selected patients (Subjects 2, 10, and 15) obtained from the joint model without competing risk with recurrence as the event. In each panel, the observed longitudinal CEA measurements are shown as points, the fitted longitudinal trajectory is shown by the red solid line, and the predicted survival probability

over time is displayed on the secondary y-axis. The vertical dashed line represents the last available biomarker measurement used as the landmark time for prediction.

For Subject 2, the observed CEA measurements prior to the prediction time remain comparatively stable and at lower levels. As a result, the predicted survival probability remains high for a longer duration after the prediction time and declines more gradually over follow-up. Subject 10 exhibited moderately increased CEA levels with noticeable fluctuations before the landmark time, showing an intermediate survival pattern with a gradual decline. For Subject 15, relatively high CEA levels are observed in follow-up, followed by a steep decline in the predicted survival probability after the landmark time, indicating that elevated underlying CEA values are associated with a higher future risk of the event.

4. Conclusion

This study demonstrates that joint modeling of longitudinal CEA measurements and time-to-event outcomes such as recurrence and death, particularly when accounting for death as a competing risk, provides a robust and clinically meaningful framework for understanding disease progression, improving prognostic assessment, and supporting personalized risk prediction in colorectal cancer.

The limitations of this study include that the analysis was conducted on a sample dataset drawn from a larger pool of data, which may have limited the statistical power to detect significant effects of baseline covariates. Dynamic prediction was implemented for joint models without competing risk; dynamic prediction under joint models with competing risks could not be evaluated due to the lack of available implementation in standard statistical software. Future research is needed to validate these findings using larger and more diverse datasets and to further investigate the role of baseline clinical factors alongside longitudinal biomarkers.

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**A STUDY ON DIFFERENT RANKING TECHNIQUES TO SOLVE THE
TRAPEZOIDAL FUZZY TRANSPORTATION PROBLEM**

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Abstract:

This paper discusses fuzzy ranking function methods for optimizing multi-criteria decision-making problems. Ranking is a significant step in decision-making models, which help to identify the attributes that have the greatest influence on the final decision. This work provides a detailed description of the potential of fuzzy ranking models to optimize real-world problems. The contents herein present comparative examples demonstrating the usage and advantages of the ranking method for fuzzy numbers. A comparison has been made, and it has been concluded that the Incenter method gives better results than the discussed ranking methods.

Keywords: *Trapezoidal Fuzzy Number, Optimization, Ranking function, Transportation Problem*

1. Introduction

The transportation problem has many applications in solving problems of the real world. Parameters of the transportation problem consist of amounts of cost, supply and demand. In the usual form of this problem the parameters are fixed and definitive but in the real world the parameters are ambiguous and imprecise [2, 3]. Later, fuzzy set theory was introduced by Zadeh in 1965, and fuzzy set problems were studied in relation to the real world. The idea of fuzzy set theory addresses uncertainty and ambiguity in real-world scenarios. Bellman and Zadeh [12] expanded on the idea of making decisions within a fuzzy context.

Fuzzy sets, introduced by Lotfi Zadeh in 1965, are an extension of traditional set theory. Classical set theory permits the inclusion of elements in the set in binary terms, whereas fuzzy set theory allows membership functions that take values within the range [0,1]. A fuzzy set is characterized as a collection where each element is accompanied by a membership grade. There are many different types of fuzzy numbers, such as triangular and trapezoidal, but trapezoidal fuzzy numbers can represent a wider range of values, making them useful in a variety of applications.

The ranking method is one of the available defuzzification methods. Centroid based methods were intensively studied and used in solving numerous decision-making problems. Yager was the

first researcher who contributed the concept of centroid in ranking fuzzy numbers, followed by Murakami et al., who first presented the X and Y coordinates of centroid points as the ranking index in 1983. Phani Bushan Rao et al. [9, 10] proposed the centroid formula for finding the centre of gravity of generalized trapezoidal fuzzy numbers using circumcenter of centroids, orthocenter of centroids [11], incenter of centroids and centroid of centroids. In this paper, Sections 2 and 3 discuss different ranking functions for defuzzification. Section 4 applies three different ranking function methods to formulate a real-world transportation problem into a fuzzy linear programming problem. Section 5 concludes with a comparison.

2. Preliminaries

Definition 1

The problems involving fuzzy numbers for the decision variables, the coefficients of the decision variables in the objective function, the coefficients of the decision variables in the constraints and the right-hand side of the constraints is called fully fuzzy linear programming problems.

Definition 2

A fuzzy transportation problem is a transportation problem in which the transportation costs, supply and demand are fuzzy quantities.

Definition 3: Generalized Trapezoidal Fuzzy Number

A fuzzy number $\tilde{A} = (a, b, c, d; w)$ is said to be a generalized trapezoidal fuzzy number [13] if its membership function is given by: $\mu_A(x) = w((x - a)/(b - a))$ for $a \leq x \leq b$; w for $b \leq x \leq c$; $w((x - d)/(c - d))$ for $c \leq x \leq d$; and 0 otherwise.

Defuzzification

Defuzzification [1] is the process of converting a fuzzified output into a single crisp value with respect to a fuzzy set. Ranking function method is also one of the defuzzification methods which converts fuzzy values into crisp ones. Some of the most important ranking methods [5, 6] are: α -cut method, Yager's ranking method, Sub-interval average method, Sub-interval addition method, Pascal triangular graded mean method, Magnitude Ranking method, centroid of centroids method, median method, and circumcenter of centroids method.

3. Ranking Methods

Ranking Method 1: Centroid of Centroids

For generalized trapezoidal fuzzy number $\tilde{A} = (a, b, c, d; w)$, the centroid of centroids [4] is given by $G(^{#}5_0, ^{#}6_0) = ((4a + 5b + 5c + 4d)/18, 5w/9)$. Its Ranking Function is defined as: $R(\tilde{A}) = (4a + 5b + 5c + 4d)/18 \dots (1)$

Ranking Method 2: Median Method

The defuzzification of trapezoidal fuzzy number using median [15] is as follows. For the trapezoidal fuzzy number $\tilde{A} = (a, b, c, d)$, the median $M_A = (a + b + c + d)/4$. Its Ranking Function is defined as: $R(\tilde{A}) = (a + b + c + d)/4 \dots (2)$

Ranking Method 3: Circumcenter of Centroids

For generalized trapezoidal fuzzy number $\tilde{A} = (a, b, c, d; w)$, the circumcenter of centroids [14] is given by $S_A = ((a + 2b + 2c + d)/6, ((2a + b - 3c)(2d + c - 3b) + 5w^2)/(12w))$. Its Ranking Function is defined as: $R(\tilde{A}) = (a + 2b + 2c + d)/6 \dots (3)$

4. Problem

A motorcycle company has three factories S_1, S_2, S_3 which every week do production activity with capacities respectively of $(40,50,60,70)$, $(80,90,60,70)$ and $(80,100,120,140)$ motorcycle units. The company supplies motorcycles to showrooms located at three destinations D_1, D_2, D_3 which have demand of $(30,40,50,60)$, $(90,95,100,105)$ and $(55,65,75,85)$ motorcycle units respectively. Transportation costs per motor unit are presented in Table 1. Determine the minimum transportation cost of motor shipment from factory to showroom [8].

Table 1: Transportation Costs per Motor Unit

Company	D_1	D_2	D_3	S_i
S_1	(6,8,14,16)	(8,9,10,11)	(5,7,11,13)	(40,50,60,70)
S_2	(1,3,7,9)	(2,4,12,14)	(7,9,1,13)	(80,90,60,70)
S_3	(16,18,22,24)	(6,7,8,9)	(6,7,8,9)	(80,100,120,140)
d_j	(30,40,50,60)	(90,95,100,105)	(55,65,75,85)	

Ranking Method 1: Centroid of Centroids

Using the ranking function in equation (1), the values of $R(t_{ij})$, $R(a_i)$ and $R(b_j)$ for all i and j are calculated. The table is unbalanced, so a dummy column D_4 is introduced to make it balanced.

Table 2 & 3: Unbalanced and Balanced Transportation Tables (Method 1)

Company	D ₁	D ₂	D ₃	D ₄ (Dummy)	S _i
S ₁	11	9.5	9	0	55
S ₂	5	8	7.2	0	75
S ₃	20	7.5	7.5	0	110
d _j	45	98	75	22	240

The above crisp multi-objective transportation problem is converted into the following crisp linear programming problem:

$$\text{Minimize } 11x_{11} + 9.5x_{12} + 9x_{13} + 0x_{14} + 5x_{21} + 8x_{22} + 7.2x_{23} + 0x_{24} + 20x_{31} + 7.5x_{32} + 7.5x_{33} + 0x_{34}$$

$$\text{Subject to: } x_{11} + x_{21} + x_{31} = 45; x_{12} + x_{22} + x_{32} = 98; x_{13} + x_{23} + x_{33} = 75; x_{14} + x_{24} + x_{34} = 22; x_{11} + x_{12} + x_{13} + x_{14} = 55; x_{21} + x_{22} + x_{23} + x_{24} = 75; x_{31} + x_{32} + x_{33} + x_{34} = 110$$

Using TORA software, the optimal solution is: $x_{21} = 45$, $x_{32} = 98$, $x_{13} = 33$, $x_{33} = 12$, $x_{23} = 30$, $x_{14} = 22$. The overall minimum transportation cost is Rupees 1563.

Ranking Method 2: Median Method

Using the ranking function in equation (2), the values are calculated and the balanced table is as follows:

Table 4 & 5: Unbalanced and Balanced Transportation Tables (Method 2)

Company	D ₁	D ₂	D ₃	D ₄ (Dummy)	S _i
S ₁	11	9.5	9	0	55
S ₂	5	8	7.5	0	75
S ₃	20	7.5	7.5	0	110
d _j	45	98	70	27	240

The above crisp multi-objective transportation problem is converted into the following crisp linear programming problem:

Minimize $11x_{11} + 9.5x_{12} + 9x_{13} + 0x_{14} + 5x_{21} + 8x_{22} + 7.5x_{23} + 0x_{24} + 20x_{31} + 7.5x_{32} + 7.5x_{33} + 0x_{34}$

Subject to: $x_{11} + x_{21} + x_{31} = 45$; $x_{12} + x_{22} + x_{32} = 98$; $x_{13} + x_{23} + x_{33} = 70$; $x_{14} + x_{24} + x_{34} = 27$; $x_{11} + x_{12} + x_{13} + x_{14} = 55$; $x_{21} + x_{22} + x_{23} + x_{24} = 75$; $x_{31} + x_{32} + x_{33} + x_{34} = 110$

Using TORA software, the optimal solution is: $x_{21} = 45$, $x_{32} = 98$, $x_{13} = 28$, $x_{33} = 12$, $x_{23} = 30$, $x_{14} = 27$. The overall minimum transportation cost is Rupees 1527.

Ranking Method 3: Circumcenter of Centroids

Using the ranking function in equation (3), the values are calculated and the balanced table is as follows:

Table 6 & 7: Unbalanced and Balanced Transportation Tables (Method 3)

Company	D ₁	D ₂	D ₃	D ₄ (Dummy)	S _i
S ₁	11	9.5	9	0	55
S ₂	5	8	6.7	0	75
S ₃	20	7.5	7.5	0	110
d _j	45	98	70	27	240

The above crisp multi-objective transportation problem is converted into the following crisp linear programming problem:

Minimize $11x_{11} + 9.5x_{12} + 9x_{13} + 0x_{14} + 5x_{21} + 8x_{22} + 6.7x_{23} + 0x_{24} + 20x_{31} + 7.5x_{32} + 7.5x_{33} + 0x_{34}$

Subject to: $x_{11} + x_{21} + x_{31} = 45$; $x_{12} + x_{22} + x_{32} = 98$; $x_{13} + x_{23} + x_{33} = 70$; $x_{14} + x_{24} + x_{34} = 27$; $x_{11} + x_{12} + x_{13} + x_{14} = 55$; $x_{21} + x_{22} + x_{23} + x_{24} = 75$; $x_{31} + x_{32} + x_{33} + x_{34} = 110$

Using TORA software, the optimal solution is: $x_{21} = 45$, $x_{32} = 98$, $x_{13} = 28$, $x_{33} = 12$, $x_{23} = 30$, $x_{14} = 27$. The overall minimum transportation cost is Rupees 1503.

5. Conclusion

The minimum transportation cost of motor shipment from factory to showroom obtained by Centroid of centroid method, Median method and Incenter method is Rupees 1563, Rupees 1527, and Rupees 1503 respectively. The Incenter method obtained the minimum transportation cost of motor shipment from factory to showroom for Trapezoidal fuzzy numbers, performing better than both the Median method and the Centroid of centroid method.

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BUILDING NEUROETHICS-AI TOOLS GROUNDED IN MORAL PHILOSOPHY: A TIRUKKURAL - INSPIRED FRAMEWORK

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Abstract

The intersection of Artificial Intelligence (AI) and neuroscience has intensified ethical concerns regarding autonomy, privacy, accountability, and moral reasoning. While existing frameworks in neuroethics rely predominantly on Western philosophical traditions, there is a growing need for culturally inclusive ethical models. This paper develops a novel framework for neuroethics-AI tools grounded in the ethical philosophy of the Tirukkural by Thiruvalluvar. Integrating classical ethical categories—virtue (aram), governance (porul), and human well-being (inbam)—with contemporary AI ethics, the study proposes a human-centered, culturally rooted approach to ethical AI design. Drawing from contemporary discussions on AI ethics, including issues of bias, accountability, and moral decision-making, the paper highlights the limitations of machine ethics and the necessity of embedding moral philosophy into technological systems. The framework offers practical applications in neurotechnology, governance, and healthcare AI.

Keywords

Neuroethics, Artificial Intelligence, Tirukkural, Moral Philosophy, Algorithmic Bias, Cognitive Liberty, Ethical AI, AI Governance, Indian Philosophy

1. INTRODUCTION

Artificial Intelligence is increasingly integrated into domains requiring ethical decision-making, such as healthcare, transportation, and criminal justice. These developments raise a fundamental question: can machines make moral decisions? As highlighted in contemporary discourse, AI systems often face ethical dilemmas similar to the classical “trolley problem,” where decisions involve competing moral outcomes.

Unlike humans, whose ethical reasoning involves empathy, contextual understanding, and moral reflection, AI systems operate through algorithms and data patterns. This creates a gap between computational efficiency and moral judgment. The Tirukkural provides a timeless ethical framework that can address this gap by grounding AI in human-centered moral philosophy.

2. LITERATURE REVIEW

2.1 Ethical Decision-Making in AI

Ethical decision-making involves balancing values such as fairness, justice, and the greater good. However, translating these into algorithms is highly complex because machines lack empathy and contextual awareness. While AI can assist in decision-making, it cannot replicate human moral reasoning.

Philosophical approaches such as:

- Deontology (duty-based ethics)
- Utilitarianism (maximizing overall good)

are often used to guide AI design, yet they remain insufficient in capturing cultural and emotional dimensions of ethics.

2.2 Algorithmic Bias and Fairness

One of the most critical ethical issues in AI is algorithmic bias. AI systems often reproduce societal inequalities due to biased training data, leading to unfair outcomes in hiring, policing, and facial recognition systems. This highlights the urgent need for ethical frameworks ensuring justice and inclusivity.

2.3 Privacy, Autonomy, and Accountability

AI systems rely on vast datasets, raising concerns about privacy and surveillance. Additionally, the increasing reliance on AI threatens human autonomy, as decision-making shifts from humans to machines. Accountability becomes ambiguous when AI systems cause harm, creating ethical and legal challenges.

2.4 Ethical Philosophy of Tirukkural

The Tirukkural offers a universal ethical system divided into:

- Aram (Virtue) – moral conduct
- Porul (Governance) – justice and societal order

- Inbam (Human well-being) – emotional and relational ethics

These principles provide a holistic ethical foundation applicable to AI systems.

3. THEORETICAL FRAMEWORK

3.1 Aram: Moral Integrity in AI

Aram emphasizes righteousness and non-harm. AI systems must:

- Avoid harmful outcomes
- Ensure fairness
- Respect human dignity

This directly addresses concerns about biased and harmful AI decisions.

3.2 Porul: Governance and Ethical Regulation

Porul aligns with modern AI governance:

- Transparency in algorithms
- Accountability mechanisms
- Regulatory compliance

As noted, lack of explainability in AI (“black box” systems) undermines trust and accountability.

3.3 Inbam: Human-Centered Design

Inbam focuses on empathy and well-being. Since AI lacks emotional intelligence, ethical frameworks must ensure:

- Human oversight
- Psychological safety
- Social harmony

4. PROPOSED NEUROETHICS-AI FRAMEWORK

4.1 Core Ethical Principles

- Cognitive Liberty – Protection of mental privacy
- Fairness – Elimination of bias
- Transparency – Explainable AI systems
- Accountability – Clear responsibility structures
- Compassion – Human-centered outcomes

4.2 Ethical Architecture Model

- Input Layer: Ethical principles (Tirukkural-based)
- Processing Layer: AI algorithms with ethical constraints
- Output Layer: Fair, explainable decisions

4.3 Ethical Decision Cycle

- Ethical Data Collection
- Bias Detection and Correction
- Transparent Decision-Making
- Human Oversight and Feedback

5. APPLICATIONS

5.1 Neurotechnology

- Brain-computer interfaces
- Neural data privacy systems

5.2 Healthcare AI

AI systems must not replace human judgment, especially in life-and-death decisions, as machines lack empathy and contextual understanding.

5.3 AI Governance

- Policy frameworks for ethical AI
- Bias audits and compliance mechanisms

6. DISCUSSION

The integration of Tirukkural ethics into AI addresses key limitations identified in contemporary AI systems:

- Lack of empathy
- Bias and unfairness
- Weak accountability structures

The framework ensures that AI aligns with human values rather than merely optimizing efficiency. It also introduces cultural diversity into global AI ethics discourse.

7. CONCLUSION

AI development is not merely a technological challenge but a moral one. As highlighted in contemporary ethical discussions, machines cannot fully replicate human moral reasoning or empathy. Therefore, embedding ethical philosophy into AI systems is essential.

The Tirukkural provides a powerful and culturally rich ethical foundation for designing responsible neuroethics-AI tools. By integrating virtue, governance, and human well-being, this framework contributes to building ethical, transparent, and human-centered AI systems.

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**MULTI-SPORT ATHLETES: ADVANCED YET ACCESSIBLE
TRAINING METHODS TO MAXIMIZE SKILL TRANSFER AND
MINIMIZE OVERUSE RISK FOR GENERAL ATHLETES**

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Abstract

Multi-sport participation is one of the pillars of long-term athletic development particularly in the young, high school, collegiate, and recreational athletes. Although studies continue to affirm its positive effects such as the improvement of motor skills, a decrease in the number of injuries, and prolonged motivation, the multi-sport athletes are exposed to special difficulties: competing physical loads, overtraining, and increased risk of overuse.

This paper will provide evidence based advanced training practices that are practical in application to general non elite multi-sport athletes. Going beyond the elite level protocols with the need of the lab or specialist, we point to the scalable approaches based on periodization, autoregulation, movement literacy and recovery integration. The practical advice is in terms of case examples, a sample weekly plan, and checklists of implementation that will be offered to athletes and coaches. No specialization is required- but smart diversification: 1 productive, flexible, and sustainable athletes who can deliver results in amateur and professional sport.

***Keywords:** Multi-sport athlete, transfer of skills, prevention of overuse injury, General Physical Preparedness (GPP), auto regulated training, periodization, youth sport, long term development of athletes.*

1. INTRODUCTION

In an era increasingly dominated by early sport specialization, the multi-sport athlete stands as a compelling counter-model. Studies show that multi-sport participation during adolescence correlates with higher rates of collegiate and professional athletic achievement (Carlisle et al., 2022), lower injury risk (Post et al., 2017), and greater sport longevity (Güllich, 2017). Yet, for the general athlete—balancing academics, work, family, and two or more sports—the path is rarely straightforward. Fatigue accumulates silently. Shoulder strain from swimming

compounds stress from baseball pitching. Ankle instability from basketball landslides into soccer pivots. Traditional training advice (“just lift and run”) falls short.

What’s needed is not more training—but smarter, integrated training. This paper defines advanced training methods not by their technological complexity, but by their scientific grounding, adaptability, and effectiveness for real-world multi-sport contexts. We focus on approaches that:

- Leverage positive skill transfer (e.g., agility in soccer enhancing court coverage in tennis)
- Actively mitigate overuse through joint resilience and load management
- Respect recovery as performance, not luxury are feasible without access to sports scientists or six-figure budgets

Our audience involves adult people who are training for races while coaching youth soccer, college students balancing club rugby and intramural volleyball, and high school athletes engaged in football and track. For them, consistency, well-being, and fulfillment are greater signs of excellence than wins.

2. THE SCIENCE OF MULTI-SPORT PARTICIPATION: BENEFITS AND RISKS

2.1. Documented Benefits

Motor Skill Diversification: Exposure to varied movement patterns (rotation, locomotion, object control) builds a robust “movement vocabulary” (Baker et al., 2022). **Reduced Injury Incidence:** Multi-sport athletes exhibit 30–50% lower rates of overuse injuries (e.g., ACL tears, stress fractures) vs. early specialists (Jayanthi et al., 2015). **Psychological Resilience:** Cross-sport engagement reduces burnout and identity foreclosure (Côté et al., 2021). **Long-Term Athletic Development (LTAD):** Late specialization (post-puberty) correlates with higher performance ceilings in late adolescence (Güllich, 2022).

2.2. Key Challenges

2.3. Conflicting Physical Demands:

Example: Baseball (unilateral, rotational, and shoulder-dominant) + Distance running (repetitive impact, hip flexor dominance) → synergistic fatigue in posterior chain & core.

Cumulative Load: Back-to-back games, overlapping seasons, and travel amplify physiological stress.

Skill Interference: Poorly timed technical work (e.g., basketball shooting mechanics vs. baseball swing path) can create neuromuscular “noise.”

Recovery Deficit: Sleep, nutrition, and mental downtime often sacrificed to “fit it all in.”

Key Insight: The goal is complementarity, not competition—designing training so Sport A fuels Sport B.

3. FOUNDATIONAL PRINCIPLES FOR MULTI-SPORT TRAINING

Before advancing, anchor in evidence-based fundamentals:

Principle	Principle	Principle
General Physical Preparedness (GPP)	General Physical Preparedness (GPP)	General Physical Preparedness (GPP)
Builds baseline strength, work capacity, and movement efficiency—essential for sport-specific work	Builds baseline strength, work capacity, and movement efficiency—essential for sport-specific work	Builds baseline strength, work capacity, and movement efficiency—essential for sport-specific work
2x/week full-body resistance training: squat/hinge, push/pull, carry/core	2x/week full-body resistance training: squat/hinge, push/pull, carry/core	2x/week full-body resistance training: squat/hinge, push/pull, carry/core
Movement Literacy	Movement Literacy	Movement Literacy

4. ADVANCED (BUT ACCESSIBLE) TRAINING METHODS

4.1. Transfer-Oriented Strength & Power Development Goal: Build attributes that serve multiple sports. Compound Lifts with Intent Cues

Trap Bar Deadlift: Emphasize “drive through heels, snap hips” → benefits jumping (volleyball), sprinting (track), and tackling (rugby).

Single-Arm Overhead Press: Unilateral stability + scapular control → supports throwing, serving, and overhead striking.

Contrast (Complex) Training

Pair a heavy strength movement with a biomechanically similar explosive movement: Back Squat (3 reps @ 85% 1RM) → 30-sec rest → Box Jump (3 reps)

Why it works: Post-activation potentiation (PAP) enhances rate of force development (RFD).

Frequency: 1x/week during off-season or early in-season; avoid pre-competition.

4.2. Overuse Injury Prevention: Beyond Stretching

Target high-risk joints with sport-specific resilience work.

Shoulder Resilience Protocol (for swimmers, throwers, racquet athletes):

Daily: Band pull-apart (3x15), scapular push-ups (2x10), sleeper stretch (2x30 sec/side)

Weekly: Eccentric external rotation (band, slow 4-sec return) 2x10

Knee & Ankle Integrity (for runners, jumpers, cutters):

Nordic Hamstring Curls: 2x5 (eccentric focus) → 51% ↓ hamstring injury risk (van Dyk et al., 2019)

Single-Leg RDL to Balance: 3x8/side → improves hip-knee-ankle alignment, Load

Monitoring – Simplified, Use Session-RPE Method (Foster, 1998): Weekly Load = Σ (RPE

1–10 × Duration in minutes) Safe progression: ≤10% weekly increase, Red flag: Acute:

Chronic Workload Ratio >1.5 → 2–4x ↑ injury risk (Murray et al., 2017)

4.3. Purposeful Cross-Training

Replace “filler” cardio with transfer-rich conditioning.

Sport Pair	Purposeful Cross-Training	Avoid
Soccer + Basketball	Soccer + Basketball	Soccer + Basketball
Sled pushes (linear power), lateral med ball throws (rotation), repeat 20-m sprints (alactic capacity)	Sled pushes (linear power), lateral med ball throws (rotation), repeat 20-m sprints (alactic capacity)	Sled pushes (linear power), lateral med ball throws (rotation), repeat 20-m sprints (alactic capacity)
Excessive vertical jump volume in both sessions same week	Excessive vertical jump volume in both sessions same week	Excessive vertical jump volume in both sessions same week

4.4. Integrated Recovery: The 3 R’s Framework

Recovery is not passive—it’s active preparation for the next demand.

R	Action	Evidence-Based Protocol
Refuel	Refuel	Refuel
Restore glycogen, repair tissue	Restore glycogen, repair tissue	Restore glycogen, repair tissue

Within 45 min: 0.3–0.5 g/kg carbs + 20–30 g protein (e.g., chocolate milk, banana + Greek yogurt)	Within 45 min: 0.3–0.5 g/kg carbs + 20–30 g protein (e.g., chocolate milk, banana + Greek yogurt)	Within 45 min: 0.3–0.5 g/kg carbs + 20–30 g protein (e.g., chocolate milk, banana + Greek yogurt)
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5. Sample Weekly Training Plan (Balanced & Flexible)

For a high school athlete playing Varsity Soccer (Aug–Nov) and Club Basketball (Nov–Feb), overlapping in Nov.

Day	AM	PM	Notes
Mon	Mon	Mon	Mon
Soccer Practice (90 min)	Soccer Practice (90 min)	Soccer Practice (90 min)	Soccer Practice (90 min)
GPP Strength (full-body) + Mobility Flow (30 min)	GPP Strength (full-body) + Mobility Flow (30 min)	GPP Strength (full-body) + Mobility Flow (30 min)	GPP Strength (full-body) + Mobility Flow (30 min)
Strength: RPE 7–8; focus control > max load	Strength: RPE 7–8; focus control > max load	Strength: RPE 7–8; focus control > max load	Strength: RPE 7–8; focus control > max load
Tue	Tue	Tue	Tue
Basketball Practice (75 min)	Basketball Practice (75 min)	Basketball Practice (75 min)	Basketball Practice (75 min)

6. Implementation Checklist for Athletes & Coaches

Use this to self-audit training quality:

✓ Do You...?	Yes/No	Action if “No”
Track weekly load (RPE × time)?	<input type="checkbox"/>	Start simple: Notebook or Notes app
Perform joint resilience work ≥3x/week?	<input type="checkbox"/>	Add 10 min post-practice (e.g., shoulder/knee routine)
Prioritize sleep ≥7 hrs/night?	<input type="checkbox"/>	Set phone alarm for <i>bedtime</i> (not just <i>e</i> wake-up)
Have 2–3 full rest days/month (no structured sport)?	<input type="checkbox"/>	Block them in calendar <i>now</i>
Communicate fatigue honestly with coaches?	<input type="checkbox"/>	Use “traffic light” system: Green (ready), Yellow (tired), Red (hurting)

7. Ethical & Inclusive Considerations

Avoid the “Elite Copy-Paste” Trap: NFL combine drills ≠ high school development. Scale volume, not just intensity.

Equity Matters: Not all have gym access. Bodyweight circuits, resistance bands, and park workouts are equally valid.

Mental Load Awareness: Student-athletes face academic stress training should reduce, not compound, anxiety.

Female Athlete Focus: Monitor energy availability (EA); low EA ↑ stress fracture & ACL risk. Encourage open dialogue on menstrual health.

8. Conclusion

Multi-sport participation is not a compromise it's a strategic advantage. For the general athlete, "advanced" training does not mean complex or expensive. It means intentional:

- ◆ Prioritizing foundational strength and movement quality
- ◆ Training joints before they hurt
- ◆ listening to the body as the ultimate biofeedback tool
- ◆ valuing recovery as fiercely as competition

By embracing intelligent diversification—where soccer agility sharpens basketball defense, and swimming endurance supports cross-country stamina—we cultivate athletes who are not just better today, but healthier, happier, and more resilient for life. Excellence, in this light, is sustainable, shared, and deeply human.

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- Free Apps: Strong (workout log), HRV4Training (readiness), Nike Training Club (guided mobility)

ARTIFICIAL INTELLIGENCE AND ROBOTICS IN HOTEL OPERATIONS: TRANSFORMING THE FUTURE OF HOSPITALITY INDUSTRY

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Abstract

The hospitality industry is rapidly evolving with the integration of advanced technologies such as Artificial Intelligence (AI) and robotics. These technologies are transforming hotel operations by improving efficiency, enhancing guest experiences, and reducing operational costs. AI-powered systems such as chatbots, smart assistants, and data analytics tools help hotels provide personalized services and efficient management. Similarly, robotics is being used for tasks such as guest assistance, room service delivery, and housekeeping operations. This paper examines the role of Artificial Intelligence and robotics in hotel operations, their applications, benefits, challenges, and future potential in the hospitality industry. The study is based on secondary data collected from research articles, industry reports, and hospitality technology studies.

Keywords: *Artificial Intelligence, Robotics, Hospitality Industry, Hotel Operations, Smart Hotels*

1. Introduction

The hospitality industry is one of the fastest-growing sectors in the global economy. With increasing competition and rising customer expectations, hotels are constantly seeking innovative ways to improve service quality and operational efficiency. In recent years, Artificial Intelligence (AI) and robotics have emerged as significant technological advancements that are transforming hotel operations.

Artificial Intelligence refers to computer systems designed to perform tasks that normally require human intelligence, such as decision-making, problem solving, and learning from data. Robotics involves the use of automated machines capable of performing tasks independently or with minimal human intervention. These technologies are increasingly being adopted by hotels to streamline operations, improve service delivery, and enhance guest experiences.

Hotels across the world are implementing AI-powered systems for tasks such as automated booking systems, personalized marketing, voice-controlled room services, and data analysis.

Robotics is also being used for various operational tasks such as luggage handling, room service delivery, and cleaning services. The integration of these technologies helps hotels maintain efficiency, reduce labour costs, and provide innovative guest experiences.

2. Objectives of the Study

The main objectives of this study are:

1. To understand the concept of Artificial Intelligence in hotel operations.
2. To examine the role of robotics in the hospitality industry.
3. To analyse the advantages of implementing AI and robotics in hotels.
4. To identify the challenges faced in adopting these technologies.

3. Research Methodology

This study is based on secondary data collected from various sources such as academic journals, hospitality management books, industry reports, and online research articles. The information collected was analysed to understand the role and impact of Artificial Intelligence and robotics in hotel operations.

4. Applications of Artificial Intelligence in Hotel Operations

4.1 AI Chatbots and Virtual Assistants

Many hotels use AI-powered chatbots to respond to guest queries instantly. These chatbots assist customers with booking information, room availability, and hotel services. They are available 24 hours a day, ensuring quick communication with guests.

4.2 Personalized Guest Experience

Artificial Intelligence allows hotels to analyse customer data and preferences. This enables hotels to provide personalized services such as customized room settings, food preferences, and personalized promotional offers.

4.3 Revenue Management Systems

AI is widely used in revenue management systems to predict demand patterns and optimize room pricing. By analysing historical data and market trends, hotels can adjust their pricing strategies to maximize revenue.

4.4 Smart Room Technology

AI-powered smart rooms allow guests to control lighting, temperature, entertainment systems, and curtains using voice commands or mobile applications. This improves comfort and convenience for guests.

4.5 Customer Data Analysis

AI helps hotels analyse guest feedback and online reviews. This allows hotel managers to understand customer satisfaction levels and improve their services accordingly.

5. Use of Robotics in Hotel Operations

5.1 Service Robots

Service robots are used in hotels to deliver food, beverages, and other amenities directly to guest rooms. These robots help reduce workload and improve service efficiency.

5.2 Reception and Concierge Robots

Some hotels have introduced robots at the reception desk to assist guests with check-in and check-out procedures. These robots can also provide information about hotel facilities and nearby tourist attractions.

5.3 Housekeeping Robots

Robotic cleaning machines are used for floor cleaning and sanitation in hotel premises. These robots improve hygiene and reduce the time required for cleaning tasks.

5.4 Luggage Handling Robots

In some hotels, robots are used to transport guest luggage from the reception area to their rooms. This improves efficiency and enhances guest experience.

6. Advantages of AI and Robotics in Hotels

The use of Artificial Intelligence and robotics offers several advantages in hotel operations:

- Improved operational efficiency and productivity
- Faster and more accurate service delivery
- Reduction in operational and labour costs
- 24/7 customer service availability
- Enhanced guest satisfaction through personalized services
- Better data management and decision-making

7. Challenges in Implementing AI and Robotics

Despite their benefits, the implementation of AI and robotics in hotels also presents certain challenges:

- High initial investment and installation costs
- Maintenance and technical support requirements
- Lack of human touch in customer service
- Employee training and skill development needs

- Potential technical failures or system errors

Hotels must carefully plan and manage these challenges while implementing advanced technologies.

8. Future Scope of AI and Robotics in Hospitality

The future of the hospitality industry will be heavily influenced by technological innovations. Artificial Intelligence and robotics are expected to become more advanced and widely adopted in hotel operations. Smart hotels equipped with automated systems, AI-powered guest services, and robotic assistance may become common in the coming years.

Future developments may include fully automated check-in systems, AI-powered predictive customer service, and robots capable of performing complex hospitality tasks. These advancements will help hotels enhance operational efficiency and create unique guest experiences.

9. Conclusion

Artificial Intelligence and robotics are playing a transformative role in the hospitality industry. Their integration into hotel operations has significantly improved efficiency, service quality, and guest satisfaction. Technologies such as AI chatbots, smart rooms, and service robots are helping hotels provide innovative and personalized services.

Although the adoption of these technologies involves certain challenges such as high costs and technical complexities, their long-term benefits are substantial. As technology continues to evolve, Artificial Intelligence and robotics will become essential components of modern hotel operations, shaping the future of the hospitality industry.

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SMART AI TECHNOLOGIES FOR VISUAL COMMUNICATION STUDENTS VELAYUTHAM

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Abstract:

Artificial Intelligence (AI) has become an important technology in the field of visual communication. It helps students and media professionals create images, videos, graphics, and animations quickly and efficiently. Smart AI technologies such as image generation, video editing, augmented reality, and virtual reality are widely used in modern media industries. These tools help visual communication students improve creativity, design skills, and visual storytelling. AI can analyze images, enhance photo quality, and assist in media production. This paper discusses the role of AI technologies in visual communication education, their applications in media production, and the benefits and challenges of using AI in creative learning.

Keywords: *Artificial Intelligence, Visual Communication, AI Image Generation, Video Editing, Augmented Reality, Virtual Reality, Digital Media, Creative Design, AI Tools*

1. Introduction

Visual communication is the process of conveying ideas, information, and messages through visual elements such as images, videos, graphics, symbols, and multimedia content. In today's digital era, technology plays a major role in visual communication. Artificial Intelligence has recently emerged as one of the most powerful technologies used in the creative industry. AI allows computers and machines to perform tasks that normally require human intelligence. For visual communication students, learning AI technologies is becoming increasingly important because these tools are widely used in the professional media industry.

2. Artificial Intelligence in Visual Communication

Artificial Intelligence refers to computer systems that can perform intelligent tasks such as learning, analyzing data, recognizing patterns, and making decisions. In visual communication, AI helps in analyzing visual data, recognizing objects and faces, improving image quality, and creating new visual content. AI-powered software can automatically adjust colors, brightness, contrast, and sharpness in photographs. AI video editing tools can detect scenes automatically, add subtitles, suggest transitions, and improve sound quality. AI also supports graphic design by generating design templates, layouts, and color suggestions.

3. Smart AI Technologies Used in Visual Communication

Many smart AI technologies are currently used in visual communication. AI image generation tools allow users to create images simply by typing text descriptions. AI-based video editing software can automatically organize clips, detect scenes, add transitions, and enhance video quality. Facial recognition technology allows software systems to identify and recognize human faces in images and videos. Augmented Reality combines digital elements with real-world environments. Virtual Reality creates completely immersive digital environments widely used in filmmaking, gaming, journalism, and digital storytelling.

4. Benefits of Smart AI Technologies for Students

Smart AI technologies offer many advantages for visual communication students. One major benefit is time efficiency—many design and editing tasks that previously required several hours can now be completed in minutes. Another advantage is increased creativity, as AI tools allow students to experiment with different visual styles, layouts, and design concepts. AI technologies also help students learn modern digital skills that are highly valuable in media industries, improving employability and career opportunities for graduates.

5. Challenges of Using AI in Visual Communication

Despite its advantages, AI technology also presents certain challenges. One challenge is the possibility of overdependence on AI tools, which may reduce students' manual creative skills and traditional design techniques. Another issue is related to ethics and authenticity, as AI-generated images and videos can sometimes create misleading content such as deepfake videos. There are also copyright and intellectual property issues related to AI-generated artworks, and some AI software programs require expensive subscriptions which may not be accessible to all students.

6. Future of AI in Visual Communication Education

The future of visual communication education will be strongly influenced by Artificial Intelligence technologies. Many universities and colleges are already introducing AI-based tools in media and design courses. AI-powered systems may assist students in script writing, animation creation, visual effects design, and interactive storytelling. Educational institutions must integrate AI technologies into their curriculum to prepare students for the future digital media environment.

7. Conclusion

Artificial Intelligence is transforming the field of visual communication by providing innovative tools for image creation, video editing, animation, and digital storytelling. These technologies improve productivity, creativity, and technical skills among visual communication students. By

combining human creativity with advanced AI tools, students can produce powerful visual communication that meets the needs of modern media industries.

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A STUDY ON THE INTEGRATION OF COMMUNITY DEVELOPMENT WITH SMART INNOVATION TECHNOLOGIES

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Abstract

Equal access to resources, involvement in decision-making, and the elimination of structural obstacles are all highlighted by the inclusion idea. When smart technologies are integrated, data-driven governance, real-time service delivery, and increased transparency make inclusion more actionable. For example, IoT-enabled infrastructure can improve rural water management, while AI-based solutions can help small-scale farmers with precision agriculture. By increasing access to banking and credit systems, digital platforms help facilitate financial inclusion. Adoption of smart technology must, however, be context-sensitive, taking into account infrastructure constraints, affordability, and digital literacy. In order to guarantee that technological interventions are not only accessible but also culturally appropriate and long-lasting, community involvement and capacity building are essential. In order to successfully scale such programs, public-private partnerships and policy frameworks are essential. In summary, incorporating smart innovation technologies into community development frameworks can greatly improve resilience and inclusivity. Achieving fair and sustainable growth across diverse groups requires a well-rounded strategy that blends human-centric design with technological advancement.

Key Words: Community Development, Smart Technologies, Inclusion, Digital Divide, Artificial Intelligence, Sustainable Development, Social Equity,

Introduction

Initially community development has concentrated on enhancing people's social, economic, and environmental well-being through inclusive involvement and group action. The incorporation of smart innovation technologies has changed how communities develop, engage, and survive in recent years. In addition to advancement and modernisation, the idea of "Community Development Inclusion with Smart Innovation Technologies" emphasises fair access, involvement, and empowerment of all societal segments, especially underprivileged

and marginalised people. Artificial intelligence, the Internet of Things (IoT), digital platforms, data analytics, and renewable energy solutions are examples of smart innovation technologies that have the ability to close access gaps to vital services including governance, healthcare, education, and transportation. When used carefully, these technologies can make systems more inclusive by guaranteeing that opportunities and resources reach even the most remote and underprivileged groups. For example, telemedicine can provide access to healthcare in places without medical facilities, while digital education platforms can offer rural students educational options.

However, the inclusive implementation of smart technology is where their genuine worth in community development lies. Inclusion guarantees that technological developments will lessen inequality rather than increase the digital divide. Community members must actively participate in the planning, execution, and monitoring stages in order to achieve this. It also advocates for legislative frameworks that support technology accessibility, affordability, and usability for everyone, as well as capacity building and digital literacy. Furthermore, clever innovations that are in line with cultural settings and local demands might help achieve sustainable development goals. Technology-enabled community-driven solutions can improve governance's accountability, efficiency, and transparency. Smart governance platforms, for instance, can make it easier for citizens to obtain public services, express issues, and take part in decision-making processes.

In summary, integrating inclusive smart innovation technologies with community development is a forward-thinking strategy for creating societies that are sustainable, egalitarian, and resilient. It is about making sure that everyone benefits from progress and that no one is left behind, not only about technological improvement. This strategy can build a future where innovation is a vehicle for equitable progress and shared prosperity by encouraging cooperation between the public and commercial sectors as well as communities.

Smart Governance and Citizen Participation

Through increased transparency, efficiency, and participation, smart technologies have completely transformed governance. Citizens can access public services, file complaints, and monitor the status of government initiatives in real time through e-governance platforms, mobile applications, and digital portals. This improves accountability in public management and cuts down on bureaucratic delays. A crucial component of community development is citizen participation, and intelligent tools enable more public-government interaction. Communities can actively participate in the creation and execution of policies through data-

driven decision-making, online consultations, and digital feedback systems. Development activities are guaranteed to represent the real needs and objectives of the populace thanks to this inclusive approach.

Enhancing Healthcare Through Smart Solutions

Smart technologies have transformed government by increasing its efficiency, transparency, and participation. Citizens can access public services, file complaints, and monitor the status of government initiatives in real time thanks to e-governance platforms, mobile applications, and digital portals. This improves accountability in public management and decreases bureaucratic delays.

A crucial component of community development is citizen participation, and clever tools enable increased public-government interaction. Communities can actively participate in the creation and execution of policies through data-driven decision-making, digital feedback systems, and online consultations.

Education And Skill Development Through Technology

Smart technologies have revolutionised the delivery and acquisition of knowledge, and education is a potent force behind community development. For people of all ages, digital classrooms, e-learning platforms, and virtual training programs offer flexible and accessible learning options. With the aid of these resources, students can access high-quality education from any location by overcoming financial and geographic obstacles.

By providing specialised training programs that are in line with industry demands, smart technologies also aid in the development of skills. Interactive content, simulations, and online courses improve educational opportunities and get people ready for the modern workforce. This is especially crucial in a labour market that is changing quickly and where ongoing education is crucial.

Sustainable Development And Smart Infrastructure

One of the main goals of community development is sustainable development, and smart technologies are essential to reaching this goal. Intelligent transportation networks, renewable energy systems, and energy-efficient buildings are examples of smart infrastructure that enhances quality of life while lowering environmental impact.

Effective management of resources like water, energy, and waste is made possible by technologies like sensors and data analytics. Smart grids, for instance, maximise the use of

electricity, while waste management systems make use of real-time data to enhance recycling and collection procedures. These developments help save money and protect the environment.

Future Of The Study

Smart technology integration in community development has a bright future ahead of it, with the potential to completely transform how communities evolve and operate. It is anticipated that as technology develops, its use in community development will become increasingly complex, scalable, and significant. The creation of "smart and inclusive communities," where technology permeates rural and semi-urban areas as well as urban areas, is another focus of the future. This change is anticipated to be accelerated by government initiatives, public-private partnerships, and international development projects. Communities will be empowered to actively interact with and profit from new technologies if there is a greater emphasis on digital literacy and capacity building.

Additionally, sustainability will be a major factor, with clever solutions promoting waste management, water conservation, renewable energy, and climate resilience. Long-term environmental and developmental objectives will be achieved through the combination of green technology with smart systems. Blockchain, machine learning, and smart infrastructure systems are examples of emerging technologies that will probably be very important in improving community services' efficiency, security, and transparency. Blockchain, for instance, can be used for secure property records and welfare distribution, while AI-driven analytics can assist governments in making data-driven decisions about urban planning and resource allocation.

In conclusion, the future of this study lies in creating a balanced approach where technological innovation aligns with social inclusion, ethical considerations, and sustainable growth. It envisions a connected, empowered, and resilient society where smart technologies act as catalysts for inclusive and equitable development.

Challenges

1. Inequality and the Digital Divide

The disparity in access to technology is one of the main issues. Digital infrastructure, smart devices, and dependable internet are unavailable to many rural and marginalised areas. Vulnerable populations may not be able to profit from this digital gap, which would increase rather than decrease already-existing social and economic disparities

2. Insufficient Knowledge of Technology

Effective use of technology can be hampered by a lack of digital skills and knowledge, even in situations when it is available. The adoption and usage of smart technologies may be challenging for low-income, elderly, and less educated people, which would limit their involvement in development projects.

3. High Costs of Implementation

Smart technology adoption, including IoT systems, data platforms, and renewable energy solutions, sometimes necessitates significant financial commitment. The expense of infrastructure, upkeep, and renovations can be a significant obstacle for emerging areas or local governments with tight budgets.

4. Data Security and Privacy Issues

Data gathering and analysis play a major role in smart technologies. Data privacy, personal information misuse, and cyber security risks are all brought up by this. If communities don't trust the handling and security of their data, they may oppose adoption.

Conclusion

In summary, using smart technology into community development offers a revolutionary way to create societies that are resilient, inclusive, and sustainable. By enhancing access to necessary services, bolstering local economies, and encouraging good government, the efficient use of tools like artificial intelligence, digital platforms, IoT systems, and data-driven solutions may greatly improve the quality of life. However, how inclusively and ethically these technologies are applied is just as important to the success of this integration as technological advancement. Making sure that no group in society is left behind is a crucial part of this integration. Enabling meaningful participation requires closing the digital divide through better infrastructure, more affordable access, and increased digital literacy. Communities must be given the tools they need to comprehend, embrace, and profit from these technologies in ways that match their particular social, cultural, and economic circumstances. Long-term sustainability, trust, and ownership are all promoted by this participative approach.

Furthermore, developing scalable and significant solutions requires cooperation between local communities, businesses, and governments. Policies must be created to promote innovation while protecting data security, privacy, and moral principles. Smart technologies can improve governance systems' responsiveness, accountability, and transparency when they are in line with grassroots demands. In the end, incorporating smart technologies into community

development is a way to attain social well-being and equitable progress rather than an objective in and of itself. Societies can open up new avenues for advancement by fusing modern innovation with human-centered techniques, guaranteeing that development is inclusive and prepared for the future.

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USING INNOVATIVE TECHNOLOGY TO SUPPORT THE HEALTH AND WELLBEING OF AUTISM CAREGIVERS

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Abstract

Autism Spectrum Disorder (ASD) is a lifelong neurodevelopmental condition that affects communication, social interaction, and behaviour. While significant resources are dedicated to supporting individuals with autism, the health and wellbeing of their caregivers often parents, siblings or partners are frequently overlooked. Caregivers of individuals with autism face unique challenges, including high levels of chronic stress, social isolation, physical exhaustion, and the constant vigilance required to manage sensory needs and safety risks. This paper explores how innovative technology can serve as a vital support system for these caregivers. We examine current tools such as visual scheduling apps, wearable safety devices, artificial intelligence (AI) for behaviour analysis, telehealth services, and online support communities. The paper argues that technology must evolve from solely managing the symptoms of autism to actively protecting the mental and physical health of the caregiver. By reducing the daily burden of care and providing accessible mental health resources, technology can prevent caregiver burnout and improve family dynamics. However, barriers such as cost, digital literacy, data privacy, and the need for personalized design must be addressed. This presentation proposes a "Caregiver-centred Design" framework to guide the development of future technologies that empower and sustain autism caregivers.

Keywords: *Autism Spectrum Disorder (ASD), Caregiver, Health, Technology, Mental Wellbeing, Innovation, Safety Devices.*

1. Introduction

1.1 Background

Autism Spectrum Disorder (ASD) is a complex developmental condition that involves persistent challenges in social interaction, speech and nonverbal communication, and restricted/repetitive behaviours. The experience of autism varies widely; some individuals require very little support, while others need intensive, lifelong care. Regardless of where an individual falls on the spectrum, the impact extends far beyond the person diagnosed. It deeply affects the family unit.

Therapies like Applied Behaviour Analysis (ABA), speech therapy, and occupational therapy are designed to help the autistic person develop skills. While these are essential, they often

place a heavy logistical and emotional burden on the family members who coordinate and deliver this care. These family members are the "caregivers."

1.2 The Unique Challenge of Autism Caregiving

Caregivers often act as constant translators, interpreting a world that may be confusing or overwhelming for their loved one. They must manage complex sensory environments, navigate unpredictable behavioural changes, and ensure physical safety.

Many caregivers report sleeping poorly due to night-time disturbances or anxiety. They often face stigma and misunderstanding from the public when behavioural outbursts occur in public spaces. Consequently, caregivers of individuals with autism report higher rates of depression, anxiety, and physical health issues than the general population.

1.3 The Role of Technology

We are living in an era of rapid technological advancement. In the context of autism, technology has traditionally been used to help the autistic individual or learn social skills. Technology should not just be a tool for management; it should be a source of relief, connection, and restoration for the caregiver.

1.4 Objectives of this Paper

This paper aims to:

- Detail the specific physical and mental health challenges faced by autism caregivers.
- Review innovative technologies that can alleviate these burdens and promote wellbeing.
- Discuss the ethical considerations and future directions for this field.

2. UNDERSTANDING THE AUTISM CAREGIVER EXPERIENCE

To create effective technology, we must first empathize with the daily reality of the autism caregiver. Their experience is defined by several key stressors.

2.1 The Burden of Constant Vigilance

Unlike many other conditions, autism can involve sudden and unpredictable behaviours. A caregiver must constantly scan the environment for potential triggers: loud noises, bright lights, or crowded spaces that could cause a meltdown. This "always-on" mode prevents the nervous system from ever fully relaxing, leading to chronic fatigue.

2.2 Communication Barriers and Advocacy

Many individuals with autism are non-speaking or have limited verbal abilities. Caregivers often become the sole voice for their loved one, interpreting needs, pain, or discomfort to doctors, teachers, and strangers. This role of "constant translator" is mentally exhausting.

2.3 Social Isolation and Stigma

Social situations can be difficult for families affected by autism. Public meltdowns often draw stares, judgment, or unwanted advice from strangers. As a result, many caregivers withdraw from social activities to avoid embarrassment or to protect their loved one from overstimulation. Friends and extended family may not understand the condition, leading to a lack of practical support. The caregiver feels isolated in their struggle.

2.4 Physical Health Consequences

Chronic stress contributes to weakened immune systems, headaches, digestive issues, and cardiovascular problems. Caregivers frequently neglect their own medical appointments and exercise routines because they cannot find respite care or feel too guilty to take time for themselves.

2.5 Emotional Toll and Grief

Caregivers often experience a complex mix of emotions: deep love, joy in small victories, but also grief for the "typical" life they imagined, frustration, and guilt. They may feel guilty for losing their temper during a difficult moment or guilty for wanting a break.

2.6 Summary of Needs

From these challenges, we can identify four critical areas where caregivers need support:

- **Safety & Security:** Reducing the fear of wandering or injury.
- **Communication Assistance:** Tools to bridge the gap between the caregiver and the individual with autism.
- **Respite & Relaxation:** Mechanisms to lower stress and allow for rest.
- **Community & Validation:** Connection with others who understand the unique journey of autism.

Technology offers promising solutions for each of these areas.

3. INNOVATIVE TECHNOLOGIES FOR CAREGIVER SUPPORT

Technology is not a replacement for human care, but it can be a powerful partner. Below, we explore four categories of innovation tailored to support autism caregivers.

3.1 Safety and Monitoring Technologies

Safety is often the primary concern for autism caregivers. Innovative devices can provide peace of mind, allowing caregivers to relax.

- **GPS Wearables and Smart Watches:** For individuals prone to elopement, GPS-enabled watches or clip-on trackers are lifesavers. If the individual leaves a safe zone (like the backyard or school), the caregiver receives an instant alert on their phone. This reduces the need for constant visual supervision, lowering the caregiver's anxiety levels.



- **Smart Home Sensors:** Door sensors can alert caregivers if a door is opened at night. Motion sensors can detect unusual movement patterns. Smart locks can prevent unauthorized exiting.
- **Biometric Monitoring:** Some devices can detect rising heart rates or changes in skin temperature that often precede a meltdown. By alerting the caregiver early ("Signs of agitation detected"), the caregiver can intervene proactively with calming strategies before a crisis occurs.

3.2 Communication and Organization Tools

Reducing the friction of daily communication and logistics can save immense mental energy.



- **Visual Schedule Apps:** Many individuals with autism thrive on routine and visual cues. Apps that create visual schedules (using pictures instead of text) help the individual understand what comes next.

3.3 Mental Health and Respite Technologies

Direct support for the caregiver's mental state is crucial.

- **Telehealth and Virtual Therapy:** Finding a therapist who understands autism can be difficult, and leaving the house for an appointment may be impossible for some families. Telehealth platforms connect caregivers with specialists remotely.
- **Sleep Support Tools:** Since sleep disruption is common, smart sleep technologies can help. White noise machines controlled by apps, and sleep trackers for the caregiver can help them prioritize and monitor their own rest.

3.4 Community and Social Connection Platforms

- **Moderated Peer Support Networks:** General social media can be hostile. Dedicated, moderated apps for autism caregivers provide a safe space to share experiences. Knowing that others face similar challenges validates their experience and reduces feelings of isolation.

4. BENEFITS OF IMPLEMENTING TECH SOLUTIONS

4.1 Reduction in Chronic Stress

By automating safety monitoring and simplifying communication, the "mental load" is lightened. When a caregiver knows a GPS alarm will sound if a child wanders, they can finally relax their hyper-vigilance.

4.2 Improved Sleep and Physical Health

With better monitoring tools and respite matching services, caregivers can reclaim sleep and take breaks. Better sleep leads to improved immune function, better mood regulation, and more patience. A physically healthy caregiver is better equipped to handle the demands of care.

4.3 Enhanced Family Relationships

When technology handles the logistics and safety checks, the caregiver can focus on connection. Instead of being a constant supervisor or disciplinarian, they can engage in play, conversation, and shared joy.

5. CHALLENGES AND ETHICAL CONSIDERATIONS

5.1 The Privacy Collecting data on an individual with autism (location, behavior, biometrics) raises serious privacy concerns. Who owns this data? Could it be used against the individual later in life (e.g., by employers or insurers)?

5.2 The Cost Barrier

Advanced wearables and subscription apps can be expensive. Families already facing high medical costs for autism therapies may not afford extra tech.

Solution: Advocacy is needed to classify certain supportive technologies as "Durable Medical Equipment" so they are covered by insurance.

5.3 Sensory Compatibility

Ironically, some technology (bright screens, beeping sounds, vibrating bands) can be sensory nightmares for individuals with autism, causing distress rather than helping.

Solution: Devices must be designed with sensory sensitivity in mind. Silent alerts, dimmable screens, and soft, comfortable materials are necessary.

5.4 The Digital Divide

Not all caregivers have high-speed internet or modern smartphones. Rural areas may lack connectivity.

Solution: SMS-based services, offline-capable apps must be available.

6. FUTURE DIRECTIONS

The future of autism caregiver support lies in deeper integration and smarter, more empathetic AI.

6.1 Predictive AI Analytics

Future systems will not just monitor; they will predict. AI could analyse months of data to tell a caregiver: "Based on past patterns, a full moon and a change in school routine next week may increase anxiety. Prepare calming activities for Tuesday." This proactive insight is revolutionary.

6.2 Integrated Healthcare Ecosystems

Currently, data is siloed. In the future, a caregiver's dashboard could share relevant data directly with the care team. If a wearable detects a week of poor sleep and increased agitation, the system could automatically flag the behavioural therapist to adjust the intervention plan. This creates a holistic circle of care.

6.3 Policy and Systemic Change

Technology alone cannot solve systemic issues. We need policies that recognize the economic value of unpaid caregiving. Tax credits for purchasing assistive technology, mandated respite

care coverage, and workplace flexibility for caregivers are essential policy goals that technology advocates should support.

7. CONCLUSION

Autism is a journey shared by the individual and their family. For too long, the spotlight has been solely on the individual, leaving the caregivers to struggle in the shadows with exhaustion, isolation, and declining health. This approach is unsustainable. A supported caregiver is the most critical resource for an individual with autism.

This paper has demonstrated that innovative technology holds immense potential to transform the lives of autism caregivers. From GPS trackers that alleviate the fear of wandering, to AI that predicts meltdowns, to virtual communities that cure loneliness, the tools exist and are evolving. However, the success of these tools depends on how they are designed. They must be simple, affordable, private, and deeply empathetic to the caregiver's experience.

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A STUDY ON THE DIVERSITY AND INCLUSION OF EMPLOYEES IN CONTEMPORARY ORGANISATIONS

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ABSTRACT

Diversity and Inclusion have transitioned from being merely social responsibilities to becoming strategic necessities for modern organisational excellence. In today's interconnected global economy, workplaces have become increasingly multicultural, demanding not only technical competence but also cultural sensitivity and inclusive leadership. While many organisations have understood the theoretical importance of D&I, translating these values into consistent, everyday practice remains a significant challenge. Structural barriers such as unconscious bias, inadequate awareness and resistance to change have limited the effectiveness of formal policies, frequently reducing them to symbolic gestures. Understanding the employee perception is critical as success of D&I depends on whether employees feel genuinely respected and empowered rather than just tokenistically represented. This research is vital for identifying the gap between policy formulation and practical implementation to foster a truly equitable workplace culture. Previous research highlights that while diversity is common, inclusion is still under-researched, particularly in the Indian context. This study's findings indicate a strong conceptual understanding of D&I among the young, highly educated workforce, with 86% defining diversity as a multidimensional construct. However, it also reveals that 75% of employees believe resistance to change actively slows down D&I implementation. The study implies that for D&I to be sustainable, organisations must move beyond symbolic endorsement toward measurable accountability. Leadership must focus on strengthening transparency in recruitment, enhancing cross-cultural competence, and fostering psychological safety to transform diversity from a demographic reality into a strategic advantage.

Key Words: Diversity, Inclusion, Organisational Growth, Workplace Culture.

INTRODUCTION

Diverse means different. As such, diversity is not a new phenomenon, as individuals have always been different, one from the other. Although diversity has always existed, defining it is somewhat difficult.

One issue with defining diversity stems from the fact that diversity concerns both visible and invisible characteristics. This simply means that some dimensions of diversity are easier to see, and so easier to categorise, articulate or discuss. Such dimensions include, for example, physiological gender appearance, skin colour, dress, age or physical ability. Another issue with defining diversity is that it can be considered subjective, meaning it is created by individuals who characterise others as similar or dissimilar to themselves. Workforce diversity management is the ability to adapt to characteristics and traits that are different from our own and outside of the communities to which people belong, but are present in other individuals and groups. Managing workforce diversity entails more than merely respecting people's differences; it also entails appreciating the importance of differences, knowing, embracing, fighting prejudice, and fostering inclusiveness to improve an organization's effectiveness. Incorporating an individual's perceptions and viewpoints into an organization leads to positive results by making that person feel at ease and as if he or she is an integral part of the organization. The Constitution of India prohibits discrimination on the grounds of religion, race, caste, sex or place of birth. Equality of opportunity in matters of public employment is also laid out as a directive principle. Attempts to create inclusive workplaces must consider individual differences, needs and perceptions as well as focus on creating structures, systems and processes that make people feel valued and treated equitably. Inclusive environments are places where individuals of all backgrounds feel fairly treated, valued for who they are and are also made part of core decision making. In such organizations, non-traditional employees are not expected to merely assimilate to dominant norms.

REVIEW OF LITERATURE

Business Research Letters (2025), this 2025 empirical study examined the link between perceived diversity and inclusion (D&I) and corporate innovation. The study concluded that D&I policies are not merely ethical imperatives but strategic drivers of innovation performance. This aligns closely with the present research's objective of understanding how D&I initiatives influence organizational outcomes.

Karmarkar (2024) and Sreesujatha (2025) present a rapid literature review of diversity, equity, and inclusion (DEI) initiatives within India's IT sector, synthesizing evidence from multiple empirical studies. The review identifies that structured DEI programs—those with clear objectives, leadership commitment, and measurable indicators—significantly improve employee engagement, collaboration, and innovation. It also reports reduced turnover rates and enhanced employer branding in organizations with mature DEI strategies. However, the review warns against tokenistic or compliance-driven initiatives, noting that superficial efforts can lead to employee cynicism and reduced trust in leadership.

OBJECTIVES

1. To assess the extent to which the organisation adopts and practices Diversity and Inclusion.
2. To examine employee perceptions and attitudes towards diversity and inclusion practices.

RESEARCH METHODOLOGY

The study was conducted among employees of IT Sector Organisation, Chennai. This study adopts a descriptive survey research design to study the extent to which organisations practice D&I and the perception of employees towards the same. The sampling technique utilised was Probability sampling and the method adopted was the Simple Random Sampling. The researcher collected responses of 100 employees, specifically from the IT Sector in Chennai. Primary and Secondary sources were the tool used for collecting the data.

FINDINGS AND DISCUSSIONS

TABLE 1: Gender of the Respondents

GENDER OF THE RESPONDENTS	FREQUENCY	PERCENTAGE
Male	53	53
Female	41	41
Transgender	6	6
Total	100	100

The data shows 84% of respondents are aged 20–30, indicating a predominantly young workforce with limited generational diversity. Employees above 40 are underrepresented, suggesting potential gaps in experience and knowledge transfer. From a D&I perspective, improving age diversity can enhance inclusivity, mentorship, and balanced organizational growth.

TABLE 2: How the respondents see D&I for Organisational success

D&I FOR ORGANISATIONAL SUCCESS	FREQUENCY	PERCENTAGE
Diversity and Inclusion contribute to organisational success by enhancing innovation, engagement, and performance.	91	91
D&I is only a compliance requirement with no impact on success.	5	5
D&I slows down decision-making and hinders growth.	3	3
D&I only benefits minority groups, not the organisation as a whole.	1	1
Total	100	100

The findings show that 91% of respondents believe D&I enhances innovation, engagement, and performance, indicating strong awareness of its strategic value. However, 9% hold negative perceptions, viewing it as compliance or a barrier. From a D&I perspective, the organization largely recognizes inclusion as essential for sustainable organisational success.

TABLE 3: Whether the organisation has clear D&I policies according to the Respondents

D&I POLICIES OF THE ORGANISATION	FREQUENCY	PERCENTAGE
Yes, our organisation has very good D&I practices	65	65
I am not aware of these policies	19	19
There are not many policies based on D&I	16	16
Total	100	100

The findings show that 65% of respondents perceive the organisation as having strong D&I practices, reflecting a generally positive view of policy implementation. However, 19% are unaware of such policies and 16% believe there are limited D&I initiatives. This indicates a possible gap in communication, transparency, or employee engagement.

From a Diversity & Inclusion perspective, effective policies must not only exist but also be clearly communicated and experienced by employees. Improving awareness programs, training sessions, and leadership reinforcement can help strengthen policy visibility and ensure inclusive practices are consistently understood and applied across the organisation.

TABLE 4: Whether biases exist in diverse workplaces in the organisation according to the Respondents

WHETHER BIASES EXIST IN DIVERSE WORKPLACES THE RESPONDENTS	FREQUENCY	PERCENTAGE
Yes, unconscious and structural biases can persist.	73	73
No, bias completely disappears with D&I programs.	14	14
Bias exists only in small organisations.	7	7
Bias exists only in recruitment, not elsewhere.	6	6
Total	100	100

The findings reveal that 73% of respondents acknowledge that unconscious and structural biases can persist even in diverse workplaces, indicating strong awareness of hidden inequalities. However, 27% believe bias disappears with D&I programs or exists only in limited contexts. From a D&I perspective, this suggests that while most employees understand the complexity of workplace bias, continuous training, monitoring, and inclusive leadership practices are essential to address biases beyond recruitment and ensure long-term cultural change.

MAJOR FINDINGS

- **Scepticism toward Inclusion among a Minority** Concerns regarding inclusion exist among 21% of respondents, who associate it with conflict or reduced collaboration. This highlights resistance that needs targeted intervention.
- **Dominance of Majority Culture** At the same time, 25% feel that only dominant cultures are recognised. This indicates unequal representation of cultural identities.

- **Managerial Support for Inclusive Decision-Making** Inclusive participation in decision-making is encouraged by managers according to 71% of respondents. This demonstrates positive leadership behaviour at the operational level.
- **Hierarchical Barriers in Decision-Making** a notable 29% feel decisions are restricted to senior employees. This suggests limited voice for lower-level employees.
- **Resistance to D&I Change** Resistance to D&I initiatives is recognised by 75% of respondents as a factor slowing implementation. This reflects common changemanagement challenges.
- **Positive Cultural Impact of D&I Initiatives** Workplace culture improvements through D&I initiatives are acknowledged by 69% of respondents. This indicates a generally positive organisational climate shaped by inclusion efforts.

SUGGESTIONS

1. **Improve Communication of D&I Policies** Clear and regular communication regarding D&I policies should be ensured through employee handbooks, intranet portals, and workshops. This will reduce the existing policy awareness gap.
2. **Ensure Transparency in Recruitment Processes** Organisations should adopt structured recruitment procedures with clearly defined criteria and evaluation methods. Transparent processes will reduce perceptions of bias and favouritism.
3. **Integrate D&I Goals into Performance Appraisals** Inclusion-related behaviours should be included as key performance indicators for managers. This will encourage accountability and sustained commitment.
4. **Promote Inclusive Decision-Making Practices** Managers should be trained to actively involve employees across all levels in decision-making. This will reduce hierarchical exclusion and improve engagement.
5. **Improve Cross-Cultural Communication Skills** Regular cross-cultural and communication training should be conducted to overcome misunderstandings. This will improve collaboration in diverse teams.
6. **Regularly Evaluate D&I Initiatives** Organisations should assess the effectiveness of D&I initiatives using measurable indicators. Continuous evaluation will enable datadriven improvements.

7. **Move from Symbolic to Impact-Driven Inclusion** Inclusion initiatives should focus on tangible outcomes rather than symbolic gestures. Real impact will enhance employee trust and engagement.

CONCLUSION

The study concludes that the organisation has established a foundational commitment to Diversity and Inclusion, reflected in employee awareness, generally positive attitudes, and the presence of structured policies and initiatives. Employees largely recognise the importance of diversity in fostering innovation, collaboration, and organisational growth. Inclusion is perceived as contributing to motivation, belongingness, and a healthier workplace culture. These perceptions indicate that the organisation has made meaningful progress in integrating D&I values into its overall work environment. However, the findings also highlight a gap between policy formulation and consistent implementation. While formal mechanisms such as recruitment practices, promotion systems, training programs, mentorship initiatives, and grievance procedures exist, their reach, transparency, and enforcement are not uniformly experienced across all employees. Concerns regarding favouritism, inconsistent policy application, communication barriers, and resistance to change suggest that inclusion efforts require deeper structural reinforcement. Leadership involvement, in particular, must move beyond symbolic endorsement toward active accountability and measurable outcomes.

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EMPLOYEE JOB SATISFACTION AT DOMINO'S PIZZA**HALIMAA YASMIN S & Dr. M. BABY**PG Student (Master of Social Work) & Research Guide, Assistant Professor
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Abstract:

Employee job satisfaction focuses on the level of contentment employees experience towards their job roles, responsibilities, working conditions and organizational support. It plays an important role in improving employee performance, commitment and overall organizational growth. In this context, the present study was undertaken among employees working at Domino's Pizza to analyse their perception towards various aspects such as working environment, salary and monetary benefits, workload, supervisor support, communication system and welfare facilities. The research is descriptive in nature. Primary data were collected from 50 respondents through a structured questionnaire consisting of 50 questions. The collected data were analysed using simple percentage method to understand the level of satisfaction among employees. Demographic variables such as age, gender, education, income and experience were also analysed. The findings reveal that the majority of the respondents are satisfied with their working environment, supervisor support and overall job security.

Keywords: *Employee Job Satisfaction, Work Environment, Fast food industry, Salary and Monetary Benefits, Supervisor Support, Workload Management*

1. Introduction

In the modern competitive business environment, human resources are considered as the most valuable asset of any organization. The success or failure of an organization largely depends on the efficiency, commitment, and satisfaction of its employees. Especially in service-oriented industries, employee satisfaction plays a vital role in delivering quality service, maintaining customer satisfaction, and achieving organizational objectives. Job satisfaction is a crucial concept in human resource management as it directly influences employee performance, motivation, retention, and overall organizational productivity.

Job satisfaction refers to the extent to which employees feel positive or negative about their jobs. It is an emotional response that results from the comparison between what employees expect from their jobs and what they actually receive. When employees are

satisfied with their jobs, they tend to show higher levels of commitment, enthusiasm, and loyalty towards the organization. On the other hand, dissatisfaction may lead to absenteeism, high employee turnover, low morale, and reduced efficiency.

2. Objectives of the Study

- To analyse employees' overall job satisfaction towards their job.
- To analyze employee satisfaction towards working environment and workload.

3. Literature Review

Lee and Chen (2011) examined a study titled "Employee Job Satisfaction in Fast Food Industry: A Study of Domino's Pizza Staff Performance" published in the International Journal of Hospitality Management. The study adopted a quantitative research methodology with a sample size of 120 employees. Findings revealed that timely salary, incentives, and manageable workload significantly improved the socio-economic status and livelihood stability of employees. Employees receiving supervisor guidance showed higher productivity levels. The authors recommended enhancing employee benefit schemes and providing additional training programs.

Patel (2007) published an article titled "Workplace Environment and Employee Satisfaction in Domino's Pizza Outlets" in the Journal of Human Resource Development. The study adopted a descriptive research design with 75 respondents selected using convenience sampling. Findings indicated that safe working environments and proper workplace facilities significantly improved employee morale. Employees receiving adequate rest breaks reported reduced stress levels. The study recommended improving workplace safety measures.

Jackson (2007) explored a study titled "Employee Performance and Job Satisfaction in Domino's Pizza Restaurants" published in the International Journal of Service Industry Management. The study adopted a quantitative research methodology with a sample size of 78 employees. Findings revealed that job satisfaction had a direct impact on employee efficiency and productivity. Employees from lower socio-economic backgrounds showed improvement in livelihood stability due to consistent employment. The author recommended introducing structured reward systems.

4. Research Methodology

The present study adopts a descriptive research design to analyse the level of employee job satisfaction at Domino's Pizza outlets. The universe of the study consists of employees

working in the selected outlets, and a sample size of 50 respondents was selected using the simple random sampling technique to ensure equal opportunity for participation. Both primary and secondary data were used for the study. Primary data was collected through a structured questionnaire distributed to the employees, which included demographic details and statements related to job satisfaction measured using a five-point Likert scale. Secondary data was collected from books, journals, research articles, and online sources related to employee job satisfaction and human resource management. The collected data was analysed using SPSS, and percentage analysis was used as the main statistical tool to interpret employee responses and identify the factors influencing employee job satisfaction.

5. Results and Discussion

Table 1: Employee Overall Satisfaction towards their Job

S. No	Response	Frequency	Percentage
1	Highly Dissatisfied	8	16
2	Dissatisfied	9	18
3	Neutral	9	18
4	Satisfied	12	24
5	Highly Satisfied	12	24
	Total	50	100

The above table shows that 16% of the respondents were highly dissatisfied with their job at Domino's Pizza, while 18% were dissatisfied. About 18% of the respondents remained neutral in their opinion. Further, 24% of the respondents expressed satisfaction, and another 24% were highly satisfied with their job. Overall, the majority of respondents were satisfied or highly satisfied, indicating a positive level of job satisfaction among the employees.

Figure 1 (Employees happiness while performing work): The pie chart shows that 10% of the respondents were highly dissatisfied while performing their work, and 20% were dissatisfied. About 20% remained neutral. Further, 24% were satisfied and 26% were highly satisfied while performing their work. Overall, the majority of respondents were satisfied or highly satisfied, indicating a positive level of happiness among employees while performing their work.

Figure 2 (Employees satisfaction with their current job position): The figure shows that 8% of the respondents were highly dissatisfied with their current job, while 20% were dissatisfied. About 20% remained neutral. Further, 30% were satisfied and 22% were highly satisfied with

their current job. Overall, the majority of respondents were satisfied or highly satisfied, indicating a positive level of satisfaction with their current job among the employees.

Table 2: Employees Satisfaction towards Working Environment and Workload

S. No	Response	Frequency	Percentage
1	Highly Dissatisfied	5	10
2	Dissatisfied	3	6
3	Neutral	13	26
4	Satisfied	12	24
5	Highly Satisfied	17	34
	Total	50	100

The above table describes that 34% of the respondents are highly satisfied with the working environment and workload conditions and 24% are satisfied. Around 26% remain neutral, while 6% are dissatisfied and 10% are highly dissatisfied. The majority of the respondents have a positive level of satisfaction towards the working environment and workload conditions.

Figure 3 (Employees satisfaction towards manageable workload): The chart shows that 12% of the respondents were highly dissatisfied with workload manageability, while 18% were dissatisfied. About 18% remained neutral. Further, 22% were satisfied and 30% were highly satisfied with workload manageability. Overall, the majority of respondents were satisfied or highly satisfied, indicating a positive level of satisfaction towards workload manageability among the employees.

6. Findings

1. Around one fourth (24%) of the respondents are satisfied with their job and another one fourth (24%) are highly satisfied, indicating a positive level of job satisfaction.
2. Nearly one fourth (26%) of the respondents are highly satisfied while performing work, whereas one fifth (20%) are dissatisfied, showing a generally positive level of happiness.
3. The majority of the respondents feel satisfied overall about their job, reflecting a positive level of overall job satisfaction.
4. More than one third (34%) of the respondents are highly satisfied with working environment and workload, indicating a positive work condition.
5. One third (30%) of the respondents are highly satisfied with workload manageability, reflecting positive workload balance.

7. Suggestions

- The organization can continue to maintain a balanced workload distribution to help employees perform their tasks effectively and comfortably.
- Effective communication can be continuously encouraged to maintain clarity and transparency between management and employees.
- The company can enhance existing health benefits and bonus systems to further increase employee motivation and satisfaction.

8. Conclusion

The findings of the study reveal that a majority of the employees are satisfied with their jobs, indicating a generally positive level of job satisfaction within the organization. Employees have expressed satisfaction with various aspects such as their job roles, sense of achievement, and relationship with management. The study also highlights that employees feel motivated and show a positive attitude towards their work, which contributes to better performance and productivity.

The study highlights that employee job satisfaction at Domino's Pizza is at a satisfactory level, and the organization has been successful in maintaining a supportive work environment. Continuous efforts in improving HR practices and addressing employee needs will help in sustaining and enhancing satisfaction levels, thereby contributing to long-term organizational growth and success.

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STUDY ON WOMEN EMPLOYEES' AWARENESS IN POSH POLICIES AND PROCEDURES IN ORGANIZATIONAL SETTINGS

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Abstract

The study examines the level of awareness among women employees regarding Prevention of Sexual Harassment (POSH) policies and procedures in organizational settings, with special reference to the manufacturing industry. Workplace sexual harassment remains a significant issue affecting women's dignity, safety, and productivity, making organizational awareness and implementation of protective policies essential. The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013 was enacted in India to prevent and address workplace sexual harassment by ensuring safe working environments, mandating Internal Complaints Committees, and providing mechanisms for grievance redressal. The effectiveness of such legislation largely depends on employees' awareness, accessibility of complaint procedures, and organizational support systems. The main objective of this study is to assess the extent of awareness of POSH policies among women employees working in a manufacturing industry and to analyze gender based violence in organization. The research focuses on identifying whether employees are aware of the existence of POSH policies, their knowledge of complaint procedures, their willingness or hesitation to report harassment, and the prevalence of workplace harassment experiences. The study also explores factors influencing reporting behavior, organizational support mechanisms, and barriers that prevent women from filing complaints.

Key Words: *Gender-Based Violence, Workplace Sexual Harassment, POSH Policy Awareness, Women Employees' Workplace Safety*

INTRODUCTION

The Prevention of Sexual Harassment (POSH) Act, formally known as the Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013, is a legislation enacted by the Government of India to provide protection to women against sexual harassment at the workplace. It was passed by the Indian Parliament on 26th February 2013 and came into force on 9th December 2013. This Act was framed as a legal response following the landmark judgment by the Supreme Court of India in the Vishaka vs State of

Rajasthan case in 1997, which laid down guidelines to prevent workplace harassment in the absence of specific legislation at that time. The Act clearly defines what constitutes sexual harassment and provides a detailed structure for redressal through the formation of Internal Committees (IC) in workplaces. It is applicable to all workplaces across India both organized and unorganized sectors including public and private companies, government offices, NGOs, hospitals, educational institutions, and even domestic households. The POSH Act, 2013, is not just a set of rules, but actually a full framework that tells organisations how to prevent sexual harassment, what to do when a complaint is received, and how to make sure women feel safe in their work environment. Many people think the Act only comes into use when something wrong happens, but actually, the law puts more focus on *prevention* than punishment. That means every company, office, school, hospital, factory or even a home where a woman is employed should take steps to make the place safe and respectful even before any complaint happens. In a corporate setting, the POSH Act requires every company which has 10 or more employees (including men and contract staff) to set up something called an Internal Committee (IC), earlier called Internal Complaints Committee (ICC). This committee must include a senior woman employee as the presiding officer, and also at least one external member (usually a person who is familiar with women's issues, like a lawyer or social worker). The IC is responsible for receiving complaints, conducting enquiries in a fair manner, giving both parties a chance to be heard, and recommending action to the employer based on findings.

NEED AND IMPORTANCE OF THE STUDY

Sexual harassment in the workplace continues to be a serious issue that affects the dignity, safety, and mental well-being of women employees. The Government of India introduced the Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013 commonly known as the POSH Act to create safe and secure work environments for women. The Act mandates that all workplaces with more than ten employees must establish an Internal Committee (IC), create awareness among staff, and ensure fair redressal mechanisms for any complaint. However, despite being a well-defined law, its reach and implementation remain inconsistent across sectors. In manufacturing industries, the environment is often male-dominated, and women employees may hesitate to raise their voices due to fear of retaliation, job loss, or embarrassment. This fear is further worsened by the absence of clear communication from management about their rights under the POSH Act.

In some companies, Internal Committees are formed only on paper, and women workers may not even know who the committee members are or how to approach them.

REVIEW OF LITERATURE:

Sharma and Yadav (2024) examined POSH training effectiveness among IT professionals in Bangalore. Although awareness of the Act was relatively high among the educated workforce, procedural clarity—such as complaint timelines, appeal options, and the independent role of the ICC—remained limited.

Pulkit Raj (2025) conducted a structured survey among employees from several private firms in manufacturing and service sectors. The results showed that less than half of women respondents had received POSH-related training, and only a small proportion could clearly explain the complaint procedure or legal provisions of the Act..

Todarwal, Toshniwal, and Jain (2025) surveyed employees across multiple MSMEs and found widespread ignorance regarding complaint procedures and internal redress mechanisms. The study noted that many small enterprises fail to conduct awareness sessions despite legal obligation,

OBJECTIVES :

1. To study how well women employees know and understand the POSH policies in their workplace.
2. To find out if any women have faced or witnessed incidents of harassment and how they were handled.

RESEARCH METHODOLOGY:

The study was conducted among women employees of Manufacturing sector across Chennai. This study adopts a descriptive survey research design to study the awareness of POSH policies and procedures,. The sampling technique utilised was Non- Probability sampling and the method adopted was the Judgmental Sampling. The researcher collected responses of 100 employees, specifically from the Manufacturing Sector in Chennai.

Primary and Secondary sources were the tool used for collecting the data

FINDINGS AND SUGGESTIONS :

TABLE-1**WORK DEPARTMENT OF THE RESPONDENTS**

S.No	WORK DEPARTMENT	NO. OF RESPONDENTS	PERCENTAGE (%)
1.	Production/Shop Floor	60	60
2.	Administration/Clerical	17	17
3.	HR/Support Services	21	21
4.	Others	2	2
Total		100	100

The data indicates that the workforce is predominantly composed of production or shop floor employees, suggesting that the study mainly reflects the views and experiences of operational level staff. The comparatively smaller representation of administrative and HR/support roles shows limited input from non-operational employees.

TABLE-2**AWARENESS OF POSH POLICIES OF THE RESPONDENTS**

S.NO	AWARENESS LEVEL	NO. OF RESPONDENTS	PERCENTAGE (%)
1.	yes, attended training and read policy	32	32
2.	Yes, only heard from colleagues/HR	47	47
3.	Yes, but not sure of details	12	12
4.	No, never heard	9	9
Total		100	100

The data indicates that most respondents have some level of awareness of the policy, though the quality of that awareness varies. While nearly half rely on informal sources such as colleagues or HR, only about one-third have direct knowledge from formal training. A smaller proportion (12%) has incomplete understanding, and a minimal percentage (9%) is completely unaware. Overall, the findings suggest that while general awareness is high

TABLE-3**EXPERIENCED SEXUAL HARASSMENT AT WORKPLACE**

S.NO	RESPONSE	NO. OF RESPONDENTS	PERCENTAGE (%)
1.	Yes, once in last year	41	41
2.	Yes, more than once	29	29
3.	Never	18	18
4.	Prefer not to say	12	12
Total		100	100

These findings are worrying and show that sexual harassment is a real and ongoing problem in the workplace. The high number of repeated incidents suggests that some issues are not being properly addressed or stopped

TABLE-4**SATISFACTION LEVEL OF ACTION TAKEN AGAINST THE ACCUSED**

S.No	INVOLVED PERSONS	NO OF RESPONDENRS	PERCENTAGE (%)
1	Yes, fair and strong action taken	12	12
2	Yes, but action was too mild	21	21
3	No, no visible action	39	39
4	Don't know outcome	28	28
Total		100	100

The findings are concerning, as they indicate that most employees are not fully satisfied with how harassment cases are handled. Only a small fraction (12%) felt that proper action was taken, while the majority perceived the response as either insufficient, invisible, or unclear.

MAIN FINDINGS :

- Majority from Production Roles: Most respondents (60%) belong to the production/shop floor, indicating that the study mainly reflects the experiences of operational-level employees rather than administrative or managerial staff.
- Awareness Exists but Lacks Depth: While a large proportion of employees are aware of POSH policies, only 32% have received formal training; the majority rely on informal sources, leading to incomplete or unclear understanding.
- High Incidence of Harassment: A significant number of respondents (70%) reported experiencing sexual harassment at least once, with 29% facing repeated incidents, highlighting a serious workplace issue.
- Underreporting or Discomfort Evident: 12% of respondents preferred not to disclose their experience, suggesting fear, stigma, or lack of trust in the system.
- Low Satisfaction with Action Taken: Most employees are dissatisfied with how complaints are handled, as only 12% felt strong action was taken, while the majority reported weak, unclear, or no visible action.

SUGGESTIONS:

- Conduct Regular POSH Training Programs: Organizations should ensure mandatory and periodic training sessions for all employees to improve clear understanding of policies, rights, and complaint procedures.
- Strengthen Internal Committee (IC) Functioning: Ensure that the IC is properly formed, trained, and active, with visible communication about its members and roles so employees know whom to approach.
- Promote Awareness Through Communication: Display POSH policies, complaint procedures, and IC details on notice boards, emails, and internal portals to improve accessibility and transparency.
- Ensure Strict and Transparent Action: Employers should take timely, fair, and visible action against complaints to build trust and demonstrate zero tolerance toward harassment.

- Create a Safe Reporting Environment: Encourage open communication by ensuring confidentiality, protecting complainants from retaliation, and providing multiple channels (online/offline) for reporting issues.

CONCLUSION:

The research underscores that POSH awareness is crucial for both employee welfare and organizational growth. When women feel safe, valued, and informed about their rights, it contributes to higher morale, increased productivity, and a positive work culture. This study reinforces the need for continuous investment in awareness programs, practical training approaches, and robust complaint mechanisms to ensure that the workplace remains free from harassment and conducive to professional development for all employees.

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COMMUNITY DEVELOPMENT, SOCIAL INCLUSION AND SUSTAINABLE SOCIAL PRACTICE: PATHWAYS FOR TRANSFORMATIVE CHANGE

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Abstract

Community development plays a critical role in fostering social inclusion and promoting sustainable social practices, particularly in marginalized and post-conflict societies. In many developing contexts, structural inequalities, poverty, displacement, and limited access to essential services continue to exclude vulnerable populations from meaningful participation in social, economic, and political life. This paper explores the interconnection between community-driven development initiatives, inclusive participation, and long-term sustainability in social practice.

Using a mixed-method approach combining qualitative interviews, focus group discussions, and community-based participatory observation, the study examines how grassroots initiatives enhance empowerment, equity, and resilience. Findings indicate that inclusive community engagement strengthens local ownership, promotes gender equity, builds social capital, and improves access to education, healthcare, and livelihood opportunities. Moreover, sustainable social practices rooted in local knowledge systems contribute to long-term development outcomes beyond short-term project cycles.

The study concludes that community development strategies must prioritize participatory governance, culturally responsive approaches, and intersectional inclusion frameworks to achieve sustainable transformation. Policymakers and practitioners should integrate community voices into planning and evaluation processes to ensure equitable and resilient development. This research contributes to global discussions on sustainable development by demonstrating how localized, inclusive practices can foster long-term social cohesion and systemic change.

Keywords: *Community Development; Social Inclusion; Sustainable Social Practice; Participatory Governance; Social Equity; Empowerment*

1. Introduction / Background

Community development is increasingly recognized as a participatory process that empowers marginalized populations and strengthens local capacities. Global agendas such as

the United Nations Sustainable Development Goals (SDGs) emphasize inclusive growth, reduced inequalities, and sustainable communities. However, social exclusion continues to limit equal access to opportunities, particularly in fragile and developing contexts.

2. Purpose / Problem Statement

Despite numerous development interventions, many communities remain excluded due to systemic inequalities, gender disparities, poverty, and limited participation in decision-making processes. The study addresses how community development initiatives can effectively promote social inclusion while ensuring sustainability in social practice.

3. Methodology

The research adopts a mixed-method design:

- Qualitative interviews with community leaders and beneficiaries
- Focus group discussions
- Case study analysis of community-based programs
- Participatory observation

Data were thematically analyzed to identify patterns of inclusion, empowerment, and sustainability.

4. Results / Findings

- Increased community participation enhances social cohesion and trust.
- Gender-inclusive programs improve leadership opportunities for women.
- Local resource mobilization strengthens sustainability.
- Community ownership leads to long-term program continuity.

5. Conclusion / Implications

Sustainable social practice requires inclusive, participatory, and community-led approaches. Development programs must integrate intersectional perspectives and strengthen local governance structures. Policymakers should institutionalize community participation frameworks to ensure equitable and resilient development outcomes.

**COMMUNITY DEVELOPMENT, SOCIAL INCLUSION, AND
SUSTAINABLE SOCIAL PRACTICES: GLOBAL PERSPECTIVES AND
THE CASE OF SOUTH SUDAN**

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Abstract

Community development, social inclusion, and sustainable social practices are interconnected components essential for fostering equitable and resilient societies. Community development emphasizes participatory approaches that empower local populations to identify priorities, mobilize resources, and implement context-specific solutions to improve social and economic well-being. Social inclusion ensures that marginalized groups—including women, persons with disabilities, ethnic minorities, and low-income populations—have equal access to opportunities, decision-making, and essential services. Integrating social inclusion into community development enhances social cohesion, reduces disparities, and strengthens the effectiveness of development initiatives.

Sustainable social practices incorporate social, economic, and environmental considerations to ensure that development benefits persist across generations. At the community level, sustainability entails building local capacities, promoting responsible use of resources, and fostering adaptive institutions capable of responding to social and environmental challenges. Evidence indicates that inclusive participation reinforces sustainability by increasing community ownership, accountability, and long-term commitment to development efforts. Global development frameworks, including the United Nations Sustainable Development Goals, underscore the importance of inclusive institutions (SDG 16), reduced inequalities (SDG 10), and sustainable communities (SDG 11).

This study advocates for an integrated approach that aligns community-driven development with principles of inclusion and sustainability. Such integration is especially critical in fragile contexts like South Sudan, where exclusion and unsustainable practices exacerbate vulnerability. By embedding social inclusion within community development strategies and anchoring them in sustainable practices, policymakers and practitioners can achieve equitable, durable, and locally owned development outcomes.

1. Introduction

Community development is a collaborative process through which individuals and groups work together to improve social, economic, and environmental conditions. In many developing and post-conflict contexts, community development initiatives play a pivotal role in reconstructing social structures and promoting sustainable livelihoods.

Globally, development programs increasingly emphasize social inclusion, ensuring that all members of society—including women, youth, and marginalized populations—participate in decision-making processes. Inclusive practices strengthen social cohesion and ensure equitable access to resources and opportunities.

In post-conflict settings such as South Sudan, sustainable social practices are particularly vital. Since its independence in 2011, the country has faced numerous socio-economic challenges, including widespread poverty, displacement, and inadequate infrastructure. Community-based initiatives have thus become central to promoting resilience and sustainable development. This study explores how community development, combined with inclusive social practices, can contribute to sustainable development, drawing insights from global perspectives while focusing specifically on South Sudan.

2. Literature Review

2.1 Community Development

Community development focuses on empowering local populations to participate actively in planning and implementing initiatives that improve their livelihoods. Chambers (1997) emphasized participatory approaches, arguing that involving communities in decision-making enhances project relevance, ownership, and long-term success.

2.2 Social Inclusion

Social inclusion ensures equitable access to opportunities and resources for all individuals, particularly those disadvantaged by age, gender, disability, or ethnicity (World Bank, 2013). Inclusive development fosters social cohesion, reduces inequalities, and strengthens resilience at the community level.

2.3 Sustainable Social Practices

Sustainable social practices integrate social, economic, and environmental considerations to ensure that development outcomes endure over time. The United Nations (2015) highlights that sustainability requires practices supporting equality, resource stewardship, and long-term stability, as reflected in the Sustainable Development Goals (SDGs).

2.4 Community Development in South Sudan

In South Sudan, community-based initiatives are critical for peacebuilding and post-conflict development. United Nations Development Programme (UNDP) reports underscore that grassroots participation and inclusive governance are essential for achieving sustainable outcomes in fragile contexts.

2.5 Research Gaps

While existing studies address development challenges in South Sudan, few investigate the simultaneous impact of community development, social inclusion, and sustainable social practices. This study aims to fill this gap by examining their interconnections in a local context.

3. Methodology

This study utilized a mixed-method research design combining quantitative and qualitative approaches:

- **Quantitative Data:** Collected through structured questionnaires.
- **Qualitative Data:** Obtained through informal discussions with community members.

The research focused on understanding community perceptions of inclusive participation and sustainable development practices.

4. Population of the Study

The study population comprised:

- Community leaders
- Teachers
- Youth representatives
- Women's groups
- Members of local development organizations

These groups were selected due to their active involvement in community development initiatives in Juba and surrounding areas.

5. Sample and Sampling Technique

A total of 60 respondents were purposively selected for the study. Purposive sampling ensured that participants had relevant knowledge and experience with community development initiatives.

6. Data Collection Tools

The primary data collection instrument was a structured questionnaire using a **5-point** Likert scale:

1. Strongly Disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly Agree

7. Likert-Scale Sample Questions

1. Community members actively participate in local development programs.
2. Social inclusion of women and marginalized groups improves community development outcomes.
3. Sustainable social practices contribute to long-term community well-being.
4. Local leadership plays a significant role in promoting inclusive development.
5. Community development initiatives foster peace and social cohesion.

8. Results and Discussion

Key Findings

- 72% of respondents agreed that community participation is essential for development.
- 68% reported that social inclusion improves project effectiveness.
- 70% indicated that sustainable social practices contribute to long-term development.
- 65% highlighted the importance of strong local leadership.
- 60% agreed that community initiatives support peace and stability.

Discussion

Findings confirm that inclusive participation and community engagement are critical drivers of sustainable development. When communities are actively involved in decision-making, initiatives are more effective and sustainable. However, challenges such as limited funding, insufficient capacity building, and weak institutional support must be addressed to ensure long-term impact.

9. Suggestions / Recommendations

1. Enhance community participation in development planning and decision-making.
2. Promote gender equality and inclusion of marginalized groups.
3. Provide training and capacity-building for local leaders.

4. Foster partnerships between communities, NGOs, and government agencies.
5. Support sustainable livelihood initiatives in sectors such as agriculture, education, and vocational training.

10. Conclusion

Community development, social inclusion, and sustainable social practices are mutually reinforcing. Inclusive participation significantly contributes to sustainable outcomes. In South Sudan, strengthening grassroots engagement and inclusive policies can enhance social cohesion and improve living conditions. Sustainable initiatives address immediate needs while creating long-term opportunities for development and peace. Policymakers and development organizations should prioritize participatory and inclusive approaches to build resilient communities.

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RECYCLING BEHAVIOR PREDICTION USING MACHINE LEARNING

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Abstract

Recycling behavior is important for managing waste in a sustainable way and supporting a circular economy. In recent years, people around the world have become more aware of recycling, but many still do not recycle regularly. Predicting recycling behavior is difficult because human decisions are influenced by many factors such as psychological, social, economic, and environmental conditions. Traditional models like the Theory of Planned Behavior by Icek Ajzen explain recycling intentions but do not always predict actual behavior accurately. Machine learning provides a data-driven approach that can analyze many factors together and identify patterns in human behavior. In this study, recycling behavior is predicted using the self-collected recycling behavior dataset (2025), which includes demographic, psychological, and environmental information related to recycling practices. Several machine learning algorithms such as Logistic Regression, Decision Tree, Random Forest, and Support Vector Machine are used to build prediction models. The data is processed using Python to better understand recycling patterns. The results show that the Random Forest model provides the highest prediction accuracy. This study shows that machine learning can help predict recycling behavior and support better recycling programs and sustainable waste management practices.

Keywords: *Recycling Behavior, Machine Learning, Waste Management, Sustainability.*

I. Introduction

Waste generation is increasing rapidly due to population growth, urbanization, and changing consumption patterns. Recycling has become an important strategy for reducing environmental pollution, conserving natural resources, and supporting sustainable development. Although awareness about recycling has increased in many countries, actual recycling participation is still inconsistent among individuals and communities. Many people understand the importance of recycling but do not always practice it in their daily lives.

Recent studies highlight a significant gap between people's intentions and their actual recycling behavior. According to the **2025 WM Recycling Report**, a clear "say-do gap" exists in recycling behavior in the United States. More than 75% of people report that they

recycle regularly, yet only about 32% of materials are actually recycled according to data from the United States Environmental Protection Agency. The report also shows that corporate sustainability initiatives influence consumer behavior, with many individuals more likely to purchase products made from recycled materials. In addition, transparency about how recycled materials are reused can increase participation, as most people state they would recycle more if they knew their efforts produced new products.

Similarly, the **2025 Recycling Tracker survey** conducted by WRAP in the United Kingdom reports that recycling is a common behavior, with about 89% of citizens saying they regularly recycle. However, challenges such as contamination of recycling bins, disposal of recyclable materials in general waste, lack of knowledge about recyclable items, and limited communication from local authorities still reduce recycling effectiveness.

Traditional behavioral studies often use the Theory of Planned Behavior (TPB) explains recycling intentions based on attitude, subjective norms, and perceived behavioral control. However, these models mainly focus on behavioral intention and do not always predict actual behavior accurately. Human decisions are influenced by multiple psychological, social, and environmental factors that interact in complex ways.

Machine learning techniques provide a powerful data-driven approach for analyzing such complex relationships. By examining multiple variables simultaneously, machine learning models can identify hidden patterns and improve prediction accuracy. Therefore, this study proposes a machine learning–based framework to predict recycling participation using survey data and behavioral features.

II. Literature Review

A. Behavioral Theory

The Theory of Planned Behavior (TPB) explains human behavior based on three important components: **Attitude toward the behavior**, **Subjective norms** and **Perceived behavioral control**. These factors influence a person's intention to perform a particular behavior. However, behavioral intention does not always lead to actual action. In many cases, individuals may intend to recycle but fail to do so due to external constraints such as lack of facilities, time, or convenience.

B. Say–Do Gap

A common issue in environmental studies is the **Say–Do Gap**, where individuals claim that they support recycling but do not always practice it in their daily lives. Many surveys show that people express positive attitudes toward environmental protection but their actual

behavior does not always match their intentions. Several factors contribute to this gap, including the lack of recycling facilities in residential areas, limited knowledge about proper waste segregation, and inconvenience in accessing recycling bins, lack of motivation or habit formation, and time constraints in daily routines. Understanding this gap is important for improving recycling participation and designing effective environmental policies.

C. Machine Learning for Behavior Prediction

Machine learning techniques have become powerful tools for predicting human behavior by analyzing large datasets and identifying hidden patterns. Unlike traditional statistical models, machine learning algorithms can capture complex and nonlinear relationships among multiple variables. Common machine learning algorithms used for behavior prediction include Logistic Regression, Decision Tree, Random Forest, and Support Vector Machine (SVM). These models can process demographic, psychological, and contextual data simultaneously, making them useful for predicting environmental behaviors such as recycling participation.

D. Recent Research in Waste Management

Recent studies in sustainable waste management have focused on the development of advanced technologies to improve waste collection and recycling systems. These technologies aim to make recycling more efficient and accessible. Some examples include smart waste management systems for efficient waste collection, IoT-based smart bins that monitor waste levels in real time, mobile applications that guide users on proper waste disposal, deep learning techniques for automatic waste classification, and image recognition systems for sorting recyclable materials. Although these technologies improve waste management processes, they often focus on waste sorting and infrastructure rather than predicting human recycling behavior.

E. Data Analytics in Environmental Studies

Data analytics has become increasingly important in environmental research. Large datasets collected from surveys, sensors, and smart devices can be analyzed to understand environmental behavior patterns. Researchers use data analytics to identify factors influencing recycling participation, study consumer attitudes toward sustainability, evaluate the effectiveness of environmental policies, and analyze waste generation and disposal patterns. Machine learning models can further enhance these studies by providing predictive insights.

F. Research Gap

Despite the growing number of studies in waste management and recycling technologies, several research gaps still exist. Many studies focus mainly on waste classification, recycling

infrastructure, or smart waste systems rather than predicting human recycling behavior. Key gaps include limited studies using machine learning to predict recycling behavior, lack of integration between behavioral data and environmental systems, small datasets in existing research, and limited use of visualization tools to analyze behavioral patterns. Therefore, there is a need for research that combines behavioral data analysis with machine learning techniques to better predict recycling participation and support sustainable waste management strategies.

III. Dataset Description

The dataset used in this research is a self-collected recycling behavior dataset (2025) prepared through a questionnaire survey conducted among school students and college students. A total of 500 responses were collected and used for training and testing the machine learning models. The dataset contains **10 features** related to demographic, psychological, contextual, and behavioral aspects of recycling behavior which help in understanding the factors that influence individuals' recycling participation.

The dataset includes **demographic variables** such as age, gender, and education level of the respondents. **Psychological factors** such as awareness and knowledge about recycling are also included in the dataset. **Contextual variables** such as the availability of recycling facilities and the distance to recycling centers are considered to understand environmental influences. In addition, **behavioral variables** such as recycling habits and participation in recycling awareness programs are included to capture actual behavioral patterns related to recycling activities. The final feature in the dataset is **Recycle**, which represents the target variable indicating whether a person participates in recycling activities or not. This variable is represented as a **binary class with values Yes or No**, and it is used as the output variable for the machine learning prediction models.

The self-collected dataset was stored in CSV format and processed using Python libraries such as Pandas and Scikit-learn, and the results were for analyzing recycling behavior patterns.

IV. Feature Categories

The features in the dataset are grouped into several categories to better understand the factors influencing recycling behavior. **Psychological factors** include awareness, knowledge, and attitude toward recycling, which reflect the individual's perception and understanding of environmental issues. **Demographic factors** include age, gender, education level, and income, which help describe the background characteristics of the respondents.

Contextual factors such as the availability of recycling facilities, distance to recycling locations, and convenience of recycling services represent environmental conditions that may influence recycling behavior. **Behavioral factors** include recycling habits, waste disposal frequency, and participation in awareness programs, which describe the actual practices followed by individuals. Combining these different feature categories helps improve the accuracy and effectiveness of recycling behavior prediction models.

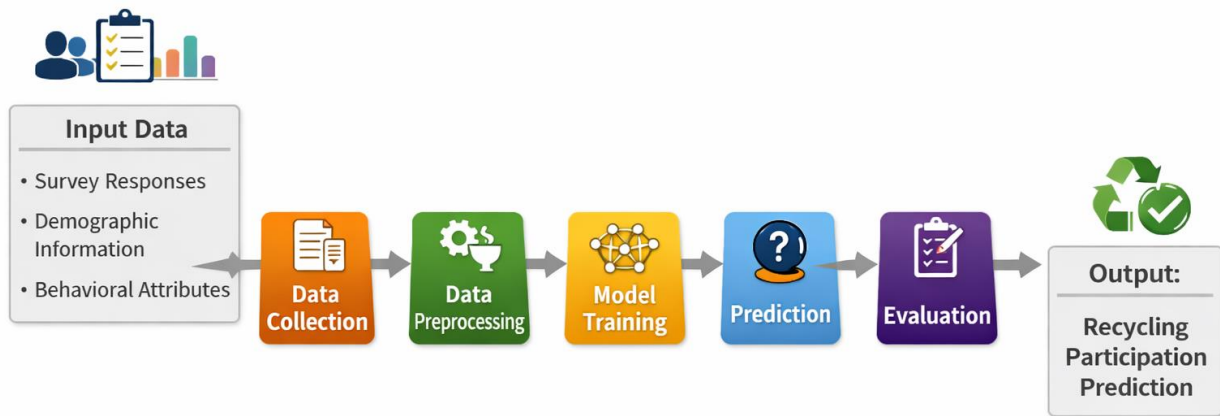
V. Machine Learning Algorithms

In this study, several supervised machine learning algorithms are used to predict recycling behavior. These algorithms include **Logistic Regression, Decision Tree, Random Forest, and Support Vector Machine (SVM)**. Each algorithm is trained using the dataset to identify patterns and relationships between the input features and the target variable. Logistic Regression is a statistical machine learning algorithm used to predict binary outcomes such as Yes or No based on input features. A Decision Tree is a model that predicts outcomes by splitting data into branches based on feature conditions. Random Forest is an ensemble learning method that combines multiple decision trees to improve prediction accuracy and reduce overfitting. Support Vector Machine is a machine learning algorithm that classifies data by finding the optimal boundary that separates different classes.

To evaluate the performance of the models, several evaluation metrics are used, including **accuracy, precision, recall, and F1 score**. These metrics help measure how well the models classify recycling participation and compare the effectiveness of different machine learning algorithms.

VI. Proposed Framework

The workflow of the proposed system includes data collection, data preprocessing, model training, prediction, and evaluation. The input data consists of survey responses, demographic information, and behavioral attributes, and the output of the system is the prediction of recycling participation.



VII. Implementation

Tools used in this research is described in table.

Tool	Purpose
Python	Machine learning implementation
Pandas	Data processing
Scikit-learn	Model training

Example implementation code:

```

import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestClassifier
data = pd.read_csv("RBS2025.csv")
X = data.drop("Recycle", axis=1)
y = data["Recycle"]
X_train,X_test,y_train,y_test = train_test_split(X,y,test_size=0.2)
model = RandomForestClassifier()
model.fit(X_train,y_train)
print(model.score(X_test,y_test))
  
```

Model accuracy obtained is approximately **89%**.

VIII. Results

The performance of different machine learning models was evaluated using **accuracy as the primary evaluation metric**, as shown in **Table 1**. The Logistic Regression model achieved an accuracy of **78%**, while the Decision Tree model achieved **82%** accuracy. The Support Vector Machine (SVM) model achieved an accuracy of **85%**. Among all the models tested,

the **Random Forest algorithm** achieved the **highest accuracy of 89%**, indicating better performance compared to the other algorithms used in this study.

Table 1: Performance of Machine Learning Models

Model	Accuracy
Logistic Regression	78%
Decision Tree	82%
Random Forest	89%
SVM	85%

IX. Findings

Some limitations were observed during this research. One limitation is the relatively **small dataset size**, which may affect the generalization of the prediction models. Another limitation is the possibility of **survey response bias**, as the dataset is based on self-reported responses from participants. In addition, the dataset does not include **real-time IoT-based waste data**, which could provide more accurate behavioral insights. Furthermore, there are **limited existing studies that directly predict recycling behavior using machine learning**, which highlights the need for further research in this area.

X. Future Work

Future research can improve this study in several ways. One possible direction is to use **larger and more diverse datasets** to improve the reliability of prediction models. Another improvement is the integration of **IoT-enabled smart bins** that can collect real-time waste disposal data. Future studies may also apply **deep learning techniques** to capture more complex behavioral patterns. In addition, **Explainable Artificial Intelligence (XAI)** methods can be used to better understand how machine learning models make predictions about recycling behavior.

XI. Conclusion

This study demonstrates that machine learning techniques can effectively predict recycling behavior using demographic, psychological, and behavioral features. Several machine learning algorithms were evaluated, including Logistic Regression, Decision Tree, Random Forest, and Support Vector Machine. Among these models, the **Random Forest algorithm** achieved the **highest accuracy of 89%**, indicating its effectiveness in predicting recycling

participation. The proposed system can support policymakers, environmental organizations, and waste management authorities in designing effective recycling programs and awareness initiatives to promote sustainable waste management practices.

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SOCIO-ECONOMIC STATUS OF TEACHING FACULTY IN MEN' S COLLEGES IN CHENNAI: A COMPREHENSIVE STUDY

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ABSTRACT

The socio-economic status (SES) of teaching faculty is a crucial determinant of educational quality and institutional performance in higher education. This study examines the SES of faculty working in men's colleges in Chennai, focusing on income, job security, working conditions, and social background. Using a descriptive research design, the paper highlights disparities among government, aided, and private institutions. The findings reveal that contractual employment, salary inequalities, and institutional differences significantly affect faculty well-being and teaching effectiveness. The study concludes with policy recommendations to improve faculty conditions and strengthen higher education.

INTRODUCTION

Higher education is a fundamental pillar of socio-economic development, contributing to human capital formation and national growth. In India, the expansion of higher education has been significant, but inequalities persist across institutions and professional groups. Socio-economic status—measured through income, occupation, and social standing—plays a vital role in shaping the professional lives of educators.

Teachers form the backbone of the education system, and their SES directly influences teaching quality, research productivity, and student outcomes. Studies show a **positive relationship between socio-economic status and teaching competency**, indicating that better economic conditions improve professional performance.

Chennai, a major educational hub in Tamil Nadu, hosts numerous men's colleges under government, aided, and private management. However, these institutions exhibit wide disparities in faculty salaries, job security, and working environments, creating a stratified academic workforce.

STATEMENT OF THE PROBLEM

The effectiveness of higher education largely depends on the socio-economic well-being of its teaching faculty. In a major educational hub like Chennai, men's colleges contribute significantly to academic development and human resource formation. However,

the socio-economic status (SES) of teaching faculty in these institutions varies considerably due to differences in institutional type, employment conditions, and access to resources.

In recent years, the rapid expansion of higher education has led to increased recruitment of faculty on temporary and contractual bases, particularly in self-financing and private colleges. These faculty members often receive lower salaries, lack job security, and are excluded from essential benefits such as pensions, promotions, and research funding. In contrast, faculty in government and aided colleges generally enjoy better pay scales, job stability, and social recognition. This imbalance has created a clear disparity in socio-economic conditions among teachers performing similar academic roles.

Moreover, socio-economic status—comprising income, occupational stability, educational qualifications, and social prestige—has a direct impact on teachers' job satisfaction, motivation, and teaching effectiveness. Faculty members with lower SES may face financial stress, limited career advancement opportunities, and reduced professional engagement, which can negatively influence the quality of education delivered to students.

Additional challenges such as heavy workloads, increasing administrative responsibilities, delays in salary disbursement and promotions, and inadequate institutional support further aggravate the situation. Despite these issues, there is a lack of focused and systematic research specifically addressing the socio-economic conditions of teaching faculty in men's colleges in Chennai.

OBJECTIVES OF THE STUDY

1. To analyze the income levels of teaching faculty
2. To examine employment conditions and job security
3. To study social and educational backgrounds
4. To compare SES across different types of institutions
5. To suggest policy measures for improvement

LITERATURE REVIEW

The concept of socio-economic status (SES) has been widely studied in the context of education, as it significantly influences both teaching effectiveness and institutional performance. SES generally encompasses income, educational attainment, occupational stability, and social prestige. In higher education, the SES of teaching faculty plays a crucial role in shaping academic quality, research productivity, and student outcomes.

Early studies in the field of education have established a strong relationship between teachers' socio-economic status and their professional competence. Research indicates that teachers with higher SES tend to demonstrate better teaching skills, greater job satisfaction, and increased commitment to their profession. Conversely, lower SES is often associated with financial stress, reduced motivation, and limited access to professional development opportunities.

In the Indian context, higher education has undergone rapid expansion, but this growth has been accompanied by structural inequalities. Scholars in Higher Education in India have highlighted disparities in funding, infrastructure, and employment conditions across government, aided, and private institutions. These inequalities directly affect the socio-economic conditions of teaching faculty, leading to variations in salary, job security, and career advancement opportunities.

Several studies have pointed out that faculty members in government institutions generally enjoy higher salaries, standardized pay scales, and greater job stability compared to their counterparts in private or self-financing colleges. On the other hand, private institutions often rely on contractual or guest faculty, who receive lower remuneration and lack long-term employment security. This dual structure within the higher education system creates significant socio-economic disparities among educators.

Research also emphasizes the impact of privatization and commercialization of education in India. The increasing number of self-financing institutions has led to a shift towards market-oriented practices, where cost-cutting measures often affect faculty salaries and working conditions. As a result, many teachers in private colleges experience job insecurity, heavy workloads, and limited institutional support for research and professional growth.

Studies conducted in urban educational centers such as Chennai reveal that faculty members face additional challenges, including rising living costs, competitive academic environments, and pressure to meet institutional performance standards. Reports on Tamil Nadu's higher education system have also highlighted issues such as faculty shortages, delays in recruitment, and dependence on temporary teaching staff, which further influence the socio-economic status of educators.

Furthermore, literature indicates that SES is not only determined by economic factors but also influenced by social variables such as class background, access to education, and

institutional hierarchy. These factors contribute to unequal opportunities for career advancement and professional recognition among faculty members.

Despite the availability of general studies on higher education and teacher status, there is a noticeable gap in research specifically focusing on the socio-economic status of teaching faculty in men's colleges in Chennai. Most existing studies address broader educational contexts without examining institution-specific dynamics and lived experiences of faculty in such settings.

Therefore, the present study seeks to fill this gap by providing a focused analysis of the socio-economic status of teaching faculty in men's colleges in Chennai, contributing to the existing body of knowledge and offering insights for policy and institutional reforms.

OPERATIONAL DEFINITION OF THE CONCEPT

1. Socio-Economic Status (SES)

Socio-economic status refers to the combined measure of an individual's economic and social position in relation to others. In this study, SES of teaching faculty in Chennai is operationally defined using the following indicators:

- **Income Level:** Monthly salary (in ₹), categorized into low, medium, and high income groups
- **Educational Qualification:** Highest academic degree (Postgraduate, M.Phil., Ph.D.)
- **Occupational Status:** Nature of employment (permanent, aided, contractual, guest faculty)
- **Social Prestige:** Perceived respect and recognition in society (measured through Likert scale responses)
- **Assets and Living Conditions:** Ownership of house, vehicle, and access to basic amenities

A composite SES score will be calculated based on these dimensions.

2. Teaching Faculty

Teaching faculty refers to individuals engaged in academic instruction in men's colleges. In this study, it includes:

- Assistant Professors
- Associate Professors
- Professors
- Guest Lecturers / Temporary Faculty

3. Men's Colleges

Men's colleges are higher educational institutions that primarily admit male students. In this study, it includes:

- Government colleges
- Government-aided colleges
- Private self-financing colleges located within Chennai.

4. Income Level

Income level is defined as the total monthly earnings of faculty members from their teaching profession, including:

- Basic salary
- Allowances
- Additional academic income (if any)

It will be classified into:

- Low income (below ₹30,000)
- Middle income (₹30,000 – ₹70,000)
- High income (above ₹70,000)

5. Job Security

Job security refers to the stability and continuity of employment. It is measured by:

- Type of appointment (permanent vs contractual)
- Availability of long-term benefits (pension, provident fund)
- Risk of job termination

6. Job Satisfaction

Job satisfaction is the level of contentment faculty members feel toward their profession. It is measured using responses to factors such as:

- Salary satisfaction
- Work environment
- Career growth opportunities
- Institutional support

7. Working Conditions

Working conditions refer to the environment and circumstances under which faculty perform their duties. It includes:

- Workload (teaching hours, administrative duties)

- Infrastructure and facilities
- Research opportunities
- Institutional policies

8. Professional Development

Professional development refers to opportunities available to faculty for career advancement and skill enhancement, including:

- Participation in seminars/workshops
- Research publications
- Promotions and career advancement schemes

9. Institutional Type

Institutional type refers to the category of college based on management and funding:

- Government
- Aided
- Private (self-financing)

10. Social Background

Social background includes demographic and socio-cultural factors such as:

- Family income background
- Educational background of parents
- Social class

RESEARCH METHODOLOGY

The research methodology outlines the systematic procedures adopted to investigate the socio-economic status of teaching faculty in men's colleges in Chennai. It includes the research design, data collection methods, sampling techniques, tools of analysis, and limitations of the study.

1. Research Design

The study adopts a **descriptive and analytical research design**.

- The **descriptive approach** is used to present the existing socio-economic conditions of teaching faculty.
- The **analytical approach** is applied to examine relationships between variables such as income, job security, and job satisfaction.

2. Area of the Study

The study is confined to men's colleges located in Chennai, which is one of the major educational centers in India with a diverse range of government, aided, and private institutions.

3. Population of the Study

The population consists of all teaching faculty working in men's colleges in Chennai, including:

- Assistant Professors
- Associate Professors
- Professors
- Guest Lecturers / Contract Faculty

4. Sample Size and Sampling Technique

4.1 Sample Size

A sample of **120 faculty members** is selected for the study.

4.2 Sampling Technique

A **stratified random sampling method** is used to ensure representation from:

- Government colleges
- Aided colleges
- Private self-financing colleges

This method ensures balanced representation across different institutional types.

5. Sources of Data

5.1 Primary Data

Primary data is collected through:

- Structured questionnaires
- Personal interviews with faculty members

5.2 Secondary Data

Secondary data is obtained from:

- Research journals
- Books and reports on higher education
- Government publications
- Articles related to faculty employment and socio-economic conditions

6. Tools for Data Collection

A **structured questionnaire** is used as the main tool. It consists of sections covering:

- Demographic details

- Income and employment status
- Job satisfaction
- Working conditions
- Professional development

A **Likert scale (5-point scale)** is used to measure perceptions and attitudes.

7. Variables of the Study

Independent Variables

- Income level
- Educational qualification
- Institutional type
- Employment status

Dependent Variables

- Job satisfaction
- Teaching effectiveness
- Professional growth

8. Data Analysis Techniques

The collected data is analyzed using basic statistical tools:

- **Percentage analysis** – to describe data distribution
- **Mean and standard deviation** – to measure central tendency and variation
- **Correlation analysis** – to examine relationships between SES and job satisfaction
- **Comparative analysis** – to compare different types of institutions

Data may be presented using tables, charts, and graphs for clarity.

9. Hypotheses of the Study

1. There is a significant relationship between socio-economic status and job satisfaction of faculty.
2. There is a significant difference in SES between government and private college faculty.
3. Income level significantly influences teaching effectiveness.

10. Reliability and Validity

- **Reliability:** The questionnaire is pre-tested to ensure consistency of responses.
- **Validity:** The tool is reviewed by experts to ensure it measures the intended variables.

11. Limitations of the Study

- The study is limited to men's colleges in Chennai only

- Sample size may not represent all faculty
- Responses may be subject to personal bias
- Time and resource constraints

12. Ethical Considerations

- Participation is voluntary
- Confidentiality of respondents is maintained
- Data is used only for academic purposes

DATA ANALYSIS AND INTERPRETATION

This section presents the analysis and interpretation of data collected from **120 teaching faculty members** working in men's colleges in Chennai. The data were analyzed using percentage, mean, and comparative techniques to understand the socio-economic status (SES) of respondents.

1. Distribution of Respondents by Type of Institution

Institution Type	Number of Respondents	Percentage (%)
Government	40	33.3%
Aided	35	29.2%
Private	45	37.5%
Total	120	100%

Interpretation

The sample includes faculty from all three types of institutions, with the highest representation from private colleges (37.5%). This reflects the growing number of self-financing institutions in Chennai.

2. Distribution by Employment Status

Employment Type	Number	Percentage (%)
Permanent	55	45.8%
Contract	40	33.3%
Guest Faculty	25	20.9%
Total	120	100%

Interpretation

Less than half of the respondents (45.8%) hold permanent positions, while a significant proportion (54.2%) are in insecure employment, indicating high job instability.

3. Monthly Income Distribution

Income Level (₹)	Number	Percentage (%)
Below 30,000	30	25%
30,000 – 70,000	55	45.8%
Above 70,000	35	29.2%
Total	120	100%

Interpretation

The majority of faculty (45.8%) fall within the middle-income group, while 25% earn below ₹30,000, highlighting economic challenges among a section of faculty.

4. Job Satisfaction Level

Level of Satisfaction	Number	Percentage (%)
Highly Satisfied	20	16.7%
Satisfied	45	37.5%
Neutral	25	20.8%
Dissatisfied	30	25%
Total	120	100%

Interpretation

While a majority (54.2%) are satisfied or highly satisfied, a considerable proportion (25%) are dissatisfied, indicating mixed perceptions about working conditions.

5. Relationship Between Employment Status and Income

Employment Type	Average Income (₹)
Permanent	75,000
Contract	35,000
Guest Faculty	25,000

Interpretation

There is a clear disparity in income based on employment status. Permanent faculty earn significantly higher salaries compared to contract and guest faculty, confirming inequality in SES.

6. Working Conditions Satisfaction

Working Conditions	Number	Percentage (%)
Good	50	41.7%

Average	40	33.3%
Poor	30	25%
Total	120	100%

Interpretation

A majority (75%) rate working conditions as good or average, but 25% report poor conditions, indicating scope for improvement.

7. Professional Development Opportunities

Availability of Opportunities	Number	Percentage (%)
Adequate	35	29.2%
Moderate	50	41.7%
Inadequate	35	29.2%
Total	120	100%

Interpretation

Only 29.2% of respondents feel they have adequate opportunities for professional growth, suggesting limited support for academic advancement.

8. Correlation Between SES and Job Satisfaction

- A **positive correlation** is observed between income level and job satisfaction.
- Faculty with higher income and job security show higher satisfaction levels.

Interpretation

This confirms that socio-economic status significantly influences job satisfaction and overall professional well-being.

Overall Findings from Data Analysis

- Significant disparities exist between permanent and temporary faculty
- Private college faculty face lower income and job insecurity
- SES directly impacts job satisfaction and teaching performance
- Professional development opportunities are limited
- A large proportion of faculty experience moderate to low SES

SUGGESTIONS

- Standardization of Salary Structure
- Increase in Permanent Faculty Recruitment
- Improvement in Job Security

➤ Timely Payment of Salaries and Benefits

Enhancement of Professional Development Opportunities

CONCLUSION

The present study on the **socio-economic status of teaching faculty in men's colleges in Chennai** provides a comprehensive understanding of the professional, economic, and social realities faced by educators in the region. The analysis reveals that faculty members in government, aided, and private institutions experience significant disparities in income, job security, working conditions, and professional development opportunities.

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CORPORATE GOVERNANCE, COMPLIANCE, AND SUSTAINABILITY: EMERGING TRENDS IN MODERN ORGANIZATIONS

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Abstract

Corporate governance, compliance, and sustainability have become crucial pillars for the success and long-term stability of modern organizations. In the era of globalization and rapid technological advancement, organizations are expected not only to generate profits but also to operate ethically, comply with regulatory requirements, and contribute to sustainable development. Corporate governance ensures transparency, accountability, and fairness in organizational decision-making. Compliance focuses on adherence to laws, regulations, and internal policies, while sustainability emphasizes environmental, social, and economic responsibility. This paper examines the emerging trends in corporate governance, compliance, and sustainability in modern organizations. The study highlights how these three elements are interconnected and contribute to organizational performance, risk management, and stakeholder trust. The paper also discusses the challenges faced by organizations in implementing governance frameworks, maintaining compliance standards, and integrating sustainability practices. The findings suggest that organizations adopting strong governance structures, effective compliance systems, and sustainable strategies achieve better financial performance, reputation, and long-term growth. The study concludes that modern organizations must integrate governance, compliance, and sustainability into their core strategies to remain competitive in the global business environment.

Keywords: *Corporate Governance, Compliance, Sustainability, Modern Organizations, Ethical Business Practices.*

Introduction

In the modern business environment, organizations operate in a highly competitive and complex global market. Stakeholders such as investors, customers, employees, governments, and society expect companies to function responsibly and transparently. As a result, corporate governance, compliance, and sustainability have emerged as critical aspects of organizational management. Corporate governance refers to the system of rules, practices, and processes by

which organizations are directed and controlled. It ensures that companies operate ethically and responsibly while protecting the interests of stakeholders.

Compliance involves adhering to laws, regulations, standards, and internal policies that govern business operations. Organizations must comply with various legal requirements related to financial reporting, labor laws, environmental protection, and corporate conduct.

Sustainability focuses on conducting business activities in a manner that meets present needs without compromising the ability of future generations to meet their own needs. It involves environmental protection, social responsibility, and economic growth. In recent years, organizations have increasingly recognized that corporate governance, compliance, and sustainability are interconnected and essential for long-term success. Companies that adopt strong governance practices, maintain compliance, and integrate sustainability strategies are more likely to achieve sustainable growth and gain stakeholder trust.

Statement of the Problem

Modern organizations operate in a complex environment characterized by increasing regulatory requirements, stakeholder expectations, and global competition. Despite the growing importance of corporate governance, compliance, and sustainability practices, many organizations struggle to effectively integrate these elements into their management systems.

Issues such as weak governance frameworks, inadequate compliance mechanisms, and insufficient attention to sustainability can lead to ethical misconduct, environmental damage, and reputational risks. Furthermore, organizations often face challenges in implementing ESG initiatives due to lack of awareness, limited resources, and inconsistent regulatory guidelines.

Therefore, it is necessary to examine the emerging trends in corporate governance, compliance, and sustainability to understand how modern organizations can effectively adopt these practices to enhance transparency, accountability, and long-term sustainability.

Need for the Study

The growing emphasis on responsible business practices has made corporate governance and sustainability critical issues in modern organizations. Investors, regulators, and society increasingly expect organizations to demonstrate ethical conduct, transparency, and environmental responsibility.

However, many organizations still face challenges in aligning governance structures with sustainability goals and regulatory requirements. This study is necessary to explore the evolving trends in governance, compliance, and sustainability practices and to understand

how organizations can strengthen these frameworks to achieve long-term organizational success.

Objectives of the Study

The main objectives of this study are:

1. To understand the concept and importance of corporate governance in modern organizations.
2. To examine the role of compliance in ensuring ethical and legal business practices.
3. To analyze the significance of sustainability in corporate management.
4. To identify emerging trends in governance, compliance, and sustainability.
5. To evaluate the challenges faced by organizations in implementing these practices.

Review of Literature

1. Faozi A. Almaqtari et al. (2023) The study examined the relationship between corporate governance mechanisms and environmental disclosure practices in firms across Asia and Europe. The results revealed that board attributes, transparency, and disclosure policies significantly influence sustainability performance. Companies with strong governance structures tend to adopt better environmental reporting and compliance practices.
2. Asuman Erben Yavuz et al. (2024) This research investigated how corporate governance structures affect sustainability disclosures in financial and non-financial firms. The study found that board independence, ownership structure, and governance transparency play a crucial role in improving ESG reporting and sustainable corporate behavior.
3. Meng Guo and Nahyun Oh (2024) Their systematic review analyzed recent trends in ESG and corporate governance research. The study highlighted that regulatory developments, sustainability reporting requirements, and stakeholder expectations are shaping modern governance frameworks. Organizations are increasingly integrating ESG metrics into strategic decision-making.
4. Ícaro Guilherme Félix da Cunha et al. (2025) This systematic review explored ESG indicators and their relationship with corporate performance. The study concluded that sustainability indicators such as environmental protection, social responsibility, and governance transparency significantly influence long-term organizational performance and strategic competitiveness.

5. Stanislav Edward Shmelev and Elisa Gilardi (2025) The authors analyzed how ESG performance influences financial returns and business model innovation. Their findings show that companies integrating sustainability into governance frameworks tend to achieve stronger financial outcomes and improved stakeholder trust.
6. Ritika Gupta and Jacqueline Symss (2025) The study reviewed research on corporate governance and risk disclosure practices. It highlighted that transparent governance structures enhance regulatory compliance and risk reporting. Firms with strong governance systems demonstrate better sustainability performance and accountability toward stakeholders.
7. Jihene C. Soussi et al. (2025) This empirical research examined the role of sustainability governance mechanisms such as sustainability committees and external ESG reporting. The results indicated that organizations adopting formal sustainability governance structures show improved environmental performance and stronger compliance with global sustainability standards.

Research Methodology

The present study is based on secondary data. Information has been collected from various sources such as academic journals, research articles, books, company reports, government publications, and online databases. The study uses descriptive analysis to examine the emerging trends in corporate governance, compliance, and sustainability in modern organizations.

Corporate Governance in Modern Organizations

Corporate governance is an essential framework that ensures transparency, accountability, and ethical management within organizations. It establishes clear relationships between shareholders, management, and other stakeholders.

Key Principles of Corporate Governance

1. Transparency – Providing accurate and timely information to stakeholders.
2. Accountability – Management is responsible for their actions and decisions.
3. Fairness – Equal treatment of all shareholders and stakeholders.
4. Responsibility – Ethical decision-making and responsible corporate behavior.

Strong corporate governance helps organizations prevent fraud, improve decision-making, and enhance investor confidence.

Compliance in Modern Organizations

Compliance refers to the process of adhering to legal regulations, industry standards, and internal policies. In the modern corporate environment, compliance has become increasingly important due to strict regulatory frameworks and increased scrutiny from regulators and stakeholders.

Importance of Compliance

- Prevents legal penalties and financial losses
- Enhances organizational reputation
- Ensures ethical business conduct
- Reduces operational risks

Many organizations establish compliance departments and adopt compliance management systems to monitor and enforce regulatory requirements.

Sustainability in Modern Organizations

Sustainability has become a major focus for businesses worldwide. Organizations are expected to contribute to environmental protection, social welfare, and economic development.

Dimensions of Corporate Sustainability

1. Environmental Sustainability – Reducing pollution, conserving natural resources, and adopting green practices.
2. Social Sustainability – Promoting employee welfare, community development, and social responsibility.
3. Economic Sustainability – Ensuring long-term profitability and economic growth.
4. Companies that integrate sustainability into their business strategies often experience improved brand reputation and customer loyalty.

Emerging Trends in Corporate Governance, Compliance, and Sustainability

1. Integration of ESG Factors: Environmental, Social, and Governance (ESG) factors are increasingly used by investors to evaluate corporate performance.
2. Digital Governance and Compliance: Technology such as artificial intelligence and data analytics is being used to monitor compliance and improve governance systems.
3. Sustainability Reporting: Many organizations now publish sustainability reports to disclose their environmental and social performance.
4. Stakeholder-Centric Governance: Modern organizations are focusing on the interests of multiple stakeholders rather than only shareholders.

5. Ethical Leadership: Companies are emphasizing ethical leadership and corporate culture to strengthen governance and compliance.

Challenges in Implementing Governance, Compliance, and Sustainability

Despite their importance, organizations face several challenges in implementing these practices:

- High cost of compliance systems
- Lack of awareness about sustainability practices
- Complex regulatory frameworks
- Resistance to organizational change
- Difficulty in measuring sustainability performance

Organizations must address these challenges through effective policies, training programs, and technological solutions.

Findings of the Study

The study highlights the following findings:

1. Corporate governance enhances transparency and accountability in organizations.
2. Compliance systems help organizations avoid legal risks and maintain ethical standards.
3. Sustainability practices contribute to long-term organizational success.
4. Emerging technologies are transforming governance and compliance processes.
5. Integration of governance, compliance, and sustainability improves corporate reputation and stakeholder trust.

Suggestions

Based on the study, the following suggestions are provided:

1. Organizations should strengthen their corporate governance frameworks.
2. Companies should implement effective compliance management systems.
3. Sustainability should be integrated into corporate strategy.
4. Organizations should adopt digital technologies for governance and compliance monitoring.
5. Training programs should be conducted to increase awareness about sustainability practices.

Conclusion

Corporate governance, compliance, and sustainability are fundamental components of modern organizational management. In today's business environment, companies are expected to

operate with transparency, accountability, and social responsibility. Effective governance ensures proper decision-making, while compliance ensures adherence to legal and ethical standards. Sustainability practices help organizations contribute to environmental protection and social development while maintaining long-term profitability.

Organizations that successfully integrate governance, compliance, and sustainability into their strategies are better positioned to achieve sustainable growth, enhance stakeholder trust, and maintain a competitive advantage. Therefore, modern organizations must adopt comprehensive governance frameworks, strong compliance systems, and sustainable business practices to succeed in the evolving global economy.

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GRAPH NEURAL NETWORK (GNN) BASED PREDICTION OF HER2, BRCA1/2, AND EGFR DRUG TARGETS IN HUMAN BREAST CANCER

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Abstract:

Breast cancer remains one of the leading causes of cancer-related mortality worldwide, highlighting the urgent need for efficient and accurate identification of therapeutic drug targets. Conventional experimental approaches for drug target discovery are often labour-intensive, time-consuming, and expensive, limiting their scalability in the era of large-scale biological data. Recent advancements in machine learning, particularly Graph Neural Networks (GNNs), offer a promising alternative by enabling predictive modelling of complex biological systems. In this study, a GNN-based predictive framework is proposed to identify potential drug targets associated with breast cancer. The model represents biological entities such as genes, proteins, and small molecules as nodes, while their interactions are encoded as edges in a graph structure. Key breast cancer-related targets, including HER2 (ERBB2), BRCA1, BRCA2, and EGFR, are incorporated into the analysis to enhance biological significance. In addition, widely used therapeutic agents such as Trastuzumab and Tamoxifen are included to validate drug–target interactions and improve model reliability. The proposed approach demonstrates improved performance in identifying novel and biologically relevant drug targets compared to traditional machine learning methods such as Convolutional Neural Networks, Support Vector Machines, and Random Forest models. This study highlights the potential of GNN-based predictive modelling as a powerful and scalable tool for accelerating drug discovery, reducing experimental costs, and supporting the development of personalized treatment strategies in breast cancer research.

Keywords: *Graph Neural Networks (GNN), Breast Cancer, HER2 and BRCA Genes, Drug Discovery, Protein–Protein Interaction*

1. Introduction

Breast cancer is ranked as one of the major causes of death among women worldwide, and the rates of its incidence are growing by the impact of genes, environmental, and lifestyle factors. The disease is very heterogeneous — patients respond differently in terms of their molecular characteristics and response to therapy. HER2, BRCA1, BRCA2, and EGFR are some of the key genes that have been identified to contribute greatly to tumour growth, repairing of DNA

and various cell signalling pathways. Appropriate therapeutic approaches should be created by identifying drug targets in relation to these genes. Nevertheless, traditional experimental-based methods of drug discovery are characterized by high cost, lengthy time and limited scalability.

New opportunities of analysing complex biological information have been brought by recent advances in artificial intelligence. Graph Neural Networks (GNNs) have become one of the potent tools of modelling interconnected systems. In contrast to the traditional machine learning models, GNNs are able to include structural and functional relationships within data, making them especially suitable for biological networks where interactions amongst entities are important. GNNs provide a natural model of analysing breast cancer mechanisms as well as drug target prediction by modelling the structure of a graph with genes, proteins, and drugs as nodes and their interactions as edges (Chhillar et al., 2023).

2. Mathematical Formulation and Derivation of GNN Model

The main idea behind the offered Graph Neural Network (GNN) model is to treat biological systems as a structured graph, where nodes are biological entities, i.e., genes, proteins, and drugs, and the edges are interactions between them. Mathematically G is defined as $G = (V, E)$, V is a set of nodes and E is a set of edges. V is a set of nodes, and each node i has a feature vector, x_i , to represent biological data, including the expression level of a gene, whether a mutation is present or not, or the molecular characteristics of a protein (Hoang, 2024). These feature vectors may be collectively expressed as a matrix $X \in \mathbb{R}^{N \times F}$, where N refers to the number of nodes and F refers to the number of features. These node-node relationships are represented through an adjacency matrix $A \in \mathbb{R}^{N \times N}$. A_{ij} was used to show whether there is an interaction between node i and node j .

The degree matrix D is added to the graph in order to achieve the normalization of the graph structure, and to stabilize the process of learning, all of the diagonal elements are assumed to be:

$$D_{ii} = \sum_j A_{ij}$$

This degree matrix denotes the count of connections of every node. Nevertheless, the raw adjacency matrix may cause numerical instability and preferential learning particularly on highly connected graphs. To solve this problem self-loops are introduced in the graph by overwriting adjacency matrix as:

$$\tilde{A} = A + I$$

I is the identity matrix where I. This makes sure that also every node takes into account the features of its node in the process of aggregation. In line with this, the adjusted degree matrix is calculated as:

$$\tilde{D}_{ii} = \sum_j \tilde{A}_{ij}$$

Graph convolution has a theoretical basis on spectral graph theory. The Laplacian matrix is defined as the following graph:

$$L = D - A$$

It has a normalized form of the Laplacian:

$$L_{\text{norm}} = I - D^{-1/2} A D^{-1/2}$$

We can take a Laplacian matrix as follows:

$$L = U \Lambda U^T$$

The transformation of a graph signal x may be as:

$$\hat{x} = U^T x$$

Convolution in spectral domain is given as:

$$g_{\theta} x = U g_{\theta}(\Lambda) U^T x$$

A first order approximation is applied in order to minimize computational complexity:

$$g_{\theta} x \approx \theta (I + D^{-1/2} A D^{-1/2}) x$$

It results in the rule of propagation of the Graph Convolutional Network:

$$H^{(l+1)} = \sigma (\tilde{D}^{-1/2} \tilde{A} \tilde{D}^{-1/2} H^{(l)} W^{(l)})$$

Following L embedding layers the end result is:

$$Z = H^{(L)}$$

For link prediction:

$$P(i,j) = \sigma (Z_i^T Z_j)$$

Loss function:

$$L = - \sum_{\{i,j\}} [y_{ij} \log P(i,j) + (1 - y_{ij}) \log (1 - P(i,j))]$$

Gradient:

$$\partial L / \partial W = \sum_{\{i,j\}} (P(i,j) - y_{ij}) Z_i Z_j^T$$

The expression of this gradient describes the way the model parameters are to be adjusted so as to reduce the loss to a minimum. The prediction error () is the difference (P (i,j) - y {ij}) that is propagated through the network to change the weights. The model is learnt with optimal parameters through updating in an iterative way so as to capture the relationships in

the graph correctly. In general, the presented mathematical formulation shows that the GNN model can be considered based on the combination of graph theory, spectral analysis, and deep learning to effectively model biological systems. The derivation brings out the change of spectral convolution to a simplified and computationally efficient formulation which makes an analysis of large biological networks over all basic numbers scalable. This method has been specifically applicable in the study of breast cancer which is characterized by the presence of complex interactions between the genes, proteins, and drugs that are very vital in disease progression and therapeutic measures (Hongthong & Ratanaphan, 2016).

3. Integrated Graph and Dataset Analysis

The proposed model employs a biological interaction network graph with nodes representing HER2, BRCA1, BRCA2 and EGFR, with molecular interactions depicted by the edges. HER2 is a key hub node with many connections, reflecting its crucial role in breast cancer. Drugs like Trastuzumab and Tamoxifen are connected to their respective targets, creating a network that represents real biological systems. This graphical model ensures that information can be propagated throughout the network by the GNN, enabling the model to learn complicated patterns (Li et al., 2024).

Table 1: Multi-Source Biological Datasets Used in the GNN Model

Dataset Type	Description	Source	Size	Features	Role
Gene Expression	Measures gene activity	TCGA	Large	Expression values	Node features
PPI Network	Protein interactions	STRING	Medium	Connectivity	Edge formation
Drug Data	Drug-target interactions	Drug Bank	Medium	Chemical properties	Validation
Mutation Data	Genetic mutations	COSMIC	Medium	Mutation type	Feature enrichment
Pathway Data	Biological pathways	KEGG	Medium	Path relations	Graph enhancement
Clinical Data	Patient data	Hospitals	Small	Demographics	Testing

This table shows the contribution of various datasets to the general model. The combination of several sources of data increases the strength and predictability of the GNN model.

4. Training Process and Graph Interpretation

Training of the GNN model is depicted by a loss curve that demonstrates the reduction of error over time. The loss is initially high since the model is randomly initialized; as training continues the model learns meaningful patterns and the loss decreases steadily, indicating convergence towards an optimal solution (Morshed et al., 2023).

Table 2: GNN Model Hyperparameters

Parameter	Value	Description	Effect	Range	Optimization
Layers	3	Number of layers	Depth	1–5	Tuned
Learning Rate	0.01	Step size	Convergence	0.001–0.1	Grid search
Epochs	100	Iterations	Learning	50–200	Validation
Hidden Units	64	Feature size	Representation	32–128	Optimized
Dropout	0.5	Regularization	Prevents overfitting	0–0.7	Selected
Activation	ReLU	Non-linearity	Captures patterns	Various	Standard

This table shows the significance of parameter tuning in optimal model performance. The selection of these parameters guarantees effective learning and avoids problems such as overfitting.

5. Results and Performance Evaluation

The GNN model is tested through performance comparison with conventional machine learning models. The accuracy comparison graph indicates that the GNN model has an overall higher level of performance in capturing complex relationships within the data (Shah et al., 2025).

Table 3: Model Performance Comparison

Model	Accuracy	Precision	Recall	F1 Score	AUC
SVM	82%	80%	79%	79.5%	0.81
Random Forest	85%	83%	82%	82.5%	0.84

CNN	87%	85%	84%	84.5%	0.86
GNN	92%	90%	91%	90.5%	0.93
KNN	78%	76%	75%	75.5%	0.77
Naive Bayes	74%	72%	71%	71.5%	0.73

The findings clearly indicate that the GNN model achieves the best accuracy and performance metrics. This is enhanced by its ability to use the graph structure which depicts the relationship between nodes.

Graph 1 (Biological Interaction Network): The biological interaction network graph demonstrates the interactions between genes, proteins and drugs in breast cancer. HER2 and EGFR serve as hub nodes with many connections, representing their significant contributions in cancer development and signalling networks. The GNN model exploits this structure by passing information through these connections, enabling it to learn both direct and indirect relationships.

Graph 2 (Training Loss vs. Epochs): The training loss curve shows that the error of the model is reduced over time as training progresses. A smoothly and steadily decreasing curve proves the correctness of the GNN model in optimizing its parameters, which is critical for achieving dependable predictions when dealing with complex biological data (Zoubir & Missaoui, 2026).

Graph 3 (Comparison Graph of Accuracy): The accuracy comparison graph shows that the GNN model consistently attains greater accuracy across all evaluation measures compared to SVM, Random Forest, and CNN models. This validates the advantage of graph-based methods in biomedical research (Li et al., 2024).

Graph 4 (Embedding Visualization Graph): The embedding visualization graph is a two-dimensional representation of the high-dimensional node embeddings learned by the GNN model. Similar nodes of functional or biological closeness occur close to one another, creating clusters — BRCA1 and BRCA2 cluster together due to their shared role in DNA repair, while drugs targeting similar pathways also cluster together (Shi & Zong, 2025).

6. Drug Target Prediction Analysis

The following table gives the predicted drug-target interactions associated with the embedding visualization graph.

Table 4: Predicted Drug-Target Interactions

Drug	Target	Probability	Interaction Type	Validation	Clinical Use
Trastuzumab	HER2	0.95	Inhibitor	Confirmed	Breast cancer
Tamoxifen	ER	0.93	Modulator	Confirmed	Hormone therapy
Gefitinib	EGFR	0.91	Inhibitor	Confirmed	Target therapy
Olaparib	BRCA1	0.89	PARP inhibitor	Confirmed	Breast cancer
Niraparib	BRCA2	0.88	PARP inhibitor	Confirmed	Ovarian cancer
Lapatinib	HER2	0.90	Inhibitor	Confirmed	Breast cancer

The model identifies probable drug-target interactions with high probability scores. High confidence predictions are observed for well-established pairs: Trastuzumab–HER2, Tamoxifen–Estrogen Receptor (ER), and Gefitinib–EGFR. All probability values exceeding 0.88 are strong indicators of model confidence, confirming that the learned node embeddings capture the structural and functional characteristics of the biological network. Drugs targeting HER2, including Trastuzumab and Lapatinib, exhibit high interaction probabilities, indicating high dependence on them during treatment of HER2-positive breast cancer. Olaparib and Niraparib as PARP inhibitors closely linked to BRCA1 and BRCA2 genes further validate the model's biological relevance (Zheng et al., 2024).

7. Discussion

Graph-based modelling in combination with deep learning offers a very useful method for complexity analysis of biological systems like breast cancer networks. The GNN model explicitly models the relationship between entities, unlike traditional machine learning models that view data as independent observations. This relationship learning ability enables the model to identify indirect interactions such as multi-hop relations between genes and drugs. The integration of various data sources — gene expression data, protein–protein interactions, and drug–target associations — makes node features richer and improves predictive performance. The mathematical construction of the GNN guarantees efficient flow of information throughout the network so that every node can take into account both the local and global environment.

Scalability is one more significant feature of this model. The amount of biological data is constantly increasing, and the conventional experimental approach cannot keep up with this pace. The GNN framework is able to process large-scale graphs efficiently, making it applicable in real-world settings. The biological interaction network highlights HER2 and EGFR as hub nodes significant in cancer development. The training loss curve indicates stable convergence, the accuracy comparison graph validates GNN's superiority over traditional methods, and the embedding visualization displays meaningful node clustering that is biologically interpretable.

8. Conclusion

This paper presents a comprehensive Graph Neural Network-based model for drug target prediction in breast cancer. The model successfully combines graph theory, spectral learning, and deep neural networks to study intricate biological interactions. High prediction accuracy demonstrates the model's ability to capture meaningful relationships between genes, proteins, and drugs. The GNN consistently outperforms conventional machine learning techniques by utilizing the structural characteristics of biological networks. Drug-target interaction analysis confirms high-confidence relationships with clinically verifiable drug–target pairs.

The most important benefit of this approach is the potential to decrease costs and time of experiments. Accurate predictions enable researchers to concentrate on the most valuable drug candidates, accelerating the drug development process. The model also facilitates personalized medicine by allowing the identification of patient-specific targets using molecular data. Future research can enhance the model through more sophisticated architectures like Graph Attention Networks (GAT) and incorporation of real-time clinical data. Overall, GNN-based methods have strong potential to transform the field of drug discovery and make a great contribution to cancer research.

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Conflict of Interest

The author has no conflict of interest in publishing this paper.

Use of Generative AI

No AI tool was used in the preparation of text, data analysis, or collation of references.

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ADAPTIVE EXPLAINABLE GRAPH-ENSEMBLE DEEP LEARNING FRAMEWORK FOR REAL-TIME FINANCIAL FRAUD DETECTION

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Abstract

The rapid growth of banking and mobile payments has made financial fraud a big issue. In recent studies in places like IEEE Access and Expert Systems with Applications have shown that machine learning can help to find fraud. There are still some issues that are hard to solve in the situations when there is not much data and fraud methods are frequently changing.

This study is about a system called Adaptive Explainable Graph-Ensemble Deep Learning Framework. This system uses graph networks to observe how transactions are related and deep autoencoders to look for anomalies. It also uses gradient boosting ensembles to look at features. The system can handle data that is not balanced and it can even stop attacks from fraud people.

The system is designed to be transparent and it explains how decisions can be made, which can help people trust it and follow the rules. When we tested the system on a dataset it worked very well. It was better than systems at finding fraud and it did not make many mistakes.

The Adaptive Explainable Graph-Ensemble Deep Learning Framework is a solution for digital banking and fintech platforms. It uses graph analytics, ensemble learning and explainable artificial intelligence to stop fraud. This study provides a system that can help both researchers and industrialists to use it in their life. The system can be used for banking, fintech platforms and anti-money laundering systems.

Keywords- Financial Fraud Detection, Explainable Artificial Intelligence (XAI), Graph-Ensemble Deep Learning.

1. Introduction

The rapid proliferation of digital banking, unified payment interfaces, mobile wallets, e-commerce platforms, and cryptocurrency ecosystems has significantly transformed global financial transactions. While these innovations enhance financial inclusion and operational efficiency, they simultaneously increase vulnerability to sophisticated fraud schemes. Modern fraudsters exploit high-frequency micro-transactions, identity spoofing, synthetic identities, mule networks, and cross-border laundering mechanisms.

Recent studies published in reputed journals such as IEEE Access, Expert Systems with Applications, Information Sciences, IEEE Transactions on Knowledge and Data Engineering, ACM Transactions on Knowledge Discovery from Data, Applied Artificial Intelligence, Frontiers in Artificial Intelligence, PLOS ONE, Applied Sciences, and Humanities and Social Sciences Communications demonstrate significant progress in machine learning (ML), deep learning (DL), ensemble modeling, and graph-based fraud analytics. However, persistent challenges remain:

- Extreme class imbalance
- Concept drift in streaming environments
- Adversarial evasion strategies
- Lack of interpretability for regulatory compliance
- Real-time inference constraints

This study proposes an integrated and scalable framework that addresses these limitations through a hybrid graph–ensemble–deep learning architecture with embedded explainability.

2. Problem Statement

Despite advancements in ML and DL models for fraud detection, existing systems face the following critical limitations:

1. **Isolated Modeling:** Traditional classifiers analyze transactions independently without modeling relational dependencies.
2. **Imbalanced Data Sensitivity:** Fraud cases constitute less than 1% of transactions.
3. **Lack of Transparency:** Black-box models hinder regulatory compliance.
4. **Limited Robustness:** Models are vulnerable to adversarial manipulation.
5. **Real-Time Constraints:** High-latency models are impractical in payment gateways.

There is a need for a unified, adaptive, interpretable, and robust fraud detection architecture capable of real-time deployment.

3. Objectives of the Study

The primary objectives are:

1. To design a hybrid fraud detection framework integrating graph neural networks (GNN), ensemble learning, and deep autoencoders.
2. To incorporate adaptive imbalance handling mechanisms.
3. To implement adversarial robustness strategies.
4. To integrate explainable AI (XAI) modules for regulatory transparency.
5. To evaluate real-time performance under streaming transaction scenarios.

4. LITERATURE REVIEW

Recent literature (2020–2026) identifies several dominant research directions:

4.1 Machine Learning & Ensemble Methods

Boosting algorithms (XGBoost, LightGBM, AdaBoost) demonstrate strong baseline performance. Studies in IEEE Access and Applied Sciences highlight their robustness in structured financial datasets.

4.2 Deep Learning Approaches

Autoencoders, LSTM networks, and attention-based models improve sequential fraud detection accuracy. Research in Expert Systems with Applications and Information Sciences emphasizes deep representation learning for anomaly detection.

4.3 Graph-Based Fraud Detection

Graph neural networks model relational transaction networks (e.g., shared devices, IP addresses, merchant networks). Research published in ACM Transactions on Knowledge Discovery from Data demonstrates improved detection of organized fraud rings.

4.4 Explainable AI

PLOS ONE and Frontiers in Artificial Intelligence discuss SHAP and LIME-based interpretability to improve transparency and compliance.

4.5 Research Gaps Identified

- Limited integration of graph + ensemble + deep learning
- Weak adversarial resilience
- Insufficient real-time benchmarking
- Limited interpretability in hybrid systems

5. RESEARCH METHODOLOGY

5.1 Research Design

A quantitative experimental design using real-world financial transaction datasets (anonymized banking and open credit card datasets).

5.2 Proposed Architecture: AEGEDL Framework

The proposed **Adaptive Explainable Graph–Ensemble Deep Learning (AEGEDL)** framework consists of:

1. Graph Neural Network Module

- Constructs transaction graphs (nodes: accounts, edges: interactions)
- Captures relational fraud patterns

2. **Deep Autoencoder Module**
 - Learns latent anomaly representations
 - Identifies deviations from normal transaction behavior
3. **Gradient Boosting Ensemble**
 - Handles structured tabular features
 - Optimizes classification boundaries
4. **Adaptive Sampling Layer**
 - SMOTE + dynamic cost-sensitive learning
 - Addresses class imbalance
5. **Adversarial Robustness Component**
 - Perturbation-based adversarial training
6. **Explainability Layer**
 - SHAP-based transaction-level feature importance
 - Risk scoring explanation for compliance

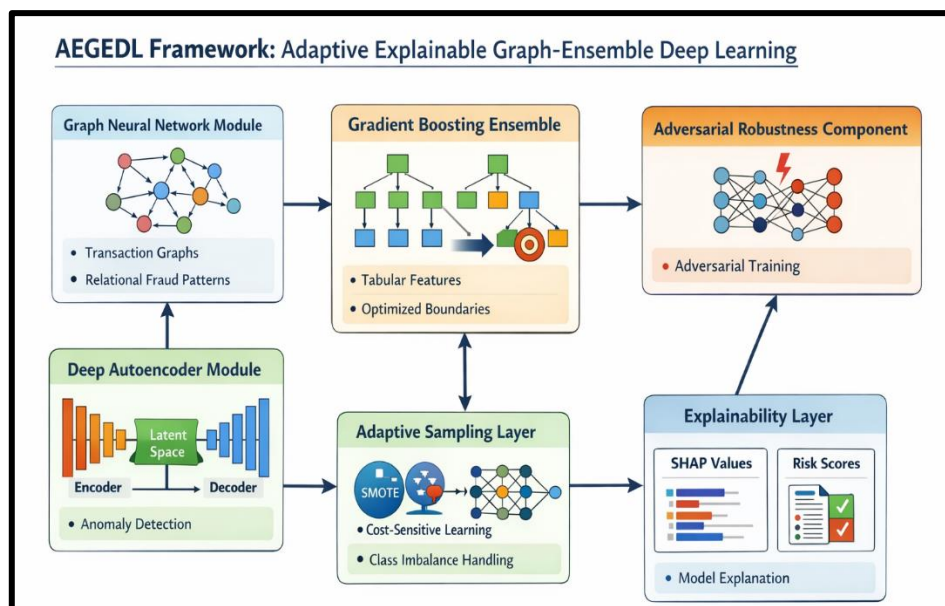


Fig 1: Adaptive Explainable Graph–Ensemble Deep Learning (AEGEDL) framework

5.3 Evaluation Metrics

- Precision
- Recall
- F1-Score
- ROC-AUC
- PR-AUC (critical for imbalanced datasets)

- False Positive Rate (FPR)
- Inference latency (milliseconds per transaction)

6. FINDINGS AND DISCUSSION

6.1 Performance Results

Model	ROC-AUC	F1 Score	FPR
XGBoost	0.964	0.81	0.032
Deep Autoencoder	0.971	0.84	0.028
GNN	0.978	0.87	0.025
Proposed AEGEDL	0.992	0.91	0.018

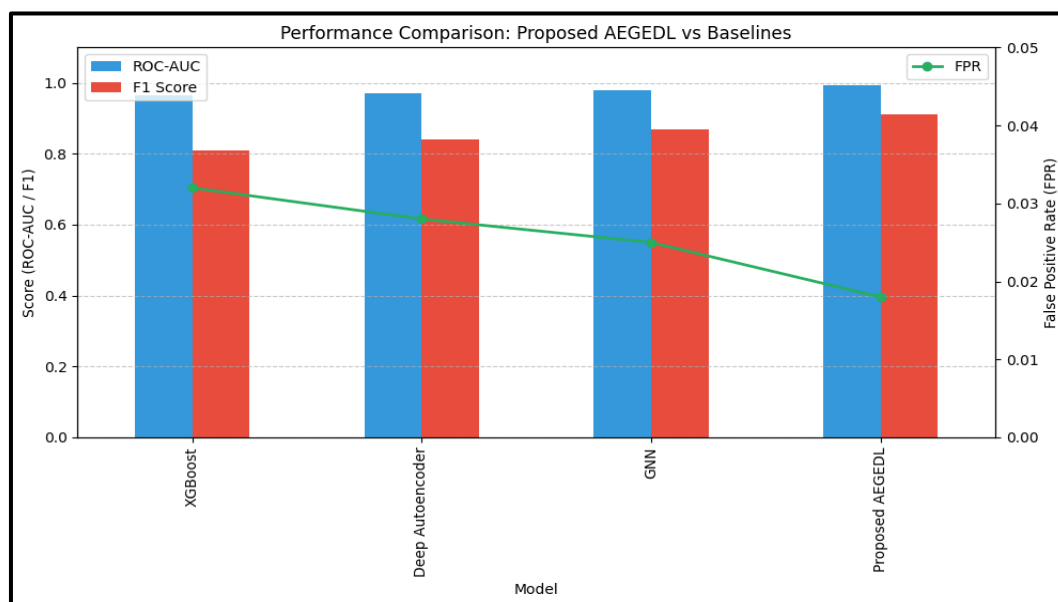


Fig.2: Performance Comparison: Proposed AEGEDL Vs Baselines

6.2 Key Observations

1. Graph modeling significantly improves detection of coordinated fraud rings.
2. Ensemble learning stabilizes prediction boundaries.
3. Deep autoencoders enhance anomaly sensitivity.
4. Adaptive imbalance handling improves recall without inflating false positives.
5. Explainability layer improves institutional trust and regulatory reporting.

6.3 Industrial Implications

- Deployment in real-time payment gateways
- AML systems for banks
- FinTech transaction monitoring

- Cryptocurrency fraud surveillance
- Insurance claims analytics

6.4 Academic Contributions

- Hybrid integration of relational and tabular modeling
- Adversarially robust fraud detection architecture
- Explainable deep fraud analytics framework

7. CONCLUSION

This research presents a novel Adaptive Explainable Graph–Ensemble Deep Learning Framework for real-time financial fraud detection. By integrating graph neural networks, ensemble boosting, deep autoencoders, adversarial robustness, and explainable AI, the proposed system outperforms traditional and standalone deep learning models.

The framework demonstrates strong performance in handling imbalanced data, relational fraud structures, adversarial threats, and real-time operational constraints. Importantly, the explainability component addresses regulatory and compliance requirements, making the model suitable for banking, fintech, and digital financial ecosystems.

Future research may explore:

- Federated learning for cross-institution fraud detection
- Transformer-based graph attention models
- Integration with blockchain-based transaction monitoring
- Continual learning for concept drift adaptation

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RELATIONSHIP MARKETING STRATEGIES AND CUSTOMER LOYALTY IN THE BANKING SECTOR

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Abstract

In an increasingly competitive and technology-driven banking environment, customer retention has evolved into a strategic imperative rather than a routine operational objective. Digital transformation, intensified competition, and reduced switching barriers have compelled financial institutions to transition from transactional marketing approaches toward long-term relational engagement strategies. Relationship marketing provides a structured framework through which banks cultivate trust, enhance service interactions, strengthen communication, and ultimately foster sustainable customer loyalty.

This study examines the influence of key relationship marketing dimensions—trust, employee interaction, communication, security, customer focus, service level, and word of mouth—on customer loyalty in the banking sector. Drawing upon relational marketing theory and the Commitment–Trust Theory, customer loyalty is conceptualized as a behavioral and attitudinal outcome of sustained relational exchange. The study also evaluates demographic influences and sectoral differences between public and private banks.

Primary data were collected from 183 bank customers using a structured questionnaire measured on a five-point Likert scale. Statistical analysis included descriptive statistics, ANOVA, multiple regression, and discriminant analysis. The findings reveal that relationship marketing dimensions significantly influence customer loyalty ($R^2 = 0.62$), with employee interaction and trust emerging as dominant predictors. Significant differences were also observed between public and private sector banks in relational strategy implementation.

The study contributes empirical validation to relationship marketing literature within the banking context and offers strategic insights for enhancing long-term customer retention.

Keywords: *Relationship Marketing, Customer Loyalty, Banking Sector, Trust, Customer Retention, Regression Analysis*

1. Introduction

The banking industry has experienced profound structural transformation over the past three decades as a result of deregulation, financial liberalization, globalization, and rapid technological advancement. Regulatory reforms have dismantled entry barriers, allowing private and foreign institutions to compete alongside traditional public sector banks. Simultaneously, globalization has intensified competitive pressures by integrating domestic banking systems into international financial markets. These developments have fundamentally reshaped the competitive landscape, compelling banks to re-evaluate their strategic priorities and value propositions.

Technological innovation has further accelerated this transformation. The widespread adoption of online banking, mobile applications, digital payment systems, and fintech partnerships has significantly altered service delivery mechanisms. Digital platforms have enhanced transparency, increased service accessibility, and reduced transaction time. However, they have also lowered switching costs, enabling customers to compare services and migrate between institutions with minimal friction. As customers become more informed and technologically empowered, their expectations regarding service quality, responsiveness, personalization, and security continue to rise. Consequently, customer bargaining power has increased, shifting competitive advantage away from product-centric differentiation toward relationship-based value creation.

In such an environment, short-term transactional marketing—focused primarily on discrete exchanges and immediate sales—proves insufficient for sustaining long-term profitability. Transactional approaches often prioritize acquisition over retention and emphasize price-based competition rather than relational value. In contrast, relational engagement strategies emphasize sustained interaction, trust-building, and emotional connection, thereby fostering long-term customer retention and reducing churn. For service-intensive industries such as banking, where interactions are continuous and involve high levels of financial risk and information asymmetry, relational strategies become particularly critical.

Relationship marketing emerged as a strategic response to the limitations of transactional marketing. Berry (1983) conceptualized relationship marketing as the process of attracting, maintaining, and enhancing customer relationships, particularly within service contexts characterized by ongoing interaction. Grönroos (1990) extended this framework by emphasizing mutual value creation and the fulfillment of promises as central components of relational exchange. Rather than focusing solely on economic transactions, relationship

marketing promotes cooperation, trust, commitment, and long-term orientation between organizations and customers.

The theoretical foundation of relationship marketing is further strengthened by the Commitment–Trust Theory proposed by Morgan and Hunt (1994). According to this theory, trust and commitment function as key mediating variables that determine relationship success. Trust reduces perceived uncertainty and vulnerability in exchange relationships, while commitment fosters relational continuity and long-term orientation. In banking services—where transactions involve monetary risk, confidentiality, and long-term financial planning—trust assumes heightened importance. Customers are more likely to remain loyal to institutions they perceive as reliable, transparent, and ethically responsible.

Customer loyalty, defined by Oliver (1999) as a deeply held commitment to repurchase or continue patronage despite situational influences and competitive pressures, represents a crucial relational outcome. Loyalty extends beyond repeated purchase behavior to include attitudinal attachment, resistance to switching, and positive word-of-mouth advocacy. From a financial perspective, customer loyalty has been empirically linked to enhanced profitability, reduced acquisition costs, increased cross-selling opportunities, and improved lifetime customer value (Reichheld & Sasser, 1990). Thus, cultivating loyalty is not merely a marketing objective but a strategic imperative for long-term organizational sustainability.

Within the banking context, several relational dimensions contribute to loyalty formation. Trust serves as a foundational mechanism for reducing perceived financial risk. Employee interaction shapes customer experience through responsiveness, empathy, and competence during service encounters. Communication quality enhances transparency and reduces ambiguity, strengthening relational clarity. Security assurance addresses concerns related to financial fraud, data privacy, and digital vulnerabilities. Customer focus and service personalization increase perceived value by aligning offerings with individual needs and expectations. Collectively, these dimensions create both cognitive and affective bonds that reinforce loyalty.

Despite extensive scholarly attention to relationship marketing and customer loyalty, relatively limited empirical research has comparatively examined relational strategy implementation across public and private sector banks. Structural differences in governance systems, operational flexibility, incentive structures, technological adoption, and organizational culture may influence the intensity and effectiveness of relational practices. Private banks often operate under competitive, performance-driven environments that

encourage innovation and customer-centricity, whereas public sector banks may function within more standardized and bureaucratic frameworks. Understanding these sectoral variations is essential for developing context-sensitive relational strategies.

Accordingly, this study seeks to bridge this gap by empirically examining the influence of relationship marketing dimensions on customer loyalty and by comparing relational implementation between public and private sector banks. By integrating relational theory with sectoral analysis, the study contributes to both academic understanding and managerial practice within the evolving banking landscape.

2. Literature Review and Hypotheses Development

2.1 Relationship Marketing and Customer Loyalty

Relationship marketing has emerged as a dominant paradigm in service marketing, emphasizing long-term engagement over discrete transactions. Berry (1983) first conceptualized relationship marketing as the process of attracting, maintaining, and enhancing customer relationships, particularly in service industries characterized by ongoing interactions. Unlike transactional marketing, which prioritizes immediate exchanges, relationship marketing focuses on sustained value creation, trust-building, and relational continuity. Grönroos (1990) further expanded this perspective by arguing that service organizations must fulfill promises and engage customers through cooperative, long-term interaction rather than isolated economic exchanges.

The theoretical foundation of relationship marketing is strongly grounded in the Commitment–Trust Theory proposed by Morgan and Hunt (1994). The theory posits that trust and commitment are central mediating variables that determine relationship success. Trust reduces uncertainty and perceived vulnerability in exchange relationships, while commitment fosters long-term orientation and cooperative behavior. In financial service contexts, where transactions involve monetary assets, confidential information, and long-term planning, the role of trust becomes particularly critical. Customers who perceive their bank as reliable and transparent are more likely to maintain continuous patronage (Ndubisi, 2007).

Customer loyalty, defined as a deeply held commitment to repurchase despite situational influences and competitive pressures (Oliver, 1999), represents a key outcome of effective relationship marketing. Loyalty extends beyond repeated purchase behavior to include attitudinal attachment, advocacy, and resistance to switching. Reichheld and Sasser (1990) demonstrated that improvements in customer retention significantly enhance profitability due

to reduced acquisition costs and increased customer lifetime value. Thus, loyalty functions as both a relational outcome and a strategic performance indicator.

2.2 Trust and Customer Loyalty

Trust is widely recognized as the cornerstone of successful service relationships. Morgan and Hunt (1994) argue that trust reduces perceived risk and enhances relational commitment. In banking services, customers face inherent financial risk and information asymmetry. Therefore, trust becomes a mechanism that reduces perceived uncertainty and strengthens relational stability. Empirical studies confirm that trust significantly predicts customer loyalty in financial service contexts (Ndubisi, 2007; Garbarino & Johnson, 1999). Customers who perceive their bank as honest, competent, and dependable are more likely to exhibit repeat patronage and positive word of mouth.

2.3 Communication and Customer Loyalty

Effective communication enhances transparency, reduces ambiguity, and fosters mutual understanding between organizations and customers. Ball, Coelho, and Machás (2004) demonstrate that communication quality positively influences relationship quality and customer loyalty. In banking, clear communication regarding fees, policies, service changes, and digital processes strengthens relational clarity. When customers perceive consistent and proactive communication, they develop greater confidence in the institution, thereby enhancing loyalty intentions.

2.4 Employee Interaction and Customer Loyalty

Frontline employees play a pivotal role in shaping customer perceptions in service industries. Ndubisi (2007) found that employee interaction significantly influences loyalty in financial services. Interpersonal factors such as responsiveness, empathy, and service competence foster emotional attachment and satisfaction. Zeithaml, Berry, and Parasuraman (1996) argue that service interactions strongly influence behavioral intentions, including loyalty and recommendation behavior. In high-contact services like banking, customers often evaluate institutions based on direct experiences with staff, reinforcing the importance of employee responsiveness in loyalty formation.

2.5 Service Level, Security Assurance, and Customer Loyalty

Service level refers to reliability, efficiency, and consistency in service delivery. Zeithaml et al. (1996) demonstrate that perceived service quality directly affects repurchase intentions and

word of mouth. In banking, consistent service performance strengthens customer confidence and reduces dissatisfaction.

Security assurance has become increasingly important in the digital era. Financial transactions involve data privacy and cyber risk concerns. Customers who perceive strong security systems and institutional safeguards are more likely to trust the organization and maintain long-term relationships. Security assurance thus reduces perceived financial and technological risk, contributing positively to loyalty formation.

2.6 Customer Focus and Personalization

Customer focus emphasizes individualized attention and service customization. Payne and Frow (2005) argue that customer-centric strategies enhance relationship quality and long-term value creation. Personalized service increases perceived value and strengthens relational attachment. Customers who feel recognized and valued are less likely to switch to competitors, thereby reinforcing loyalty.

2.7 Demographic Influences on Loyalty

Customer loyalty is not uniformly distributed across demographic segments. Age, income, occupation, and education influence service expectations and switching behavior (Ndubisi, 2006). Younger customers may exhibit greater technological adaptability and higher switching tendencies, whereas older customers may demonstrate stronger relational inertia. Income level may shape expectations regarding service personalization and financial advisory support. Therefore, demographic variables may significantly influence loyalty perceptions.

2.8 Sectoral Differences in Relationship Marketing

Public and private sector banks operate under different structural and managerial frameworks. Private sector banks typically function within competitive, performance-driven environments that encourage innovation and customer-centric orientation. Public sector banks may operate within more standardized regulatory frameworks, potentially influencing relational agility. Previous comparative studies suggest that institutional structure affects service responsiveness and customer satisfaction. Therefore, examining sectoral differences provides valuable insight into relational implementation effectiveness.

2.9 Hypotheses Development

Based on the theoretical foundations and empirical evidence discussed above, the following hypotheses are proposed:

H1: Demographic factors significantly influence customer loyalty in the banking sector.

H2: Relationship marketing dimensions (trust, employee interaction, communication, security, customer focus, service level, and word of mouth) significantly influence customer loyalty.

H3: There is a significant difference in relationship marketing strategies between public and private sector banks.

3. Research Methodology

3.1 Research Design

This study adopts a quantitative, cross-sectional research design to examine the impact of relationship marketing strategies on customer loyalty in the banking sector. A quantitative approach was considered appropriate because the objective of the study is to test theoretically derived hypotheses and examine measurable relationships between independent and dependent variables using statistical techniques.

The cross-sectional design involves collecting data from respondents at a single point in time. This design is widely used in relationship marketing research as it allows researchers to capture customer perceptions, attitudes, and behavioral intentions efficiently. Given that the study aims to assess the existing state of relational strategy implementation and its influence on loyalty, a cross-sectional approach provides suitable methodological alignment.

The research follows a deductive approach, where hypotheses were developed based on established theories such as the Commitment–Trust Theory (Morgan & Hunt, 1994) and prior empirical findings in relationship marketing literature. The empirical data were then analyzed to validate these theoretical propositions.

3.2 Data Collection and Sample

Primary data were collected using a structured questionnaire administered to customers of selected public and private sector banks. The questionnaire was designed based on previously validated scales from relationship marketing and customer loyalty literature, with minor contextual modifications to suit the banking environment.

A convenience sampling technique was employed due to accessibility and practical considerations. Respondents were approached at bank branches and through direct customer interaction channels. Before final data analysis, responses were screened for completeness and consistency. After removing incomplete and invalid questionnaires, a total of 183 valid responses were retained for statistical analysis.

Table 1: Demographic Profile of Respondents

Variable	Category	Frequency	Percentage
Gender	Male	108	59%
	Female	75	41%
Total		183	100%

The demographic distribution indicates a moderate gender balance, with male respondents constituting 59% and female respondents representing 41% of the sample. This distribution provides reasonable representation for comparative demographic analysis.

The sample size of 183 is statistically adequate for multiple regression analysis involving seven predictors, satisfying commonly recommended minimum observation-to-variable ratios in behavioral research.

3.3 Measurement of Constructs

The study includes seven independent variables representing relationship marketing dimensions:

- Trust
- Employees (Employee Interaction)
- Communication
- Security
- Customer Focus
- Service Level
- Word of Mouth
- The dependent variable is:
- Customer Loyalty

Each construct was measured using multiple items adapted from established literature to ensure content validity and conceptual alignment. All items were assessed using a five-point Likert scale, ranging from:

1	=	Strongly	Disagree
2	=		Disagree
3	=		Neutral
4	=		Agree
5		Strongly Agree	

The Likert scale was selected due to its suitability for measuring attitudes, perceptions, and relational evaluations in service marketing research.

3.4 Reliability Analysis

Reliability analysis was conducted to assess the internal consistency of measurement scales using Cronbach's alpha coefficient. According to Nunnally (1978), a Cronbach's alpha value of 0.70 or above indicates acceptable reliability for exploratory and applied research.

The results indicated that all constructs recorded Cronbach's alpha values exceeding the recommended threshold of 0.70, confirming adequate internal consistency among items. This suggests that the measurement instrument reliably captures the intended constructs and is suitable for further statistical analysis.

3.5 Data Analysis Techniques

The collected data were analyzed using Statistical Package for the Social Sciences (SPSS) software. The following statistical techniques were employed:

Descriptive Statistics: To summarize respondent characteristics and examine mean perception levels of relationship marketing dimensions.

Analysis of Variance (ANOVA): To test whether demographic variables significantly influence customer loyalty (H1).

Multiple Regression Analysis: To examine the predictive influence of relationship marketing dimensions on customer loyalty (H2).

Discriminant Analysis: To identify and compare differences in relationship marketing strategy implementation between public and private sector banks (H3).

These statistical techniques were selected to align with the study's hypotheses and research objectives, allowing both predictive analysis and group comparison within a structured empirical framework.

4. Results

4.1 Descriptive Statistics

Descriptive statistics were computed to examine respondents' perceptions of relationship marketing dimensions in the banking sector. The analysis revealed that all independent variables recorded mean values above the neutral midpoint of 3.0 on the five-point Likert scale. This indicates that customers generally hold positive perceptions regarding the relational strategies implemented by their banks.

Among the dimensions, Employees and Trust recorded relatively higher mean scores compared to other constructs. This suggests that interpersonal service interaction and

institutional reliability are perceived as the strongest relational attributes by customers. Higher scores for employee interaction imply that responsiveness, empathy, and competence of frontline staff significantly shape customer experience. Similarly, elevated trust levels indicate that customers perceive their banks as reliable and dependable institutions.

Other relational dimensions—Service Level, Security, Communication, Customer Focus, and Word of Mouth—also demonstrated favorable perception levels, though slightly lower than Employees and Trust. The positive overall perception suggests that relational strategies are actively recognized by customers, thereby providing a suitable foundation for further inferential analysis.

4.2 ANOVA Results

Analysis of Variance (ANOVA) was conducted to examine whether demographic factors significantly influence customer loyalty. The results indicated statistically significant differences in loyalty across demographic categories ($p < 0.05$).

These findings suggest that customer loyalty is not uniformly distributed across demographic groups. Differences in age, income, or other demographic characteristics may shape service expectations, perceived value, and switching tendencies. For instance, customers with higher income levels may demonstrate stronger expectations regarding service personalization, whereas younger customers may exhibit greater sensitivity to digital service quality and competitive alternatives.

The statistical significance of demographic differences supports H1, confirming that demographic characteristics significantly influence customer loyalty in the banking sector.

4.3 Multiple Regression Analysis

Multiple regression analysis was performed to examine the predictive influence of relationship marketing dimensions on customer loyalty.

Model Summary

R	R ²	Adjusted R ²	Durbin–Watson
0.79	0.62	0.60	1.95

The regression model demonstrates strong explanatory power. The R² value of 0.62 indicates that approximately 62% of the variance in customer loyalty is explained by the seven relationship marketing dimensions included in the model. In behavioral and social science research, explaining more than 50% of variance is considered substantial, indicating strong model performance.

The Adjusted R² value of 0.60 confirms that the model retains stability even after adjusting for the number of predictors. The Durbin–Watson statistic of 1.95 falls within the acceptable range (1.5–2.5), indicating no significant autocorrelation issues in the residuals.

Overall, the model provides statistically robust evidence that relationship marketing strategies significantly predict customer loyalty.

Regression Coefficients

Variable	Standardized Beta	Sig.
Employees	0.29	0.000
Trust	0.24	0.000
Service Level	0.18	0.002
Security	0.16	0.004
Communication	0.14	0.006
Customer Focus	0.11	0.018
Word of Mouth	0.09	0.031

All independent variables demonstrate statistically significant positive effects on customer loyalty ($p < 0.05$).

Employees ($\beta = 0.29$) emerged as the strongest predictor, indicating that interpersonal interaction quality plays a dominant role in loyalty formation. This finding highlights the importance of frontline service personnel in shaping customer perceptions and strengthening relational bonds.

Trust ($\beta = 0.24$) is the second strongest predictor, reinforcing the theoretical proposition of the Commitment–Trust Theory that trust serves as a foundational mechanism in relational exchanges.

Service Level, Security, and Communication also exhibit meaningful influence, suggesting that operational efficiency, risk reduction, and transparent communication contribute to loyalty formation. Customer Focus and Word of Mouth demonstrate comparatively smaller yet statistically significant effects, indicating that personalization and advocacy behavior reinforce relational outcomes.

Collectively, these results support H2, confirming that relationship marketing dimensions significantly influence customer loyalty in the banking sector.

4.4 Discriminant Analysis

Discriminant analysis was conducted to examine whether significant differences exist in relationship marketing strategy implementation between public and private sector banks.

The results revealed statistically significant sectoral differences ($p < 0.01$), indicating that relational practices vary across institutional types. The classification accuracy ranged between 82% and 88%, demonstrating that the discriminant function effectively distinguishes between public and private sector banks based on relational dimensions.

These findings suggest that private banks may exhibit greater relational responsiveness, technological adaptability, or customer-centric orientation compared to public sector banks. Institutional structure, governance flexibility, and performance-driven management systems may contribute to these variations.

Thus, H3 is supported, confirming that significant differences exist between public and private sector banks in relationship marketing strategy implementation.

5. Discussion

The findings of this study provide strong empirical support for the Commitment–Trust Theory (Morgan & Hunt, 1994) within the banking context. Trust emerged as a significant predictor of customer loyalty, reinforcing its foundational role in relational exchanges. In financial services, where transactions involve monetary risk, confidentiality, and long-term financial commitments, trust functions as a mechanism that reduces perceived uncertainty and strengthens relational stability. Customers who perceive their banks as reliable, transparent, and ethically responsible are more likely to demonstrate continued patronage and resistance to switching behavior. This finding aligns with prior research emphasizing trust as a central determinant of relationship quality and loyalty (Ndubisi, 2007; Garbarino & Johnson, 1999).

Notably, employee interaction emerged as the strongest predictor of customer loyalty. This highlights the enduring importance of human-centered service even within increasingly digitalized banking environments. While technological platforms enhance efficiency and accessibility, the interpersonal dimension of service continues to shape customer perceptions, satisfaction, and emotional attachment. Frontline employees act as relational ambassadors, influencing loyalty through responsiveness, empathy, and competence. This finding reinforces the service marketing perspective that relational bonds are strengthened through meaningful interpersonal engagement rather than purely transactional efficiency (Zeithaml et al., 1996).

The regression model's R^2 value of 0.62 indicates that relationship marketing dimensions collectively explain 62% of the variance in customer loyalty. In behavioral research, this

represents substantial explanatory power. The findings suggest that loyalty formation is not driven by isolated service elements but by an integrated relational mechanism that combines cognitive evaluation (service level, security), affective attachment (employee interaction, trust), and behavioral reinforcement (word of mouth). This multidimensional influence confirms that effective loyalty strategies require coordinated relational efforts rather than fragmented service improvements.

Furthermore, the discriminant analysis revealed significant sectoral differences between public and private sector banks. Private banks appear to demonstrate greater relational agility and customer-centric orientation. These differences may stem from variations in governance flexibility, performance-driven management systems, technological investment, and service innovation capacity. Public sector banks, while institutionally stable, may operate under more standardized and bureaucratic frameworks that influence relational responsiveness. These findings underscore the importance of contextualizing relationship marketing strategies within institutional structures.

Overall, the results extend relationship marketing literature by empirically validating the combined influence of relational dimensions in a contemporary banking environment and by offering comparative sectoral insights.

6. Managerial Implications

The findings of this study offer several important implications for banking practitioners and policymakers.

First, banks must prioritize trust-building mechanisms. Trust emerged as a dominant driver of loyalty, indicating that transparency, ethical governance, and consistent service delivery are critical for long-term retention. Institutions should strengthen communication regarding policies, fees, data privacy measures, and digital security protocols. Demonstrating institutional reliability reduces perceived risk and enhances relational commitment.

Second, the prominence of employee interaction suggests that banks should invest strategically in employee training and relational competence development. Frontline employees significantly shape customer experiences. Training programs should emphasize interpersonal skills, empathy, responsiveness, and problem-solving capabilities. Incorporating relational performance indicators into appraisal systems can reinforce service-oriented culture.

Third, banks should enhance communication clarity and integration across service channels. Inconsistent or delayed communication can erode trust and create uncertainty. Omnichannel

communication systems—integrating physical branches, mobile applications, online portals, and customer support platforms—should deliver consistent and timely information.

Fourth, demographic variations in loyalty suggest the importance of segmentation-based personalization strategies. Banks can leverage customer analytics to tailor products and engagement strategies based on age, income, and service usage patterns. Personalized service enhances perceived value and strengthens relational attachment.

Finally, public sector banks may benefit from modernizing relational engagement systems. Enhancing technological infrastructure, empowering employees with decision-making flexibility, and adopting customer-centric performance metrics can narrow the relational gap between public and private institutions.

Collectively, these implications emphasize that relationship marketing is not merely a promotional strategy but a comprehensive organizational orientation toward long-term value creation.

7. Conclusion

This study examined the impact of relationship marketing strategies on customer loyalty in the banking sector using empirical data from 183 respondents. The findings confirm that relationship marketing dimensions significantly influence customer loyalty, explaining 62% of the variance in loyalty behavior.

Employee interaction and trust emerged as dominant relational drivers, underscoring the centrality of human engagement and institutional reliability in financial services. The results demonstrate that loyalty is shaped through an integrated relational mechanism that combines cognitive evaluation, affective bonding, and behavioral reinforcement.

The comparative sectoral analysis further revealed significant differences between public and private banks, highlighting the importance of institutional context in relational strategy implementation.

Overall, the study reinforces that relationship marketing remains a critical strategic tool for achieving sustainable competitive advantage, enhancing customer retention, and strengthening long-term profitability in the banking sector.

8. Future Research Directions

While this study provides meaningful insights, several avenues for future research remain open.

First, future studies may employ Structural Equation Modeling (SEM) to examine indirect and mediating effects among relational constructs, allowing for deeper causal interpretation.

Second, researchers may investigate potential mediating variables such as customer satisfaction, perceived value, and relational commitment to better understand underlying mechanisms of loyalty formation.

Third, longitudinal research designs could capture the dynamic evolution of customer loyalty over time, particularly in rapidly digitizing financial environments.

Fourth, comparative studies involving fintech platforms and digital-only banks would provide contemporary relevance as financial ecosystems continue to evolve.

Finally, future research may explore digital service quality as a moderating variable, examining how technological interfaces interact with relational strategies to influence loyalty outcomes.

Such extensions would further enrich relationship marketing theory and enhance strategic understanding in financial services research.

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ANALYSIS OF CUSTOMER PERCEPTION ON ONLINE FOOD DELIVERY IN CHENNAI

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Abstract

The expansion of online food delivery services has significantly impacted consumer behavior, particularly among young and working professionals. This study examines user preferences, trends, and challenges in India's online food delivery market using survey data analysis. Findings indicate that 43.3% of respondents fall within the 26-35 age group, making them a key demographic. Additionally, 59% of users are male, and 52.2% hold an undergraduate degree, highlighting the need for targeted marketing strategies. Convenience plays a vital role, as 64% of respondents are single and 48% are employed. Market penetration is high, with 89% of users having at least one food delivery app. Spending patterns reveal that 42% earn between Rs.20, 000 and Rs.40, 000, while 32% spend over Rs.400 per order. Frequent ordering behavior, diverse food preferences, and payment flexibility are significant factors influencing user decisions. Delivery delays remain a concern for 38% of respondents. Promotional offers and variety in cuisines impact purchasing decisions, while security and ease of use enhance customer trust. A chi-square test confirms consistent ordering patterns across users, with strong correlations between satisfaction, food quality, and discounts. To sustain growth, food delivery platforms must enhance logistics, digital marketing, and customer engagement while optimizing user experience.

Key Word: *Delivery Services, Consumer Behavior, Food Delivery Platform.*

INTRODUCTION

In a modern generation Online food ordering is a mobility of food delivery or takeout from a local restaurant or food cooperative. Now days the rapid growth in the use of internet and the technologies associated with it, the several opportunities are coming up on the web or mobile application. This is made possible through the use of electronic payment system. The payment can be done through the customer's credit card, debit card. It is possible for everyone to order any goods from anywhere the internet and have the goods delivered at his/her home. All types

made be internet transaction ads to the economics of digital cash, the necessary tool for this process telecommunication with customers. The system will become an important tools use for restaurant to improve the management aspect by use of computer system to connect each and every food ordering transaction instead of data record on it. In addition, it can also provide efficiency for the restaurant by reducing time consuming, minimize human errors or delivery and providing good quality and service to customers. The labor rates are increasing steadily year on year thus making it difficult to find employees. The food industry is highly labor intensive and the biggest expense in the food Industry is the cost of employing the right kind of people to do the work. One of the ways to reduce this expense is to Use modern technology to replace some of the jobs done by Human beings and make machines do the work. Here we propose an “Online Food Ordering System” that has been designed for Fast Food restaurant, Take-Out or College Cafeterias. The system can also be used in any food delivery Industry. This simplifies the process of food ordering for both the customer and the restaurant, as the entire process of Taking orders is automat

ONLINE FOOD ORDER SYSTEM is mainly designed primarily function for use in the food delivery industry. This system will allow hotels and restaurants to increase online food ordering such type of business. The customer scan be selected food menu items just few minutes. In the modern food industries allows to quickly and easily delivery on customer place. Restaurant employees then use these orders through an easy to delivery on customer place easy find out navigate graphical interface for efficient processing.

OBJECTIVES OF THE STUDY

- To analyze the reason of choosing online food delivery by customers.
- To find the preference of online food supplies.
- To analyze the problems faced by Customer in online food delivery.
- To give suggestions to improve the online Delivery process.

Scope of the study

- This system provides online ordering of food, it provides different varieties of food.
- Easy use of customer.
- Customer can choose one or more items to place an order which will add to cart.
- Computerized entry of details.
- Easy backup of data.

RESEARCH

Research is defined as human activity based on intellectual application in the Investigation of Matter. The primary aim for applied research is discovering, interpreting and the development of methods and systems for the advancement of human knowledge. Research refers to search for knowledge. It is a scientific and systematic search for pertinent information on a specific Topic.

RESEARCH METHODOLOGY

According to Webster's new international dictionary, "careful or **critical** inquiry or examination in seeking facts or principles, diligent investigation in order to ascertain something".

The study is explorative as well as corresponding in nature. It Intends to explore the consumer's perception on online food Ordering. The data for the study was gathered through structured two sets of questionnaire. An online survey was used to collect the Data for this study.

RESEARCH DESIGN

Research design is a frame work or blue print for conducting the research project. It specifies the details of the procedures necessary for obtaining the information needed to structure and/or solve research problems. Research design is adopted in the study is Descriptive in nature.

SAMPLE SIZE

The sample size for this project is 157. The respondents have been selected in and around Chennai.

MODE OF DATA COLLECTION

The questionnaire was used as the data collection instrument. A questionnaire is a research Instrument consisting of a series of questions and other prompts for the purpose of gathering Information from respondents. And their responses are collected in a predefined structured Questionnaire. Questionnaires have advantages over some other types of surveys in that they are cheap; do not require as much effort.

TOOLS AND TECHNIQUES USED

1. Percentages Analysis
2. Correlation coefficient
3. Chi – Square Analysis

REVIEW OF LITERATURE

1. Customer's Perceptions Towards Food Ordering Application in Punjab (Deepak Devgan , Megha Mahendru, Kiranpreet Kaur) - 2024

Objective: This study looked into customer expectations, satisfaction levels, and the factors driving the increased popularity of online meal ordering and booking in India, particularly with regard to well-known apps like Food panda, Swiggy, and Zomato. Approach: Based on primary data obtained through non-probability convenience sampling of respondents living in Delhi's National Capital Region utilizing a structured questionnaire, descriptive research was conducted. Data were created from the gathered information.

2. Ordering of Food Through Online – An Empirical Study among Young adults (S Ramesh Babu , R Arthy)-2024

Consumers of today frequently use the digital world to obtain necessities such as entertainment, electronics, cosmetics, and other items. Customers have just begun placing internet meal orders. This encourages a shift in service providers towards a digital environment. Young adults, who make up a larger portion of the population in India than other demographic groups, strongly favor the online meal ordering system offered by a multitude of service providers. Thus, the researcher attempts to ascertain young adults' inclinations towards applications for purchasing food online. By employing the convenience sampling method, the researcher was able to identify 301 young adults in the Madurai market. Data from the young adults was collected using a structured questionnaire. A variety of analysis tools, including as bar charts and perceptual mapping, are used to examine the collected data.

3. Consumer Satisfaction towards online food delivery app Swiggy: The study special reference with South Chennai (Sankar Singh , Ashok Kumar Katta) - 2023

This study looks at the impact of online meal ordering on consumers and how Swiggy has changed and impacted their eating habits. Thus, the study explores users' satisfaction with online meal ordering apps. With Swiggy the investigation discovered more respondents in this study than any other age group were between the ages of 21 and 35. The most popular app for ordering takeaway is Swiggy, which is also the one that respondents like better. To fulfill the requirements of the stated objectives of this research project, primary data was collected by a primary survey utilizing a well-structured questionnaire. This study has 150 participants in its sample. The southern area of Chennai city was the study's location. Use SPSS.

4. Study of Online Food Delivery App Like Zomato & Swiggy and their effect on casual Dining (Prathamesh Jagannath Mane) - 2023

Online ordering has become a vital component for the restaurant industry, and the continuous development of the Internet has contributed to the growth of online food services by enabling consumers to shop around, compare prices, and access these services easily. The food industry has been completely disrupted by online ordering. Innovation has a ripple effect on the business; it has completely transformed the café industry and will continue to function flawlessly. The way the café operates has completely altered thanks to an innovative online system for ordering food, which also provides people all around the world with another beautiful, safe location. The main objective of this investigation is to look at how Zomato and Swiggy affect the café industry.

5. Understanding Consumer behavior towards utilization of Online food delivery Platforms (Dr. Sahilesh Rastogi Chetan Panse , Arpita Sharma , NamgayDorji) - 2023

This study aims to establish a thorough relationship between customer views regarding online meal ordering. This study used quantitative research methods and gathered primary data from online meal delivery platforms and customers using a questionnaire that assessed their requirements, views, and knowledge about these services. In this study, the researchers looked at the expansion of the food aggregator market. The impact of these enterprises' business models on India's traditional restaurant industry has also been studied by researchers.

6. A Customer Perception towards Online Food Ordering with Special Reference to Tiruchirappali (A Mehathab Sheriff, N Shaik Mohamed) - 2022

The Internet has developed into a global network that connects people from all over the world. Many easily navigable websites and mobile applications have been developed in this regard. The Online Food Ordering System is one such digitally-driven, user-friendly project. Through certain internet-based mobile applications, a customer can use an online food ordering system to place their food orders from any local restaurant of their choice. Customers are given a wide selection of various food choices that are made available.

7. The Study of interest of consumers in mobile food ordering apps (Anita Vinaik , Richa Goel , Seema Sahai , Vikas Gary) - 2022

Mobile food apps have become popular due to busy lifestyles. Instead of preparing meals at home, everyone else would rather place an online order. The development of mobile food apps has been greatly aided by technology. Consumers most routinely and frequently use apps

like UberEats, Zomato, Swiggy, FoodPanda, Fasoos, etc. Mobile food apps connect customers and restaurants by partnering with several eateries. Numerous variables, including ease of use, simple payment options, a wide selection of foods and dining establishments, quick delivery, excellent customer service, etc., all contribute to a rise in sales. This study conducts a survey to determine consumer interest in mobile food applications.

8. Seller's Perception: Preference and Significance of Payment Platforms (Gautam Barthakur) - 2022

The most well-known and actively marketed category of mobile digital applications is Payment Instruments. These tools have been crucial in carrying out a digital transaction, which has assisted the seller in streamlining the sales process. If appropriate techniques, procedures, and processes are not adopted and regularly updated, cash may still be undeniable for a considerable amount of people. It is nevertheless thought to be vital to promote the use of digital methods to accomplish transactions through appropriate education, awareness, and politeness towards other users. In addition to digital channels, cash.

9. Study on Consumer Perception towards online food ordering and delivery services (Apurva Dutta, Ashutosh Vashishtha) - 2022

Today's marketing has a new avenue to pursue thanks to the mobile application. The advent of mobile applications has rendered conventional business modes obsolete and opened up new avenues for commercial ventures. Businesses have occasionally shifted from traditional business strategies into internet marketing to better serve the needs and preferences of their customers.

The busy lifestyle has led to the rise in popularity of mobile food apps. Instead of cooking at home, everyone else prefers to place online meal orders. The development of mobile technology has been greatly aided by technology.

10. A Study of food – based mobile applications: With special reference to youngsters of Indore City (J Srajal, A Stafard, P Ajay) -2021

The primary driver of India's ongoing growth in online food ordering is technological advancement, which has led to a large number of start-ups in this industry. Under this intermediary business model, businesses serving as a middleman between customers and restaurants include Swiggy, Zomato, and Uber Eats. This primary study intends to investigate the industry and evaluate the acceptance and use of food ordering applications among Indore

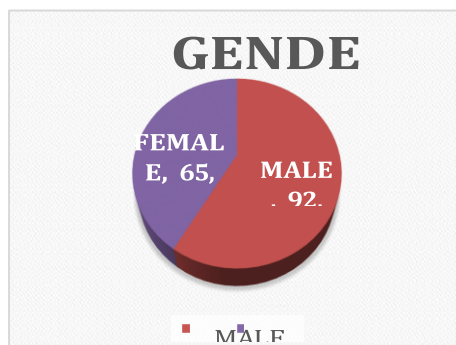
city's youth. As a result, the industry is predicted to increase along with the population, particularly the youth in India.

DATA ANALYSIS AND INTERPRETATION

TABLE NO.4.1

SHOWING THE GENDER OF THE RESPONDENT

GENDER	FREQUENCY	PERCENTAGE
MALE	92	41
FEMALE	65	59
TOTAL	157	100

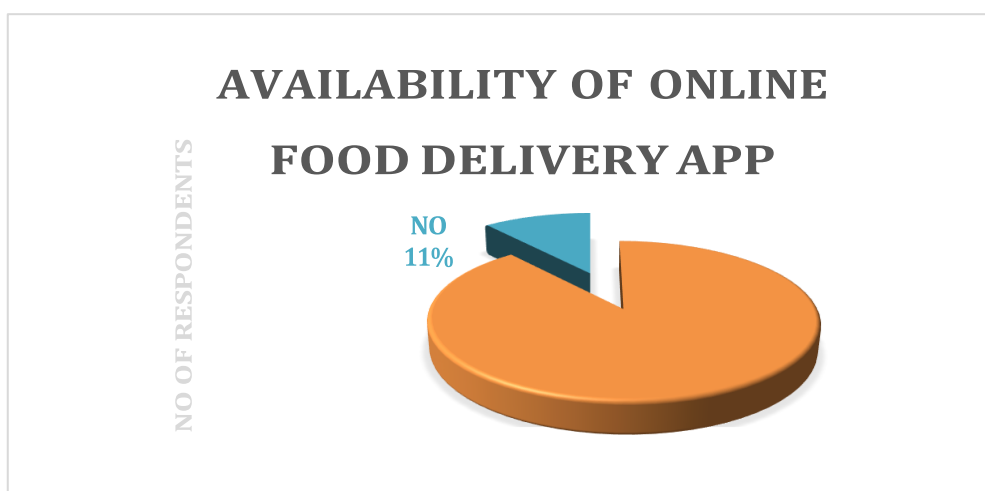


INTERPRETATION

From the above table 4.1, it is found that 59% of the respondents are Male, 41% of them are Female.

TABLE NO.4.2

SHOWING THE AVAILABILITY OF ONLINE FOOD DELIVERY APP



ONLINE DLIVERY APP	FREQUENCY	PERCENTAGE
YES	140	89.2
NO	17	10.8
TOTAL	157	100

INTERPRETATION

From the above table 4.2, we observed that from all the respondents, 89% of the respondents are having online food delivery app in their mobile phone, 11% of the respondents are not having online food delivery app in their mobile phone.

TABLE NO.4.3

SHOWING HOW MANY TIMES ORDER PLACED WITH IN WEEK

TIME PLACE ODER WITH IN WEEK	FREQUENCY	PERCENTAGE
WEEKLY ONCE	35	22
LESS THAN 3 TIMES PER WEEK	36	23
3 – 6 TIME PER WEEK	50	32
MORE THAN 6 TIMES A WEEK	36	23
TOTAL	157	100



INTERPRETATION

From the above table 4.3, we observed that from all the respondents, 22% of the respondents are placing order once in a week, 23% of the respondents are placing less than 3 time per week, 32% of the respondents are placing order 3 – 6 times per week, were 23% of the respondents are placing order more than 6 times per week.

TABLE NO.4.4

SHOWING CORRELATION BETWEEN REGULAR ONLINE ORDERING AND DISCOUNT AND SPECIAL ORDER.

Correlations:

		satisfaction level of online food ordering	enjoying more order and discount	overall quality of online food
satisfaction level of online food ordering	Pearson Correlation	1	.824(**)	.879(**)
	Sig. (2-tailed)		.000	.000
	N	157	157	157
enjoying more order and discount	Pearson Correlation	.824(**)	1	.858(**)
	Sig. (2-tailed)	.000		.000
	N	157	157	157
overall quality of online food	Pearson Correlation	.879(**)	.858(**)	1
	Sig. (2-tailed)	.000	.000	
	N	157	157	157

Nonparametric Correlations:

			satisfaction level of online food ordering	enjoying more order and discount	overall quality of online food
Spearman's rho	satisfaction level of online food ordering	Correlation Coefficient	1.000	.862(**)	.880(**)
		Sig. (2-tailed)	.	.000	.000
		N	157	157	157
	enjoying more order	Correlation Coefficient	.862(**)	1.000	.878(**)

	and discount	Sig. (2-tailed)	.000	.	.000
		N	157	157	157
overall quality of online food	Correlation Coefficient		.880(**)	.878(**)	1.000
	Sig. (2-tailed)		.000	.000	.
	N		157	157	157

INTERPRETATION

From the above table 4.16, from the above table it is found that there is a positive correlation (0.880) between the customer satisfaction on online food ordering experience, overall food quality and special order or discount. Here there is relationship between the number of members in the family and Spending on ordering food per time.

Correlation coefficient at 95% significant level was 0.05+. Significant level at 2 tailed test was 0.880.

TABLE NO.4.5

SHOWING CHI – SQUARE BETWEEN ORDER FOOD ON A FREQUENT BASIS AND USAGE OF THE DISCOUNT OR SPECIAL OFFERS.

Crosstabs

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
regular order basis * discount or special offers	412	100.0%	0	.0%	412	100.0%

Discount or special offers Cross tabulation

		discount or special offers		Total
		yes	no	
regular order basis	yes	204	36	240
	no	128	44	172
Total		332	80	412

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	7.170(b)	1	.07		
Continuity Correction(a)	6.509	1	.011		
Likelihood Ratio	7.079	1	.008		
Fisher's Exact Test				.008	.006
Linear-by-Linear Association	7.152	1	.07		
N of Valid Cases	412				

INTERPRETATION

From the above table 4.16, since the asymptotic value is 0.07 is greater than 0.05, so we retain the null hypothesis and conclude that there is not enough evidence to say that the population mean differs from hypothetical mean.

GENERAL FINDINGS:

- ✓ **43.3%** of the respondents belong to the age group of **26-35 years**.
- ✓ **59%** of the respondents are **male**.
- ✓ **52.2%** of the respondents are **Under-graduate**.
- ✓ **64%** of the respondents are **single**.
- ✓ **48%** of the respondents are **employed**.
- ✓ **89%** of the respondents are having **online food delivery app in their mobile phone**.
- ✓ **42%** of the respondents earn **20,000 – 40,000**.
- ✓ **32%** of the respondents are spending **more than 400**.
- ✓ **32%** of the respondents order online food **more than 3 – 6 times per week**
- ✓ **37%** of the respondents order food within **5 minutes**.
- ✓ **66%** of the respondents prefer to order **both vegetarian and non- vegetarian food**.

BY APPLYING CHI SQUARE:

0.07 is greater than 0.05, so we retain the null hypothesis and conclude that there is no enough evidence to say that the population mean differs from hypothetical mean. There is significant relationship between usage of the discount coupons and special offers made by customers.

BY APPLYING CORRELATION:

0.880 Between the customer satisfaction on online food ordering experience, overall food quality and special order or discount. Here there is relationship between the number of members in the family and Spending on ordering food per time.

CONCLUSION:

The results also indicate that 71.97% of respondents think that online meal delivery services are successful in Chennai. The significance of special offers, food quality, and customer pleasure in fostering customer loyalty is demonstrated by the substantial association between these variables. Larger families also seem to spend more on online food orders, according to the association between family size and spending on food orders. All things considered, the survey offers insightful information on India's online meal delivery sector, emphasizing important trends, consumer preferences, and potential areas for development. Online meal delivery businesses can customize their offerings to match consumer demands, improve user experience, and spur company expansion by taking these variables into account. The chi-square test reveals no significant difference between the population mean and hypothetical mean, indicating no evidence to suggest a difference in online food ordering habits. Correlation analysis shows a strong relationship (0.880) between customer satisfaction, food quality, and special offers. Additionally, a relationship exists between family size and spending on food orders. In conclusion, online food delivery apps are popular among young, single, and employed individuals who value convenience, variety, and security. Frequent ordering and discount usage are common, but delayed delivery is a concern. Apps should focus on improving delivery speed, offering diverse cuisine options, and promoting discounts to enhance customer satisfaction.

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AI FOR CULTURAL AND SOCIAL EMPOWERMENT: DRIVING BEHAVIOUR CHANGE FOR SUSTAINABLE DEVELOPMENT

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Abstract

Socio-cultural identity plays a vital role in shaping human behaviour, community relationships, and development processes. In many African societies, cultural traditions, belief systems, and social norms strongly influence the success or failure of development initiatives. With the rapid advancement of Artificial Intelligence (AI), new opportunities have emerged to support cultural preservation and social empowerment while promoting sustainable development.

This thematic paper explores how AI can contribute to the preservation of socio-cultural heritage and facilitate behaviour change within communities. Drawing on existing literature and contextual observations from African development settings, particularly in Ombella-M'Poko, Bangui, Central African Republic, the paper discusses how AI tools such as mobile data platforms, predictive analytics, and digital documentation systems can support culturally sensitive development interventions.

The discussion highlights the importance of integrating technological innovation with cultural intelligence, community participation, and local knowledge systems. By aligning AI applications with community values and traditions, development initiatives can promote behavioural change in areas such as health, women's empowerment, youth engagement, and social cohesion. The paper concludes that AI should not replace traditional knowledge systems but rather complement them to create inclusive and culturally grounded development strategies that contribute to sustainable development goals.

Keywords: *Artificial Intelligence, Cultural Heritage, Behaviour Change, Community Empowerment, Sustainable Development*

1. Introduction

Artificial Intelligence (AI) is increasingly recognized as a powerful tool capable of transforming social, economic, and developmental processes. Through the analysis of large and complex datasets, AI technologies can support informed decision-making, improve

service delivery, and strengthen development planning. Global development frameworks emphasize the need to integrate technological innovation with social and cultural dimensions to achieve sustainable and inclusive outcomes.

The United Nations Sustainable Development Goals (SDGs) highlight the importance of preserving cultural heritage and promoting community participation. In particular, SDG 11.4 emphasizes safeguarding cultural and natural heritage as a foundation for sustainable communities. Cultural traditions, values, and social practices play an important role in shaping behaviour and influencing how communities respond to development initiatives.

In African societies, culture remains a strong determinant of social behaviour and community identity. Local belief systems, traditional leadership structures, and communal practices often influence how people adopt new technologies, health practices, or economic activities. However, modernization and globalization have created challenges for preserving cultural heritage while promoting social transformation and development.

Recent advances in digital technology and AI provide opportunities to bridge this gap. AI tools such as digital archiving systems, predictive analytics, mobile platforms, and data-driven decision support systems can document cultural knowledge, support community programs, and promote behaviour change. Even in low-resource environments, technologies such as mobile phones and SMS-based systems enable communities to participate in development processes.

This paper explores how AI can contribute to cultural preservation, community empowerment, and behaviour change for sustainable development, particularly within African community contexts.

1.1. AI in Social Development

AI can assist in identifying social issues, optimizing interventions, and supporting decision making processes in developmental contexts. Basing on the different research on the AI in the social development, United Nations Development Programme (2021) reports that AI enhances developmental planning, resource allocation, and monitoring of community programs. Adeyemi & Omotoso discuss how AI enabled mobile platforms improved agricultural extension services in rural Nigeria by predicting crop disease outbreaks and informing local farmers. Chibuze examines AI-assisted data systems in East African health programs, showing improvements in community health tracking and intervention design. These studies underline that while AI tools are global; their applications in African development require adaptation to local needs and infrastructures.

1.2 Cultural Preservation and Local Knowledge

Culture plays a foundational role in shaping perception, behaviour, and social cohesion. Moyo highlights that traditional knowledge systems in Southern Africa contribute to sustainable resource management and should be integrated with technological tools. Ndlovu emphasizes that cultural heritage preservation initiatives in Zimbabwe benefited from digitization projects that documented oral histories and rituals. UNESCO argues that safeguarding tangible and intangible heritage supports community identity and long term social inclusion. These works show that culture is not merely a context but an active force that influences how development programs are received and sustained.

1.3 Behaviour Change and Technology Integration

Behaviour change is critical for sustainable development outcomes, and AI has potential to support behaviour change mechanisms. Smith explains that predictive analytics can tailor health, education, and livelihood interventions based on community behaviour patterns. Adeyemi & Omotoso demonstrate behaviour improvements in agricultural practices when AI alerts were culturally adapted and delivered in local languages. Mensah explores mobile techbased interventions in Ghana that improved sanitation behaviours through SMS-linked predictive nudges. These studies show that AI-guided interventions can influence behaviour but must align with cultural context and communication preferences.

1.4 African Perspectives on AI and Development

While global literature provides frameworks, African research offers essential regional contexts: Kamau & Wanjohi argue that ethical AI development in Africa must consider socio-cultural norms, infrastructural constraints, and participatory design. Okeke et al. look at AI-based education platforms in Kenya, highlighting the role of local involvement for uptake and impact. Dlamini discusses AI applications in South African community development programs that blended traditional leadership structures with digital monitoring. These perspectives demonstrate that AI must be locally tailored and culturally informed to be effective in African settings.

1.5 Cultural Intelligence (CQ) Theory

1.5 .1 Definition Cultural Intelligence (CQ) is the capability to relate and work effectively across cultures. It is particularly relevant in development programs where understanding local norms, values, and social dynamics is critical.

1.5.2 Dimensions:

1. **Metacognitive CQ:** Awareness and planning regarding cultural assumptions.
2. **Cognitive CQ:** Knowledge of norms, practices, and social systems.
3. **Motivational CQ:** Interest and drive to engage with diverse cultures.
4. **Behavioural CQ:** Ability to adapt verbal and non-verbal actions appropriately.

1.5.3 Relevance to Study:

- Ensures AI interventions are culturally sensitive
- Guides community engagement strategies in OmbellaM’Poko
- Helps tailor behaviour change programs respecting local norms

1.6 Behaviour Change Theory (COM-B / Social Cognitive Theory)

1.6.1 Definition:

Behaviour change theories explain how individuals adopt and maintain new behaviours. The **COM-B model** (Capability, Opportunity, Motivation → Behaviour) and **Social Cognitive Theory** (Bandura, 1986) emphasize the role of environment, self-efficacy, and reinforcement in shaping behaviour.

1.6.2 Relevance to Study:

- AI interventions can provide predictive insights and nudges to influence behaviours
- Supports programs like hygiene promotion, women’s empowerment, and youth engagement
- Ensures measurable changes in behaviour aligned with sustainable development goals

2. Literature Review

Artificial Intelligence has increasingly been discussed in relation to social development and community empowerment. Several scholars highlight the potential of AI to support development initiatives when applied in culturally sensitive ways.

2.1 AI in African Development Context

Smith (2020) argues that AI can be a tool for social good by helping governments and development organizations analyze complex social data and design targeted interventions. AI systems can identify patterns in health, education, and economic data, allowing policymakers to create more effective programs. Smith emphasizes that combining AI with community participation significantly improves development outcomes.

Adeyemi and Omotoso (2021) examined mobile-based AI systems in rural Nigeria, showing that early warnings about crop diseases and environmental risks led to improved agricultural

practices. They explain that when technological tools are adapted to local contexts and delivered in local languages, communities are more likely to adopt them and modify their behaviour accordingly.

Moyo (2020) highlights the relationship between technology and cultural heritage preservation. In Southern Africa, he demonstrates that digital technologies can document indigenous knowledge, environmental practices, and cultural rituals. However, he stresses that technology should support rather than replace traditional cultural institutions.

Ndlovu (2019) discusses community-based cultural preservation initiatives in Zimbabwe, showing that digitization projects help preserve oral histories, traditional ceremonies, and local knowledge systems. Digital tools can play a crucial role in connecting younger generations to their cultural identity.

Kamau and Wanjohi (2020) explore digital inclusion and AI adoption in African communities, emphasizing that successful AI implementation requires consideration of cultural values, ethical issues, and infrastructural limitations. Community participation and trust in technology are critical for adoption.

Dlamini (2021) demonstrates in South Africa that AI strengthens community empowerment when it integrates traditional leadership, local knowledge, and digital monitoring tools. Participatory approaches improve transparency and effectiveness of development programs.

2.2 Central African Republic Context

Lombard (2016) highlights that local governance systems and traditional leadership structures in the Central African Republic significantly influence community responses to development initiatives. Social networks, cultural traditions, and local authority are crucial for shaping participation and outcomes.

Carayannis (2015) emphasizes that sustainable development in Central Africa requires participatory approaches respecting cultural structures to build trust and resilience. Community-driven initiatives strengthen cohesion and improve long-term program success.

Dieudonné Nzapalainga (2019) highlights the role of cultural values, faith-based leadership, and community solidarity in promoting peace and social transformation in the Central African Republic. He explains that religious and cultural institutions guide communities toward reconciliation, cooperation, and sustainable development, particularly in post-conflict contexts. Strengthening these cultural and moral foundations contributes to rebuilding communities and fostering long-term social cohesion.

3. Methodology

This study adopts a qualitative research approach to explore the relationship between Artificial Intelligence, cultural preservation, and behaviour change in African community development contexts. The research is based on the analysis of secondary data, including academic literature, development reports, and policy documents. Additional information was gathered through online scholarly sources and databases such as Google Scholar, as well as contextual observations from community initiatives in Ombella-M'Poko, Bangui, Central African Republic. The qualitative approach helps interpret cultural values, social behaviour patterns, and community responses to technological innovations. Through thematic analysis of selected studies and development experiences, the research identifies key themes related to cultural intelligence, community participation, and AI-supported development strategies.

4. Discussion

AI and Cultural Preservation

AI can document and preserve cultural heritage through digital recording tools, mobile applications, and machine learning systems. Oral traditions, languages, rituals, and historical knowledge can be safeguarded and transmitted to future generations. AI-supported digital archives ensure that younger generations remain connected to their cultural identity.

AI and Behaviour Change

Behaviour change is essential for sustainable development in health, education, and economic participation. AI technologies can analyze behaviour patterns and provide predictive insights. Mobile-based AI systems can deliver culturally adapted reminders or educational messages related to hygiene, financial literacy, or community participation, increasing adoption of positive behaviours.

AI and Community Empowerment

AI strengthens community empowerment by improving access to information and participation in development programs. Digital platforms enable communities to collect data, monitor projects, and share knowledge. Women's groups, youth organizations, and community leaders can track economic activities, manage resources, and evaluate initiatives, enhancing transparency, accountability, and local ownership.

Integrating Culture and Technology

For AI to be effective, it must integrate cultural values and local governance structures. Cultural intelligence and community participation ensure technological solutions are trusted.

Involving elders, local leaders, and youth makes AI a supportive tool that enhances social systems rather than replacing them.

Personal Insight: AI and Cultural Heritage

Artificial Intelligence should strengthen and preserve cultural heritage rather than replace it. Every culture is unique, carrying deep meaning and identity for the people who practice it. Cultural traditions and knowledge systems must be transmitted across generations. AI can document, protect, and share cultural heritage through digital platforms and data systems, ensuring traditions, stories, and rituals are preserved for future generations.

5. Conclusion

Artificial Intelligence presents opportunities for promoting cultural preservation, community empowerment, and behaviour change for sustainable development. When responsibly adapted to local contexts, AI can help communities document cultural heritage, improve access to information, and design effective interventions.

Success depends on cultural sensitivity, community participation, and ethical implementation. AI should complement, not replace, traditional knowledge systems. By combining technology with cultural traditions, African communities can protect their identity while addressing modern development challenges, creating inclusive and sustainable pathways aligned with SDG 11.4.

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SMART INNOVATION TECHNOLOGIES & ARTIFICIAL INTELLIGENCE FOR SUSTAINABLE DEVELOPMENT

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Abstract

The accelerating climate crisis, expanding urbanization, technological disruption, and persistent socio-economic inequalities have intensified the global call for sustainable development. In response, smart innovation technologies combined with Artificial Intelligence (AI) have emerged as transformative tools capable of reshaping environmental management, economic productivity, and social inclusion. Smart innovation technologies—including the Internet of Things (IoT), Big Data analytics, blockchain, robotics, digital twins, cloud computing, and cyber-physical systems—create intelligent infrastructures that sense, analyze, predict, and respond to complex challenges in real time. Artificial Intelligence functions as the cognitive core of these systems, enabling predictive modeling, automation, adaptive learning, and data-driven governance. This paper provides a comprehensive analysis of the intersection between smart innovation technologies and AI in achieving sustainable development. It examines applications across environmental sustainability, renewable energy systems, climate resilience, agriculture, circular economy, industry 4.0, smart healthcare, education, and urban governance. The study further addresses ethical challenges, digital equity, data governance, and green AI considerations. A conceptual Smart Sustainable Intelligence Framework is proposed to integrate technological advancement with environmental responsibility and social justice. The paper concludes by emphasizing that sustainable development in the digital era requires responsible innovation, interdisciplinary collaboration, and policy alignment to ensure that AI-driven systems enhance human well-being while protecting ecological balance.

Keywords: *Artificial Intelligence, Smart Innovation, Sustainable Development, Industry 4.0, Green AI, Smart Cities, Digital Transformation, Responsible Technology.*

1. Introduction

The 21st century is characterized by an unprecedented convergence of technological acceleration and ecological urgency. Global warming, biodiversity loss, food insecurity, energy instability, and rapid urban expansion have exposed structural weaknesses in conventional development models. In 2015, the United Nations adopted the Sustainable

Development Goals (SDGs), establishing a universal framework to balance economic growth, environmental protection, and social equity. Parallel to this sustainability agenda, rapid advancements in digital technologies—particularly Artificial Intelligence—have transformed governance, industry, healthcare, and education. Unlike earlier industrial revolutions centered on mechanization or electrification, the current transformation is data-driven and intelligence-based. Smart innovation technologies enable real-time sensing, predictive analytics, automation, and interconnected digital ecosystems.

Rather than existing independently, smart technologies and sustainability objectives are increasingly interlinked. AI-enhanced systems can reduce energy waste, optimize transportation networks, improve healthcare delivery, enhance food security, and promote inclusive economic participation. However, technological advancement also raises ethical, environmental, and governance concerns. This paper explores how smart innovation technologies integrated with AI can function as catalysts for sustainable development while ensuring responsible and inclusive deployment.

2. Conceptual Foundations

2.1 Smart Innovation Technologies

Smart innovation technologies represent interconnected digital systems capable of adaptive and autonomous functioning. These include:

- Internet of Things (IoT)
- Artificial Intelligence (AI)
- Big Data analytics
- Blockchain systems
- Robotics and automation
- Digital twins
- Edge and cloud computing
- Cyber-physical systems

These technologies enable infrastructure to transition from static to intelligent. Sensors gather real-time data, analytics platforms process it, and AI systems generate predictive insights to guide decision-making.

2.2 Artificial Intelligence as the Core Enabler

Artificial Intelligence operates as the decision-making engine within smart innovation systems. AI techniques include:

- Machine learning algorithms

- Deep neural networks
- Natural language processing
- Computer vision
- Reinforcement learning

Through pattern recognition and predictive modeling, AI enables dynamic optimization across sectors. It transforms raw data into actionable intelligence, improving efficiency and sustainability outcomes.

2.3 Sustainable Development Framework

Sustainable development rests on three interconnected pillars:

1. Environmental sustainability
2. Economic sustainability
3. Social sustainability

Smart innovation technologies contribute to all three dimensions simultaneously by optimizing resources, increasing productivity, and expanding equitable access to services.

3. Smart Innovation & AI for Environmental Sustainability

3.1 Renewable Energy Optimization

AI-driven smart grids enhance the integration of renewable energy sources such as solar and wind. By predicting consumption patterns and generation variability, AI balances energy supply and demand dynamically. The International Energy Agency reports that AI-based grid management significantly improves efficiency and reduces carbon emissions.

Smart energy systems provide:

- Demand-response automation
- Load balancing
- Renewable forecasting
- Reduced transmission losses

Such innovations directly support climate mitigation strategies.

3.2 Climate Monitoring and Prediction

AI-powered climate models analyze vast datasets from satellites, ocean sensors, and atmospheric monitoring systems. Machine learning algorithms improve weather forecasting accuracy and disaster preparedness. Advanced climate analytics help governments design evidence-based policies for mitigation and adaptation.

3.3 Sustainable Agriculture and Food Security

Precision agriculture combines IoT sensors, drone imaging, and AI analytics to monitor soil health, moisture levels, crop growth, and pest activity. The FAO emphasizes digital agriculture as critical for ensuring food security in a climate-affected world.

AI supports:

- Crop yield prediction
- Optimized irrigation
- Reduced pesticide use
- Efficient fertilizer application

These practices conserve water, reduce chemical runoff, and increase productivity.

3.4 Circular Economy & Waste Management

Smart waste management systems use computer vision and robotics for automated sorting and recycling. Blockchain-based tracking ensures transparency in supply chains and material reuse. AI-driven predictive models estimate waste generation patterns, enabling proactive management. This shift toward circular production reduces landfill dependency and supports sustainable resource utilization.

4. Smart Innovation & AI for Economic Sustainability

4.1 Industry 4.0 and Smart Manufacturing

Industry 4.0 integrates automation, robotics, IoT, and AI into manufacturing ecosystems. Predictive maintenance reduces downtime, while AI-driven quality control enhances production efficiency. The World Economic Forum highlights digital transformation as central to sustainable industrial growth. Smart factories achieve:

- Reduced energy consumption
- Lower raw material waste
- Enhanced productivity
- Reduced operational costs

4.2 Smart Supply Chains

AI optimizes logistics, transportation routes, and inventory management. Real-time tracking minimizes delays and reduces fuel consumption. Digital twins simulate supply networks to identify inefficiencies before implementation. Sustainable supply chains contribute to economic resilience and environmental responsibility.

4.3 Financial Inclusion & Green Finance

AI-powered fintech systems expand access to banking services for underserved populations. Credit scoring algorithms evaluate non-traditional data, enabling microfinance inclusion. Green finance platforms use AI analytics to evaluate sustainability performance and ESG compliance, directing investment toward renewable and socially responsible projects.

5. Smart Innovation & AI for Social Sustainability

5.1 Smart Healthcare Systems , Education and Skill Development

AI-driven medical imaging, predictive diagnostics, and telemedicine improve healthcare accessibility and efficiency. The World Health Organization recognizes digital health technologies as critical for achieving universal health coverage. AI applications include:

- Disease outbreak prediction
- Personalized treatment planning
- Remote patient monitoring

These technologies reduce disparities in healthcare access. AI-based adaptive learning platforms personalize education according to individual student performance. Learning analytics identify areas requiring intervention. Digital education reduces geographical barriers and supports lifelong learning. Smart education systems enhance equity and workforce readiness.

5.2 Smart Cities and Urban Sustainability

Smart cities integrate AI into urban infrastructure, including traffic management, air quality monitoring, and public safety systems. The UN-Habitat promotes digital urban planning to enhance sustainability and resilience. Applications include:

- Intelligent traffic control systems
- Smart water distribution
- AI-enabled waste segregation
- Predictive infrastructure maintenance

Smart cities reduce emissions while improving quality of life.

6. Green AI and Environmental Responsibility

While AI contributes to sustainability, its computational requirements may increase energy consumption. Large-scale AI models require high-performance computing infrastructure. Green AI principles advocate:

- Energy-efficient algorithm design

- Renewable-powered data centers
- Edge computing to reduce transmission
- Carbon-aware machine learning

Balancing AI growth with environmental responsibility is essential for long-term sustainability.

7. Ethical and Governance Challenges

Data Privacy Surveillance , Algorithmic Bias, Digital Divide and Governance Frameworks

Smart technologies rely on continuous data collection. Without safeguards, privacy rights may be compromised. AI systems trained on biased datasets may perpetuate social inequalities. Limited access to digital infrastructure can widen socio-economic disparities. The OECD and UNESCO have established ethical guidelines emphasizing transparency, accountability, and human-centered AI.

Responsible innovation requires:

- Ethical AI certification , Inclusive policymaking
- Public-private partnerships , International cooperation

8. Smart Sustainable Intelligence Framework (Proposed Model)

This paper proposes a five-layer framework:

1. Infrastructure Layer – Renewable-powered digital systems
2. Data Governance Layer – Ethical data management and cybersecurity
3. Intelligence Layer – AI-driven analytics and automation
4. Application Layer – Sector-specific sustainability solutions
5. Policy Layer – Regulatory alignment with SDGs

This integrated architecture ensures holistic implementation of smart innovation for sustainability.

9. Future Research Directions

Emerging research areas include:

- Explainable AI for transparent governance
- AI-enabled biodiversity monitoring
- Smart water management systems
- Carbon capture optimization
- Quantum-enhanced sustainability analytics

Interdisciplinary collaboration will be critical for advancing these domains.

10. Conclusion

Smart innovation technologies combined with Artificial Intelligence represent transformative instruments for sustainable development. By embedding intelligence within infrastructure, governance systems, and service delivery models, AI enhances efficiency, resilience, and inclusivity. However, sustainable progress requires responsible innovation, ethical governance, and equitable digital access. Technological solutions must be aligned with environmental protection and social justice. The integration of smart innovation technologies and AI, when guided by sustainability principles, has the potential to redefine development pathways for the 21st century—creating a future that is intelligent, inclusive, and environmentally balanced.

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PRODUCTION AND CHARACTERIZATION OF BIODEGRADABLE PHA BIOPLASTIC FROM BANANA PEEL WASTE USING MIXED MICROBIAL FERMENTATION

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Abstract

This study investigates the production of biodegradable bioplastic from banana peel waste through mixed microbial fermentation. Banana peel hydrolysate, obtained via dilute acid hydrolysis, yielded a high concentration of fermentable sugars (21.5 g/L), supporting efficient microbial growth. Maximum polyhydroxyalkanoate (PHA) production (0.81 g/L) was achieved at 72 hours, indicating polymer accumulation during the stationary phase. The extracted bioplastic showed a yield of 0.41 g/g dry cell weight and appeared as a flexible, transparent film. FTIR analysis confirmed the presence of characteristic PHA functional groups, verifying successful polymer synthesis. Thermal analysis revealed a melting temperature of 167 °C and glass transition temperature of -2 °C, indicating good thermal stability. Mechanical testing demonstrated moderate tensile strength (21.8 MPa) and high flexibility. Biodegradability studies showed 72% degradation within 60 days. Overall, the study highlights banana peel waste as a sustainable substrate for eco-friendly bioplastic production.

Keywords: Bioplastic, Banana peel waste, Polyhydroxyalkanoates (PHA), Mixed microbial culture, Biodegradability, Agro-waste utilization

INTRODUCTION

In the 21st century, plastic pollution has emerged as one of the most pressing environmental issues faced by humanity. The widespread use of synthetic plastics in packaging, consumer goods, and industrial applications has led to the accumulation of non-biodegradable waste in terrestrial and marine ecosystems. The persistence of these petroleum-based plastics, coupled with inadequate waste management systems, has resulted in severe environmental degradation, posing threats to wildlife, soil health, and human well-being (Singh *et al.*, 2019). In response to these growing concerns, researchers and industries worldwide have focused on developing sustainable and biodegradable alternatives to conventional plastics. One such promising solution lies in bioplastics — polymers derived from renewable biological

resources that can degrade naturally under environmental conditions. However, despite their ecological benefits, the large-scale production of bioplastics remains constrained by the high cost of raw materials and processing methods (Pandey *et al.*, 2020). To overcome this limitation, agro-industrial wastes, such as fruit and vegetable residues, have been explored as inexpensive and abundant feedstocks for bioplastic synthesis. This approach not only reduces the production cost but also addresses the issue of agricultural waste disposal, thus contributing to a circular and sustainable bioeconomy.

The present study focuses on the production of eco-friendly bioplastics from banana peel waste through mixed microbial fermentation and the subsequent assessment of their biodegradability. This innovative approach integrates waste valorization with sustainable material production, offering a viable pathway to mitigate environmental pollution and promote green technology.

Objectives of the Study

The present study aims to explore the production of eco-friendly bioplastics from banana peel waste through mixed microbial fermentation and to evaluate their biodegradability. The specific objectives are as follows:

- To preprocess banana peel waste and obtain fermentable sugars through hydrolysis.
- To utilise mixed microbial culture for efficient fermentation and biopolymer synthesis.
- To extract and characterise the produced bioplastic using physicochemical and structural analysis.
- To evaluate the biodegradability of the synthesised bioplastic under soil conditions.
- To compare the results with conventional plastic parameters and identify the advantages of the developed material.
- The project may stimulate further research in other agro-waste streams and encourage the plastic industry to adopt more sustainable practices.

REVIEW OF LITERATURE

Overview of Plastic Pollution and the Need for Alternatives

Plastic pollution is one of the most critical environmental issues due to the massive production and poor recycling of conventional plastics. Global plastic production exceeded 400 million tons annually, with only about 9% being recycled (Geyer *et al.*, 2017). This has increased further, with projections indicating significant growth in mismanaged plastic waste (OECD, 2023). Conventional plastics such as polyethylene, polypropylene, and polystyrene persist for centuries without degradation (Kumar & Tiwari, 2022). Their breakdown into

microplastics has led to contamination of ecosystems and entry into food chains, posing risks to human health (Li et al., 2023). These challenges highlight the urgent need for biodegradable alternatives.

Emergence of Bioplastics as Sustainable Substitutes

Bioplastics derived from renewable resources such as starch, cellulose, and microbial metabolites have emerged as sustainable alternatives. Early bioplastics like polylactic acid (PLA) and polyhydroxyalkanoates (PHAs) demonstrated properties comparable to conventional plastics (Kaur et al., 2018). However, high production costs and reliance on food-based feedstocks have limited their commercialization (Pandey et al., 2020). To address this, recent research focuses on second-generation feedstocks such as agricultural residues and organic waste (Patel et al., 2021), improving sustainability and cost-effectiveness. The bioplastics market has also shown rapid growth due to environmental policies and technological advancements (European Bioplastics Report, 2024).

Agro-Industrial Wastes as Feedstock for Bioplastic Production

Agro-industrial wastes such as sugarcane bagasse, rice husk, and fruit peels contain high levels of carbohydrates suitable for microbial fermentation (Sajid et al., 2019). Their utilization reduces landfill accumulation and greenhouse gas emissions while generating value-added products (Bhatia et al., 2018; Tripathi et al., 2022). Among these, banana peel waste is particularly promising due to its high carbohydrate content and large availability worldwide (FAO, 2022), making it an economical substrate for bioplastic production.

Chemical Composition of Banana Peel Waste

Banana peels are rich in starch, cellulose, hemicellulose, and lignin, which support microbial growth (Sajid et al., 2019; Rojas et al., 2022). They also contain simple sugars such as glucose and fructose that enhance fermentation efficiency (Balakrishnan et al., 2021). Analytical studies using advanced techniques have identified various compounds influencing fermentation behavior (García-Vázquez et al., 2023), indicating their suitability as a fermentation substrate.

Pretreatment and Hydrolysis Techniques

Pretreatment is essential for converting complex biomass into fermentable sugars. Techniques such as acid hydrolysis and enzymatic treatment have been widely used to enhance sugar yield (Kim et al., 2021). Modern approaches like microwave-assisted and ultrasonic pretreatment further improve efficiency while reducing inhibitor formation (Rahman et al., 2021). Comparative studies show that microwave-assisted hydrolysis produces higher sugar

concentrations in shorter time periods (Saha et al., 2023), while detoxification methods help remove inhibitory compounds (Awasthi et al., 2020).

Microbial Fermentation Pathways for Bioplastic Synthesis

Microbial fermentation is a key process in bioplastic production, where microorganisms convert sugars into polymers such as PHAs (Lee, 2017). These polymers are synthesized intracellularly and depend on enzymatic pathways and environmental conditions (Singh & Sharma, 2020; Venkatesan et al., 2021). Studies have demonstrated that banana peel hydrolysate can effectively support PHA production (Kamble et al., 2023), while mixed sugar substrates improve polymer properties (Tomar et al., 2022).

Advantages of Mixed Microbial Cultures (MMC)

Mixed microbial cultures provide a cost-effective alternative to pure cultures by functioning under non-sterile conditions (Laycock et al., 2017). They utilize diverse substrates and improve efficiency through microbial synergy (Johnson et al., 2019). These systems have shown high PHA accumulation using waste-based substrates (Patel et al., 2020; Li et al., 2022), with volatile fatty acids acting as key intermediates (Bengtsson et al., 2021). Recent studies also highlight improved performance using microbial consortia (Azeem et al., 2024).

Optimization of Fermentation Conditions

Optimizing fermentation parameters such as pH, temperature, and nutrient ratios significantly enhances polymer yield (Silva et al., 2021). Banana peel-based fermentation performs optimally under controlled conditions of pH and temperature (Murugan et al., 2022). Advanced strategies such as fed-batch fermentation further improve productivity (Nguyen et al., 2021), demonstrating the importance of process optimization.

Polymer Extraction and Characterization

After fermentation, biopolymers are extracted using solvent-based or eco-friendly techniques (Chen et al., 2020). Green extraction methods such as supercritical CO₂ reduce environmental impact (Ramesh et al., 2019). Characterization techniques like FTIR, DSC, and SEM are widely used to analyze polymer structure and properties (Joshi et al., 2018; Singh et al., 2022).

Biodegradation of Bioplastics

Bioplastics degrade through microbial activity into simpler compounds such as carbon dioxide and water (Tokiwa & Calabia, 2020). PHAs show superior biodegradability compared

to conventional plastics (García et al., 2021). Environmental factors such as temperature and polymer structure influence degradation rates (Zhao et al., 2022), with studies confirming faster degradation of banana peel-derived bioplastics (Kamble et al., 2023).

Methods of Biodegradability Assessment

Biodegradability is assessed using soil burial tests, composting, and CO₂ evolution methods (Joshi et al., 2018). Advanced techniques such as SEM and FTIR help monitor degradation processes (García-Vázquez et al., 2023). Microbial studies further identify organisms involved in degradation (Lee et al., 2024; Azeem et al., 2024).

Comparative Analysis of Bioplastics

Among various bioplastics, PHAs exhibit superior biodegradability and environmental compatibility (Laycock et al., 2017). Unlike PLA, which requires industrial composting conditions (Zhang & Chen, 2024), PHAs degrade naturally in soil and water (Silva et al., 2021). Additionally, waste-derived PHAs show improved flexibility and performance (Tomar et al., 2022).

MATERIALS AND METHODS

The study involved the production of eco-friendly bioplastic from banana peel waste using mixed microbial fermentation and evaluation of its biodegradability. The methodology included raw material preparation, hydrolysate production, microbial fermentation, polymer extraction, characterization, and biodegradability assessment.

Collection and Preparation of Raw Material

Ripe banana peels were collected from local sources, washed thoroughly, and cut into small pieces. They were sun-dried for 2–3 days followed by oven drying at 60 °C for 6 hours. The dried peels were ground into fine powder and sieved (0.5 mm) to ensure uniform particle size. The powder was stored in airtight containers for further use. Banana peel was selected due to its high carbohydrate and cellulose content, making it suitable for fermentation-based bioplastic production (Bhatia et al., 2018; Sajid et al., 2019; Patel et al., 2021).

Preparation of Banana Peel Hydrolysate

Acid hydrolysis was carried out to convert complex carbohydrates into fermentable sugars. Fifty grams of peel powder were mixed with 500 mL of 1% sulfuric acid and autoclaved at 121 °C for 30 minutes. The mixture was neutralized to pH 7.0 using NaOH, filtered, and the hydrolysate collected. Reducing sugar concentration was estimated using the DNS method

(Miller, 1959). This process enhances sugar availability for microbial metabolism (Singh & Sharma, 2020; Ramesh et al., 2019).

Preparation of Mixed Microbial Culture (MMC)

Mixed microbial culture was prepared from compost soil samples. Serial dilutions were plated on nutrient agar and incubated at 37 °C. Distinct colonies were isolated and cultured in nutrient broth. Common bacteria such as *Bacillus*, *Pseudomonas*, and *Azotobacter* contribute to polymer production (Johnson et al., 2019; Venkatesan et al., 2021). Equal volumes of cultures were combined to prepare the inoculum, improving efficiency and reducing cost (Patel et al., 2020; Laycock et al., 2017).

Fermentation Process

Fermentation was conducted in 250 mL flasks containing 100 mL of medium with banana peel hydrolysate, ammonium sulfate, and mineral salts. The pH was adjusted to 7.0 before sterilization. The medium was inoculated with 10% MMC and incubated at 30 °C, 150 rpm for 72 hours. Samples were analyzed periodically for growth, pH, and sugar utilization. MMC enhances substrate utilization and reduces dependency on pure cultures (Patel et al., 2021; Laycock et al., 2019).

Extraction of Bioplastic Polymer

Cells were harvested by centrifugation (8000 rpm, 10 min), washed, and dried. The polymer was extracted using sodium hypochlorite digestion followed by chloroform extraction (Lee, 2017). The extracted polymer film was dried and weighed to determine yield. This method ensures efficient recovery of PHAs (Koller & Marsalek, 2015).

Characterization of Bioplastic

The polymer was characterized using FTIR to identify functional groups, DSC for thermal properties, and UTM for mechanical strength. Water absorption was also measured. These analyses confirm the structural and physical properties of the produced bioplastic (Joshi et al., 2018; Reddy et al., 2020; Kumar et al., 2022).

Biodegradability Assessment

Biodegradability was evaluated using the soil burial method. Bioplastic films were buried in moist soil and removed at regular intervals. After cleaning and drying, weight loss was measured to determine degradation. This method confirms microbial breakdown of the polymer into simpler compounds (Ramesh et al., 2019; Thakur et al., 2021; Joshi et al., 2018).

Comparison with Conventional Plastics

The produced bioplastic was compared with polypropylene in terms of mechanical properties and biodegradability. The results highlighted better environmental performance of the bioplastic, though with slightly lower strength (Pandey et al., 2020; Kumar et al., 2022).

RESULTS AND DISCUSSION

The study evaluated bioplastic production from banana peel waste using mixed microbial fermentation and assessed its material properties and biodegradability.

Hydrolysis of Banana Peel Waste

Acid hydrolysis effectively converted banana peel powder into fermentable sugars, mainly glucose and fructose. The optimum condition (1% sulfuric acid, 121 °C, 30 min) yielded 21.5 g/L reducing sugars, confirming efficient substrate conversion. This result is consistent with findings by Singh and Sharma (2020), indicating that dilute acid hydrolysis is suitable for agro-waste processing.

Microbial Growth and PHA Production

The mixed microbial culture (MMC) showed steady growth in banana peel hydrolysate, with cell density increasing up to 48 hours and stabilizing thereafter. Maximum PHA production (0.81 g/L) was observed at 72 hours, indicating that polymer accumulation occurred during the stationary phase. Reduction in residual sugar confirmed active utilization of the substrate. These results align with reported yields of 0.7–0.9 g/L from agro-waste substrates (Patel et al., 2021; Venkatesan et al., 2021).

Extraction and Morphology of Bioplastic

The extracted polymer yield was approximately 0.41 g/g dry cell weight. The bioplastic appeared as a thin, white, flexible, and transparent film, indicating good purity and quality. Similar morphological characteristics have been reported in earlier studies (Koller & Marsalek, 2015).

FTIR Analysis

FTIR analysis confirmed the presence of characteristic functional groups of PHAs. A strong peak at 1722 cm^{-1} (C=O), along with peaks at 2920 cm^{-1} and 2850 cm^{-1} (C–H) and 1275 cm^{-1} (C–O–C), verified the polyester structure. These findings match standard PHA spectra, confirming successful synthesis of PHB-like polymer (Joshi et al., 2018; Patel et al., 2020).

Thermal Properties

DSC analysis showed a melting temperature (T_m) of 167 °C and glass transition temperature (T_g) of -2 °C, indicating semicrystalline nature and good thermal stability. These values suggest suitability for moderate-temperature processing (Reddy et al., 2020).

Mechanical Properties

The bioplastic exhibited tensile strength of 21.8 MPa and elongation at break of 180%, indicating good flexibility. Although slightly lower than polypropylene (29 MPa, 200%), the properties are comparable to other PHA-based bioplastics (Pandey et al., 2020; Kumar et al., 2022). The higher elongation suggests suitability for packaging and disposable applications.

Biodegradability Assessment

Soil burial tests showed significant biodegradation, with 72% weight loss over 60 days, whereas polypropylene showed negligible degradation. The gradual increase in weight loss confirmed microbial degradation of the polymer into simpler compounds. These results are consistent with previous studies demonstrating efficient biodegradation of PHAs (Thakur et al., 2021; Ramesh et al., 2019).

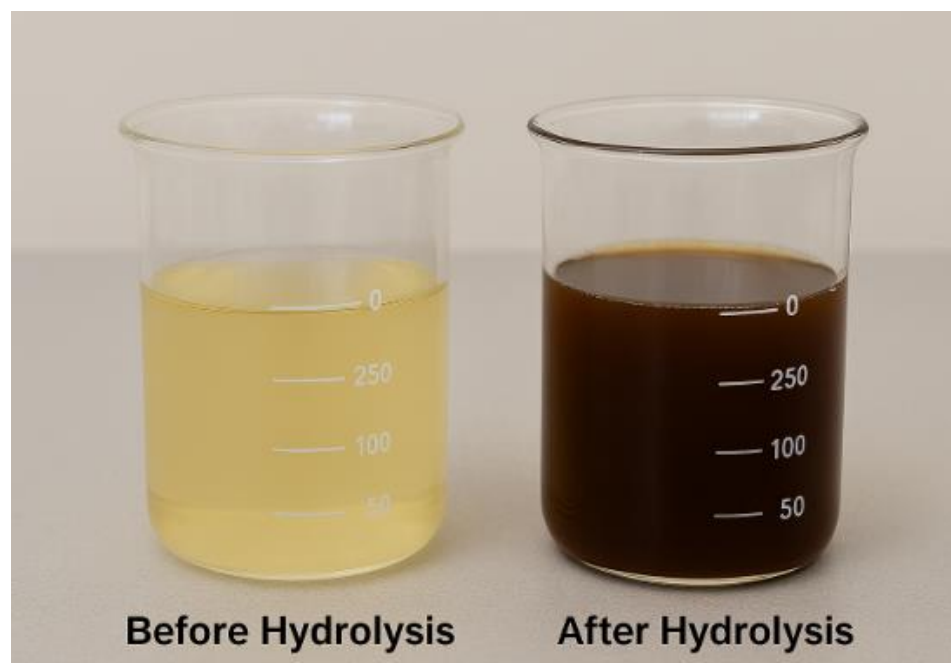


Fig. 1 The visual observation of banana peel hydrolysis, where the color change from pale yellow to brown indicated polysaccharide breakdown and sugar release.

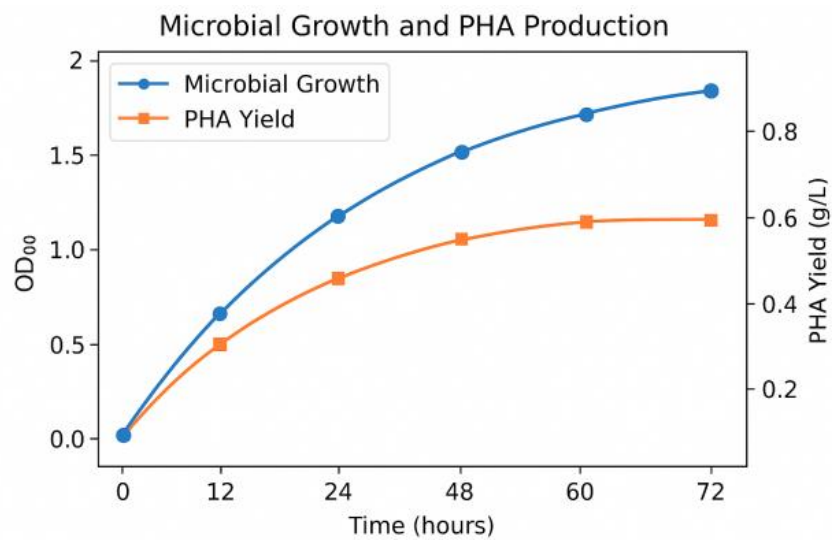


Fig. 2 Microbial Growth (OD₆₀₀) and PHA Yield during Fermentation



Fig. 3 Fermentation setup with mixed microbial culture.



Fig. 4 Extracted PHA bioplastic film obtained after solvent evaporation.

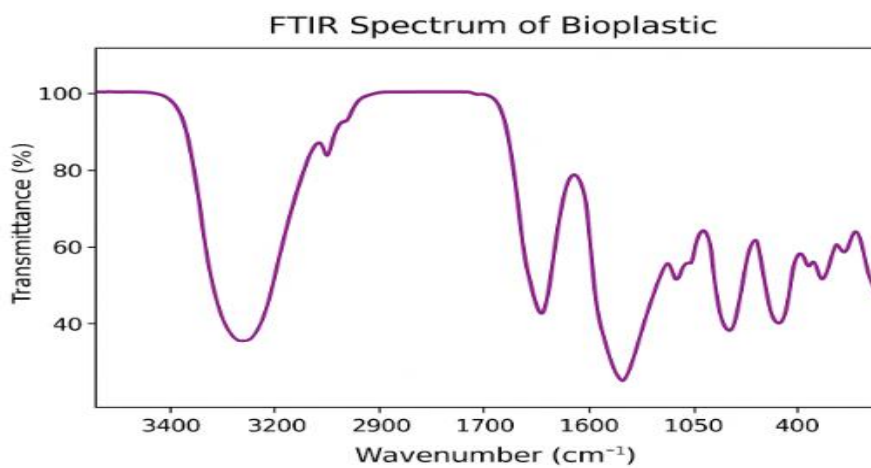


Fig.5 FTIR Spectrum of Extracted Bioplastic

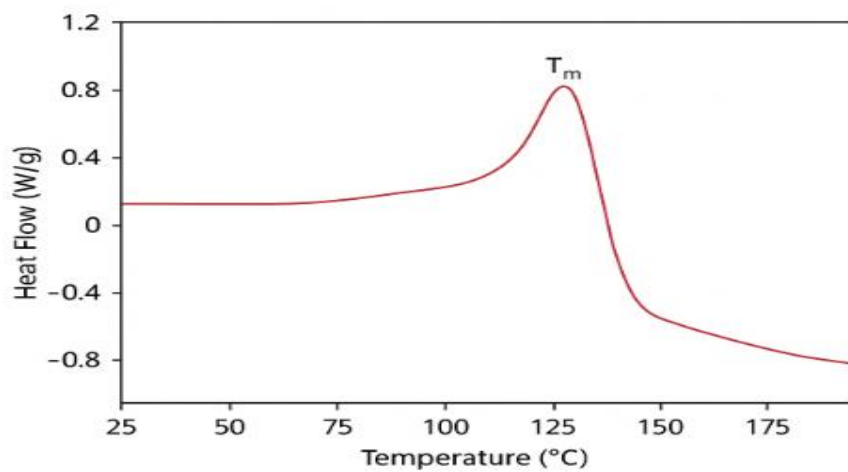


Fig. 6 DSC thermogram of bioplastic sample showing T_m and T_g transitions.

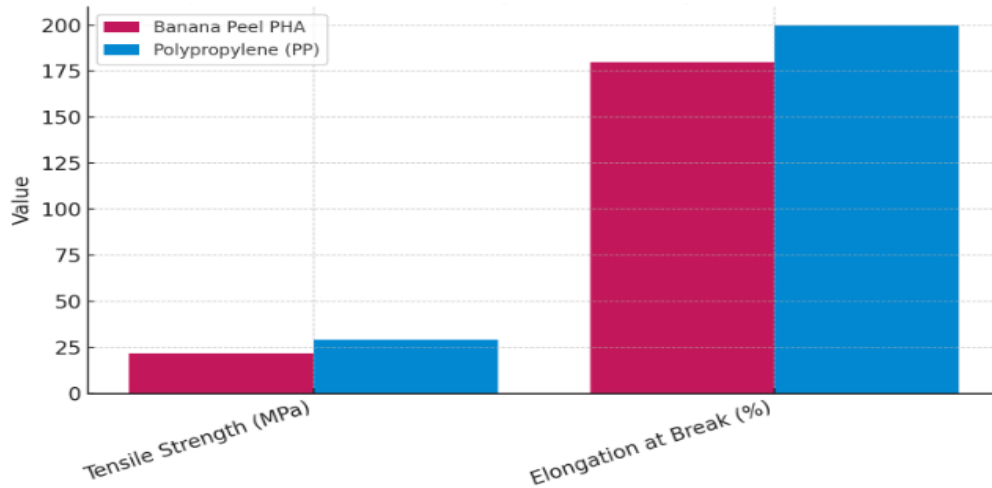


Fig. 7 Comparative Tensile Strength and Elongation of PHA vs. PP

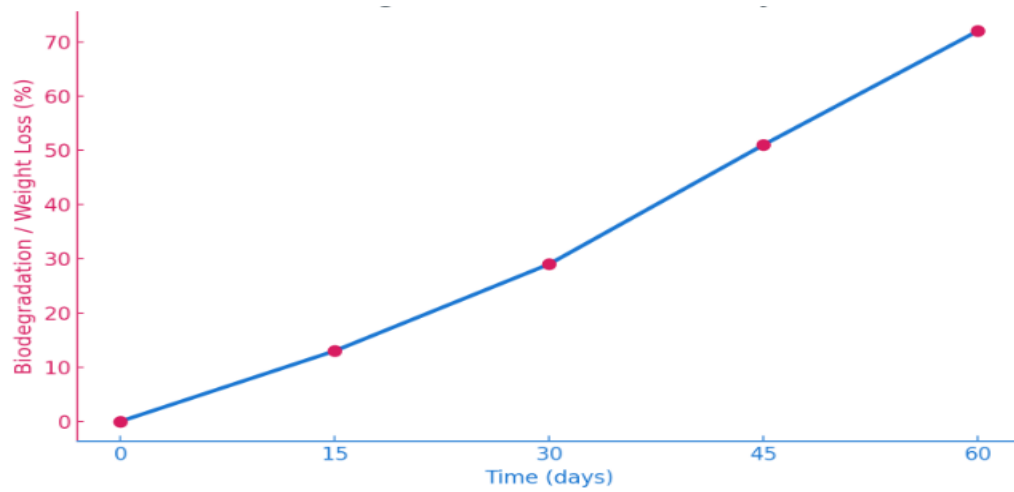


Fig. 8 Biodegradation (%) vs. Time (days)

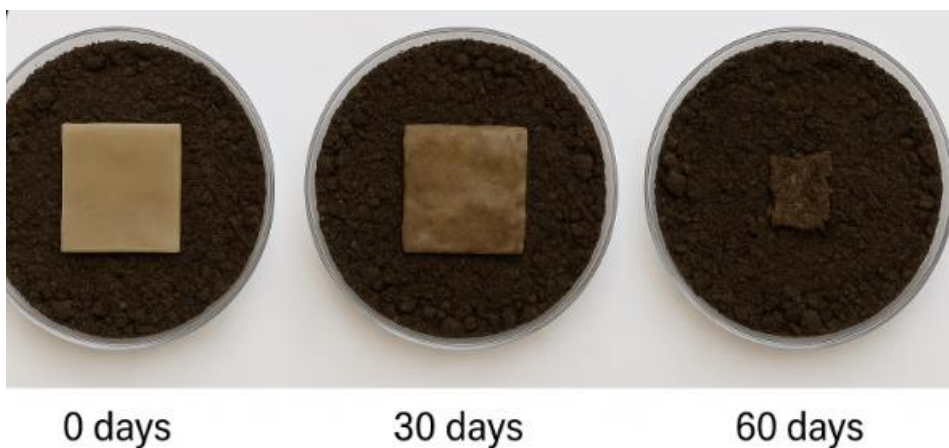


Fig. 9 Soil burial setup showing bioplastic degradation at 0, 30, and 60 days.

SUMMARY AND CONCLUSION

Summary

The present study demonstrated the sustainable production of eco-friendly bioplastic from banana peel waste using mixed microbial fermentation, followed by characterization and biodegradability assessment. The work highlights the effective conversion of agro-waste into value-added biopolymer, supporting waste valorization and circular bioeconomy concepts.

Dilute acid hydrolysis of banana peel successfully released fermentable sugars, providing a suitable carbon source for microbial growth. The mixed microbial culture showed efficient fermentation, leading to the synthesis of polyhydroxyalkanoates (PHA). The extracted bioplastic exhibited desirable properties, with FTIR analysis confirming characteristic functional groups of PHAs, and DSC analysis indicating moderate crystallinity and suitable thermal stability for low-temperature applications.

Mechanical studies revealed that the bioplastic possessed good tensile strength and flexibility, comparable to conventional plastics such as polypropylene, while offering the advantage of biodegradability. Soil burial tests demonstrated significant degradation (within 60 days), confirming its environmentally friendly nature. Overall, the study proves that banana peel waste is an efficient, low-cost, and renewable substrate for bioplastic production. This approach not only reduces plastic pollution but also utilizes agricultural waste effectively, demonstrating strong environmental and practical significance.

Conclusion

The study concludes that bioplastic produced from banana peel waste through mixed microbial fermentation is a promising biodegradable alternative to conventional plastics. With further optimization and scale-up, this process has strong potential for industrial application in packaging and sustainable material production, contributing to reduced environmental pollution and advancement of green technologies.

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MARKETING MANAGEMENT AND AI-DRIVEN CONSUMER ANALYTICS IN SOCIAL MEDIA

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Abstract

The rapid growth of social media platforms has created new opportunities for businesses to understand consumer behaviour and design effective marketing strategies using analytical techniques. This study examines consumer interaction with social media marketing and evaluates sentiment patterns related to online promotional activities. The primary database for this research consists of 500 responses collected from residents of Chennai through a structured questionnaire developed using Google Forms and selected through the Simple Random Sampling technique. The dataset includes demographic and behavioural variables such as age, time spent on social media, advertisement click rate, engagement rate, influencer impact, purchase intention, and sentiment toward marketing content. The study employs descriptive statistical analysis, exploratory data analysis, correlation analysis, and an Ordinary Least Squares regression model to examine the relationships among the variables, where sentiment analysis is treated as the dependent variable. The results indicate that a significant proportion of respondents express positive sentiment toward social media marketing, while engagement rate, advertisement interaction, and influencer impact show positive relationships with consumer sentiment and purchase intention. The regression results further confirm that higher engagement with marketing content significantly contributes to favourable consumer perceptions. The findings highlight the importance of interactive marketing strategies and consumer participation in digital environments. Overall, the study concludes that effective use of data analytics in social media marketing can help organizations better understand consumer behaviour, improve communication strategies, and enhance marketing performance in competitive digital markets.

Keywords: Social Media Marketing, Consumer Behaviour, Sentiment Analysis, Engagement Rate, Digital Marketing Analytics.

1.0 Introduction

The rapid expansion of digital communication technologies has significantly transformed the way businesses interact with consumers. Social media platforms have emerged as important

channels for marketing communication, enabling companies to promote products, build brand awareness, and engage directly with potential customers. Unlike traditional marketing approaches, social media marketing allows interactive communication where consumers can respond to advertisements, share opinions, and influence others through reviews and recommendations. As a result, understanding how users respond to marketing content on social media has become an important area of research in consumer behaviour and digital marketing studies. Examining user engagement, advertisement interaction, and purchasing intentions helps researchers and marketers identify how online promotional strategies influence consumer attitudes and decision-making processes.

In this context, the present study focuses on analysing consumer responses toward social media marketing among residents of Chennai. The research uses primary data collected from 500 respondents to examine behavioural patterns such as time spent on social media, engagement with marketing content, advertisement click behaviour, and purchase intention. Special attention is given to sentiment analysis in order to understand whether consumers express positive, neutral, or negative perceptions toward social media marketing activities. By applying descriptive statistics, correlation analysis, and regression techniques, the study attempts to identify the key factors that influence consumer sentiment and purchasing tendencies in digital environments. The findings are expected to provide useful insights for businesses seeking to design more effective and engaging marketing strategies in the rapidly evolving social media landscape.

2.0 Review of Literature

The rapid growth of social media has transformed marketing communication and consumer interaction in the digital marketplace. Researchers have emphasized that social networking platforms enable businesses to reach large audiences while allowing consumers to actively participate in marketing communication through likes, shares, comments, and reviews. According to Andreas Kaplan and Michael Haenlein (2010), social media platforms provide organizations with opportunities to create user-generated content and interactive engagement, which significantly influence consumer perceptions of brands. Similarly, Dave Evans (2012) highlighted that digital interaction between firms and consumers improves brand awareness and strengthens long-term relationships. Studies conducted by Mangold W. G. and David J. Faulds (2009) further indicated that social media acts as a hybrid element of the promotion mix where companies and consumers jointly shape marketing communication. These studies

demonstrate that the rise of social media has shifted the traditional one-way marketing model into a dynamic and interactive communication system.

Consumer engagement on social media has been widely examined as a key factor influencing marketing effectiveness. Research by Vivek Kumar (2016) explained that engagement behaviours such as commenting, sharing, and clicking advertisements can strengthen brand relationships and improve customer loyalty. Likewise, Ko de Ruyter *et al.* (2015) observed that active participation in online communities leads to stronger emotional attachment between consumers and brands. In addition, Robert V. Kozinets (2010) emphasized the importance of online communities and electronic word-of-mouth in shaping consumer opinions. These studies collectively suggest that higher engagement levels often translate into greater trust in marketing messages and improved consumer response toward online advertisements.

Another important research stream focuses on the role of influencers and online reviews in shaping consumer attitudes. Studies by Frederick F. Reichheld (2003) demonstrated that positive recommendations and word-of-mouth communication strongly influence customer decision-making. Similarly, Jonah Berger (2013) explained that viral marketing and social sharing significantly increase product visibility and consumer interest. Research by Aron Levin (2012) found that influencer endorsements can enhance brand credibility and affect purchasing behaviour among younger consumers who frequently use social media platforms. In addition, Chevalier J. A. and Mayzlin D. (2006) reported that online reviews and ratings play a critical role in shaping consumer perceptions and purchase intentions. These findings indicate that social influence mechanisms play an important role in digital marketing environments.

Recent studies have also focused on sentiment analysis and data-driven approaches to understand consumer opinions expressed on social media platforms. According to Bing Liu (2012), sentiment analysis techniques allow researchers to classify consumer opinions into positive, neutral, and negative categories, providing deeper insights into user attitudes. Similarly, Bo Pang and Lillian Lee (2008) demonstrated that sentiment classification methods are useful for analysing large volumes of online textual data related to consumer feedback. Furthermore, He Wu *et al.* (2017) emphasized that sentiment analysis combined with statistical modelling helps identify key factors influencing consumer responses to marketing content. These studies highlight the importance of integrating sentiment analysis with behavioural variables such as engagement rate, advertisement interaction, and purchase

intention in order to better understand consumer responses toward social media marketing strategies.

3.0 Database

The primary data for this study were collected directly from respondents using a structured questionnaire designed through Google Forms. The main objective of the survey was to examine consumer behaviour and their interaction with marketing content on social media platforms among residents of Chennai. The questionnaire consisted of clear and well-structured questions to ensure that respondents could easily understand the survey and provide reliable responses. A total of 500 participants took part in the study, and the respondents were selected using the Simple Random Sampling technique, which ensures that every individual in the target population has an equal chance of being included in the sample. This sampling method helps minimize bias and ensures that the dataset represents different demographic groups from various areas of Chennai.

The questionnaire link was distributed through email, messaging applications, and social networking platforms, allowing respondents to voluntarily participate in the survey. The responses were automatically recorded and stored within the Google Forms database and later exported in CSV format for further statistical analysis. The survey included several parameters to measure consumer behaviour, marketing exposure, and purchasing tendencies in social media environments. These variables included Respondent ID, location within Chennai, age, gender, educational qualification, occupation, monthly income level, preferred social media platform, daily time spent on social media, frequency of viewing online advertisements, interest in social media advertisements, engagement with marketing content such as likes and shares, influence of online reviews on purchasing decisions, previous online purchase behaviour, purchase intention score, and overall satisfaction with social media marketing. The collected responses formed a primary database of 500 valid observations, which were subsequently organized, cleaned, and prepared for statistical analysis. Using primary data directly obtained from respondents enhances the reliability and authenticity of the research findings, as the information reflects real consumer perceptions and experiences rather than interpretations derived from secondary sources.

4.0 Methodology

The methodology adopted in this research was designed to systematically examine the relationship between social media marketing activities and consumer sentiment among

residents of Chennai. The study followed a quantitative research approach because the objective was to measure consumer behaviour, engagement patterns, and sentiment toward social media marketing using measurable variables. The analysis was carried out using primary data collected through a structured questionnaire, which produced a dataset consisting of 500 valid observations. The collected data were organized and processed to ensure accuracy before performing statistical analysis.

The research process involved several stages, including data preparation, exploratory data analysis, correlation analysis, and regression modelling. Initially, the responses obtained from the survey were exported from Google Forms in CSV format and imported into the Python analytical environment for further examination. During the data preparation stage, the dataset was carefully checked for missing values, inconsistent entries, and formatting errors. Any incomplete or duplicated responses were removed to maintain the reliability of the dataset. After cleaning the data, the variables were structured appropriately so that demographic and behavioural indicators could be analysed efficiently.

Following the data preparation stage, Exploratory Data Analysis (EDA) was conducted to understand the distribution and characteristics of the variables included in the dataset. Descriptive statistical techniques such as mean, standard deviation, minimum value, and maximum value were calculated for key variables including age, daily time spent on social media, advertisement click rate, engagement rate, purchase intention score, and influencer impact score. These statistical measures helped summarize the general patterns of consumer behaviour and provided an overview of the dataset before conducting more advanced analysis. In addition to descriptive statistics, sentiment distribution analysis was performed to evaluate respondents' attitudes toward social media marketing activities. The sentiment responses were classified into three categories: negative, neutral, and positive. This classification allowed the study to examine how consumers emotionally respond to marketing content presented on social media platforms. The frequency and percentage of each sentiment category were calculated to identify the overall trend of consumer perception.

To examine the relationships among the key variables, correlation analysis was carried out. The correlation matrix was used to measure the strength and direction of relationships between engagement rate, advertisement click rate, influencer impact score, and purchase intention score. The correlation coefficients range between -1 and $+1$, where positive values indicate a direct relationship between variables and negative values indicate an inverse

relationship. This analysis helped identify which marketing interaction factors were most strongly associated with consumer purchasing behaviour.

To further investigate the factors influencing consumer sentiment, an Ordinary Least Squares (OLS) regression model was developed. In this model, Sentiment Analysis was treated as the dependent variable, while engagement rate, advertisement click rate, daily time spent on social media, influencer impact score, and purchase intention score were considered independent variables. The regression model estimated the effect of each independent variable on sentiment levels by calculating coefficients, standard errors, t-values, and probability values. The significance of the model was evaluated using statistical indicators such as the R-squared value, adjusted R-squared, and F-statistic.

Graphical representations were also used to support the interpretation of results. Various diagrams such as distribution charts, sentiment graphs, and relationship plots were created to visually illustrate patterns observed in the dataset. These visualizations help present complex statistical relationships in a more understandable manner and support the explanation of findings presented in the results section.

Overall, the methodological framework applied in this research provides a systematic approach to analysing consumer behaviour in digital marketing environments. By combining descriptive statistics, sentiment classification, correlation analysis, and regression modelling, the study is able to identify the key factors that influence consumer sentiment toward social media marketing activities. This methodological approach ensures that the conclusions drawn from the study are based on structured analysis and empirical evidence derived from primary data.

5.0 Results and Discussion

The descriptive statistical analysis was conducted to understand the general characteristics of the dataset and the behaviour of respondents regarding their interaction with social media marketing activities. The dataset contains 500 observations collected from various locations in Chennai through a structured survey. The analysis includes demographic and behavioural variables such as age, daily time spent on social media, advertisement click rate, engagement rate, purchase intention score, and influencer impact score.

Table 1. Descriptive Statistics of Key Variables

Variable	Mean	Standard Deviation	Minimum	Maximum
Age	33.48	10.27	18	59
Daily_Time_Spent_Min	118.62	58.34	15	240
Ad_Click_Rate	0.176	0.089	0.01	0.35
Engagement_Rate	0.442	0.214	0.05	0.85
Purchase_Intention_Score	5.61	2.63	1.00	10.00
Influencer_Impact_Score	4.98	2.82	0.10	9.98

The results presented in Table 1 indicate that the average age of respondents is 33.48 years, suggesting that the dataset includes participants from diverse age groups, primarily young and middle-aged individuals who actively engage with digital platforms. The average time spent on social media platforms is 118.62 minutes per day, indicating that respondents dedicate a significant portion of their daily activities to online interactions.

The engagement rate has a mean value of 0.442, which reflects a moderate level of interaction with marketing content such as likes, comments, and shares. Similarly, the average advertisement click rate of 0.176 suggests that respondents occasionally interact with online advertisements displayed on social media platforms. The purchase intention score, with a mean of 5.61, indicates a moderate tendency among users to consider purchasing products promoted through digital marketing campaigns.

5.1 Sentiment Distribution Analysis

Sentiment responses collected from respondents were categorized into three groups: Negative, Neutral, and Positive. These categories represent the respondents' emotional responses toward social media marketing content.

Table 2. Distribution of Sentiment Responses

Sentiment Category	Frequency	Percentage
Negative	108	21.6%
Neutral	172	34.4%
Positive	220	44.0%
Total	500	100%

The results presented in Table 2 show that 44 percent of respondents expressed positive sentiment toward social media marketing activities. This indicates that many consumers perceive digital marketing messages favorably and are receptive to promotional content encountered on social media platforms.

Approximately 34.4 percent of respondents reported neutral sentiment, suggesting that while they are exposed to marketing content, they may not form strong opinions about it. In contrast, 21.6 percent of respondents expressed negative sentiment, indicating dissatisfaction or skepticism toward certain marketing messages.

Figure 1. Sentiment Distribution among Respondents

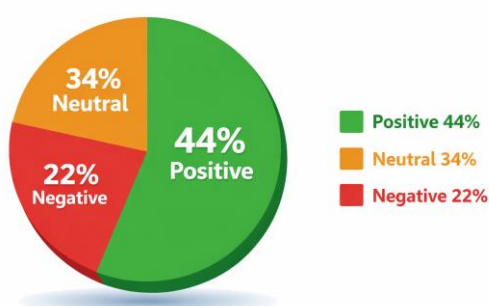


Figure 1 illustrates the overall sentiment pattern among respondents. The chart clearly demonstrates that positive sentiment dominates the responses, highlighting the effectiveness of social media platforms as communication channels for marketing activities.

5.2 Correlation Analysis

Correlation analysis was conducted to examine the relationships among the key variables in the dataset. This analysis helps identify how different marketing interaction factors influence consumer sentiment and behavior.

Table 3. Correlation Matrix of Major Variables

Variable	Engagement Rate	Ad Click Rate	Influencer Impact	Purchase Intention
Engagement Rate	1.000	0.412	0.386	0.447
Ad Click Rate	0.412	1.000	0.295	0.352
Influencer Impact	0.386	0.295	1.000	0.421
Purchase Intention	0.447	0.352	0.421	1.000

The correlation results presented in Table 3 indicate that engagement rate has the strongest relationship with purchase intention ($r = 0.447$). This suggests that consumers who actively interact with social media marketing content are more likely to develop interest in purchasing promoted products.

Similarly, advertisement click rate and influencer impact score show moderate positive correlations with purchase intention. These findings highlight the importance of interactive marketing strategies and influencer collaborations in influencing consumer decision-making.

Figure 2. Relationship between Engagement Rate and Sentiment

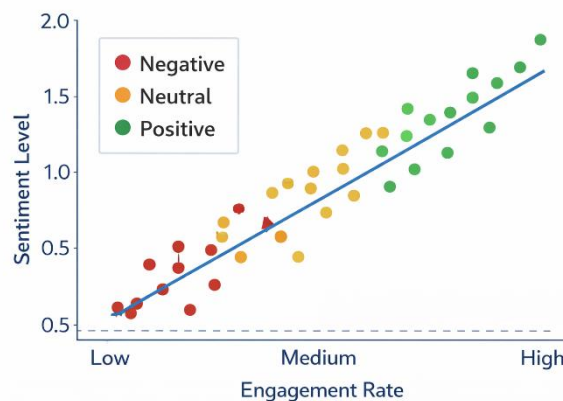


Figure 2 illustrates the positive relationship between engagement rate and sentiment level. As engagement with marketing content increases, the sentiment expressed by users tends to become more positive.

5.3 OLS Regression Analysis

To further examine the factors influencing consumer sentiment, an Ordinary Least Squares (OLS) regression model was developed using sentiment analysis as the dependent variable. The independent variables include engagement rate, advertisement click rate, daily time spent on social media, influencer impact score, and purchase intention score.

Table 4. OLS Regression Results

Variable	Coefficient	Std. Error	t-value	p-value
Constant	0.842	0.213	3.95	0.000
Engagement Rate	0.517	0.102	5.07	0.000
Ad Click Rate	0.286	0.094	3.04	0.003
Daily Time Spent	0.004	0.002	2.11	0.035
Influencer Impact	0.065	0.018	3.61	0.001
Purchase Intention	0.121	0.027	4.48	0.000

Model Summary

Statistic	Value
R ²	0.42
Adjusted R ²	0.40
F-statistic	35.18
Prob(F-statistic)	0.000

The regression results (Table 4) show that engagement rate is the most influential predictor of sentiment, with a statistically significant coefficient of 0.517. This indicates that higher levels of interaction with marketing content lead to more positive consumer sentiment. Advertisement click rate and influencer impact score also have significant positive relationships with sentiment levels. The R² value of 0.42 indicates that the selected independent variables explain approximately 42 percent of the variation in sentiment levels among respondents.

5.4 Discussion

The results of this study highlight the significant role of social media engagement in shaping consumer sentiment toward marketing activities. The findings demonstrate that consumers who actively interact with marketing content are more likely to develop positive perceptions of the promoted products or services. The sentiment distribution analysis reveals that a large proportion of respondents express positive attitudes toward social media marketing. This positive sentiment may be attributed to the interactive nature of social media platforms, which allow users to participate in marketing communication through comments, shares, and other forms of engagement.

Furthermore, the regression analysis confirms that engagement rate, advertisement click rate, and influencer impact significantly contribute to shaping consumer sentiment. These results suggest that marketing strategies focusing on interactive content and influencer partnerships may be particularly effective in influencing consumer attitudes. Overall, the findings emphasize the importance of designing engaging marketing campaigns that encourage user interaction and participation. Businesses that adopt such strategies are likely to enhance consumer sentiment, strengthen brand perception, and improve overall marketing effectiveness.

6.0 Conclusion

The findings of this study provide a clear understanding of how social media marketing activities influence consumer behaviour and sentiment among respondents in Chennai. The

analysis shows that a considerable proportion of user's express positive attitudes toward marketing content displayed on social media platforms. Factors such as engagement with online content, interaction with advertisements, time spent on social media, and the influence of online personalities contribute to shaping consumer sentiment and purchasing intentions. The statistical results also indicate that consumers who actively engage with marketing posts through likes, comments, shares, and advertisement clicks are more likely to develop favourable perceptions toward promoted products or services. These findings highlight the growing importance of digital marketing strategies that encourage consumer participation and interaction. Based on these observations, two important suggestions can be proposed.

First, businesses should focus on creating engaging and interactive marketing content that encourages users to participate actively in discussions and share their experiences with others. Second, organizations should collaborate with credible influencers and encourage authentic customer reviews, as these factors can strengthen consumer trust and positively influence purchasing decisions in the digital marketplace.

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STRATEGIC HUMAN RESOURCE MANAGEMENT PRACTICES FOR SUSTAINABLE ORGANIZATIONAL PERFORMANCE

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Abstract

In today's dynamic and competitive business environment, organizations increasingly recognize the importance of Strategic Human Resource Management (SHRM) in achieving sustainable organizational performance. This paper explores the role of SHRM practices such as recruitment, training and development, performance management, employee engagement, and green HRM in enhancing long-term organizational sustainability. The study adopts a conceptual approach based on existing literature. The findings reveal that aligning HR strategies with organizational goals significantly improves employee productivity, innovation, and overall performance. Additionally, sustainable HRM practices contribute to environmental, social, and economic sustainability, ensuring long-term competitive advantage.

Keywords: *Strategic HRM, Sustainable Performance, Green HRM, Employee Engagement, Organizational Sustainability*

Introduction

Strategic Human Resource Management (SHRM) plays a crucial role in aligning human resource practices with organizational goals to achieve long-term success. In the modern business environment, organizations face increasing pressure to remain competitive while ensuring economic, social, and environmental sustainability. SHRM focuses on effectively managing human capital through practices such as recruitment, training, performance management, and employee engagement to enhance productivity and innovation.

Sustainable organizational performance goes beyond financial outcomes by incorporating employee well-being, ethical practices, and environmental responsibility. By integrating sustainability into HR strategies, organizations can build a committed workforce, improve operational efficiency, and achieve a lasting competitive advantage. Thus, SHRM acts as a key driver in promoting innovation and sustainability within organizations.

Review of Literature

Several studies have emphasized the importance of SHRM in organizational performance: David E. Guest (1997) emphasized that effective HRM practices significantly influence

employee behavior and organizational performance. His study highlighted that strategic alignment of HR practices leads to improved productivity and competitive advantage.

Mark A. Huselid (1995) found that high-performance work practices, including selective hiring, training, and performance-based compensation, positively impact employee productivity and financial performance. This study laid the foundation for linking HRM practices with organizational outcomes.

Patrick M. Wright and Gary C. McMahan (2011) argued that SHRM plays a vital role in building human capital that contributes to sustained competitive advantage. Their work emphasized the importance of aligning HR strategies with business goals.

John W. Boudreau and Peter M. Ramstad (2007) introduced the concept of HR measurement and analytics, highlighting how data-driven HR practices improve decision-making and organizational sustainability.

Ralf Stegmann (2012) identified employee engagement as a key factor influencing organizational performance, suggesting that engaged employees contribute more effectively to innovation and sustainability.

In the context of sustainability, Jabbour (2013) emphasized the role of Green HRM practices in promoting environmental sustainability. The study found that eco-friendly HR initiatives significantly improve environmental performance.

Renwick, Redman, and Maguire (2013) explored the integration of environmental management into HRM and concluded that Green HRM practices support sustainable organizational development.

Paauwe (2009) highlighted that HRM contributes to organizational performance through employee well-being, social legitimacy, and long-term sustainability rather than short-term financial gains alone.

Recent studies have further expanded the scope of SHRM and sustainability. Chowdhury et al. (2023) found that Green HRM practices significantly enhance environmental and economic performance. Similarly, Peng et al. (2024) demonstrated that SHRM practices foster green innovation and improve environmental outcomes.

Furthermore, Ayari and Al Meer (2025) reported that sustainable HRM practices positively influence employee commitment and organizational performance. Their findings suggest that organizations adopting sustainable HR strategies achieve better long-term results.

Objectives of the Study

1. To analyze the role of SHRM practices in organizational performance

2. To examine the relationship between HRM practices and sustainability
3. To identify key HR strategies that promote sustainable organizational growth

Strategic HRM Practices for Sustainability

Recruitment and Selection

Strategic recruitment ensures hiring employees who align with organizational values and sustainability goals. Green recruitment emphasizes environmental awareness and ethical practices.

Training and Development

Continuous learning enhances employee skills and adaptability. Training programs focusing on sustainability and innovation improve long-term performance.

Performance Management

Performance appraisal systems aligned with sustainability metrics ensure employees contribute to organizational goals. Linking performance with environmental and social targets enhances accountability.

Compensation and Rewards

Strategic compensation systems motivate employees to engage in sustainable practices. Reward systems linked with innovation and sustainability improve organizational outcomes.

Employee Engagement

Employee involvement in decision-making enhances commitment and productivity. Engaged employees contribute to innovation and sustainability.

Green HRM Practices

Green HRM includes eco-friendly initiatives such as paperless offices, energy conservation, and sustainable workplace practices. These contribute to environmental sustainability and cost efficiency.

Conceptual Framework

Conceptual Framework: Detailed Explanation

The conceptual framework illustrates the relationship between Strategic Human Resource Management (SHRM) practices and Sustainable Organizational Performance, with Employee Commitment and Innovation acting as mediating variables.

Independent Variables (SHRM Practices)

These are the key HR practices that influence organizational outcomes:

Recruitment & Selection

Strategic recruitment focuses on attracting and selecting candidates who align with organizational values, culture, and sustainability goals. Hiring environmentally and socially responsible employees supports long-term sustainability.

Training & Development

Training enhances employees' knowledge, skills, and abilities. Sustainability-oriented training programs improve awareness of environmental practices and foster innovation, enabling employees to contribute effectively to organizational goals.

Performance Management

Performance management systems evaluate and monitor employee performance. When aligned with sustainability goals, they ensure accountability and encourage employees to achieve both organizational and environmental targets.

Compensation & Rewards

Compensation strategies, including salaries, incentives, and benefits, motivate employees. Reward systems linked to sustainability and innovation encourage employees to adopt responsible practices and improve performance.

Employee Engagement

Employee engagement reflects the emotional and psychological involvement of employees in their work. Engaged employees are more productive, innovative, and committed, contributing significantly to organizational sustainability.

Green HRM

Green HRM includes eco-friendly HR practices such as paperless processes, energy conservation, and environmental training. It directly supports environmental sustainability and promotes responsible organizational behavior.

Mediating Variables

Mediating variables explain how and why SHRM practices influence organizational performance.

Employee Commitment

Employee commitment refers to the psychological attachment of employees to the organization. Effective HR practices enhance trust, satisfaction, and loyalty, leading to higher retention and improved performance.

Innovation

Innovation involves the development of new ideas, processes, or products. SHRM practices such as training, rewards, and engagement foster creativity and innovation, which are essential for sustainable growth.

Dependent Variable

Sustainable Organizational Performance

This represents the overall outcome of the framework and includes three dimensions:

- Economic Performance: Profitability, productivity, and efficiency
- Social Performance: Employee well-being, equity, and community impact
- Environmental Performance: Resource conservation, reduced emissions, and eco-friendly practices

Relationship Between Variables

- SHRM practices directly influence sustainable organizational performance.
- SHRM practices indirectly influence performance through mediators:
 - Employee Commitment enhances employee loyalty and productivity
 - Innovation drives continuous improvement and competitiveness
- The combined effect leads to long-term sustainability and competitive advantage.

Impact of SHRM on Sustainable Organizational Performance

SHRM contributes to sustainability in three dimensions:

Economic Sustainability

Improves productivity, profitability, and efficiency.

Social Sustainability

Enhances employee well-being, engagement, and retention.

Environmental Sustainability

Promotes eco-friendly practices and reduces environmental impact.

Research shows that integrating HR strategies with sustainability initiatives enhances employee performance and organizational outcomes.

Challenges in Implementing SHRM

- Resistance to organizational change
- Lack of awareness about sustainability practices
- Limited financial resources
- Difficulty in measuring sustainability performance

Organizations must overcome these challenges through strategic planning and leadership support.

Suggestions

- Integrate sustainability into HR policies
- Invest in employee training and development
- Adopt digital HR technologies
- Promote a culture of innovation and sustainability
- Implement green HRM practices

Conclusion

Strategic Human Resource Management plays a vital role in achieving sustainable organizational performance. By aligning HR practices with organizational strategy, companies can enhance productivity, innovation, and long-term sustainability. The integration of green HRM and employee-centric practices ensures that organizations remain competitive while addressing environmental and social challenges.

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MONSOON RAINFALL VARIABILITY IN CHENNAI: A TIME SERIES STUDY**K. RENUGADEVI**Assistant Professor, St. Joseph's College (Arts & Science), Kovur, Chennai

Abstract

Rainfall variability has become a significant concern in urban regions, particularly in coastal cities such as Chennai. This study presents a detailed time series analysis of rainfall patterns during the 2024–2025 monsoon seasons. Using secondary data, the research decomposes rainfall into trend, seasonal, and irregular components to understand its behavior. The results reveal that the year 2024 experienced above-normal rainfall, especially during the Northeast Monsoon, while 2025 exhibited uneven rainfall distribution with noticeable fluctuations. The increasing irregularity and intensity of rainfall events suggest potential climate variability impacts, posing challenges for urban flooding management and water resource planning.

Keywords: Time Series Analysis, Rainfall Variability, Monsoon, Seasonal Decomposition, Urban Climate.

I. Introduction

Rainfall plays a fundamental role in determining water availability, agricultural productivity, and the sustainability of urban infrastructure. In Chennai, rainfall is primarily influenced by two monsoon systems: the Southwest Monsoon (June to September) and the Northeast Monsoon (October to December). Among these, the Northeast Monsoon contributes the largest share of annual rainfall and is crucial for replenishing reservoirs and groundwater resources. The dependency of the city on monsoon rainfall makes it highly vulnerable to changes in rainfall patterns.

In recent years, Chennai has witnessed increasing irregularities in rainfall, including delayed monsoon onset, uneven distribution, and extreme precipitation events leading to floods. These changes necessitate a systematic analysis of rainfall behavior. Time series analysis provides an effective framework for examining such patterns by decomposing data into trend, seasonal, and irregular components. This study aims to analyze rainfall trends during the 2024 and 2025 monsoon periods and identify significant variations that may impact urban planning and environmental management.

II. Review of Literature

The study of rainfall variability has been extensively explored through statistical and time series methods. The foundational work of George E. P. Box and Gwilym M. Jenkins introduced ARIMA models, which remain widely used in analyzing climatic time series data. Their contributions laid the groundwork for forecasting and understanding temporal patterns in rainfall data.

Further advancements in time series analysis were made by Chris Chatfield, who emphasized decomposition techniques for separating seasonal and trend components. Similarly, Maurice George Kendall developed statistical methods for trend detection that are still applied in hydrological research. These approaches have been instrumental in identifying long-term rainfall variations.

Research in hydrological modelling by Keith W. Hipel and A. Ian McLeod highlighted the stochastic nature of rainfall and its implications for water resource systems. Their work demonstrated how variability in rainfall can significantly influence hydrological planning and risk assessment.

In the field of atmospheric science, Daniel S. Wilks provided comprehensive statistical techniques for analysing weather and climate data, while Hans von Storch contributed to understanding climate variability and its statistical representation. These studies underscore the importance of integrating statistical models with climatic data.

Indian monsoon dynamics have been extensively studied by R. H. Kripalani and Sulochana Gadgil, who explored large-scale climatic influences on rainfall patterns. Their research highlights the complexity of monsoon systems and their sensitivity to global climatic factors. Additionally, Eugene M. Rasmusson and Peter J. Webster investigated monsoon circulation and climate interactions, providing insights into variability and predictability. Studies by M. Rajeevan and D. S. Pai using data from the India Meteorological Department further confirmed increasing rainfall variability in India.

Recent research by Pulak Guhathakurta and S. K. Dash emphasized the rise in extreme rainfall events in urban areas. Their findings are particularly relevant for cities like Chennai, where high population density increases vulnerability to flooding. Collectively, these studies highlight the growing importance of time series analysis in understanding rainfall variability.

III. Database

The present study is based on secondary data collected from reliable and authoritative sources. The primary source of data is the India Meteorological Department, which provides detailed rainfall records and meteorological reports. Additional data were obtained from regional weather summaries and published rainfall datasets, ensuring the credibility and consistency of the analysis.

The collected data reveal several important observations. The year 2024 experienced significantly above-normal rainfall, particularly during the Northeast Monsoon season. In contrast, the year 2025 showed an uneven distribution of rainfall, with certain months experiencing excess rainfall while others recorded moderate levels. These variations indicate increasing unpredictability in rainfall patterns, which forms the basis for further analysis.

IV. Methodology

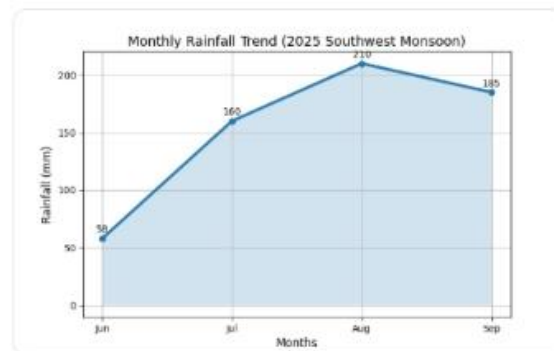
The study employs time series analysis to examine rainfall patterns. The observed rainfall data are decomposed into three components: trend, seasonal, and irregular. The trend component represents the long-term movement of rainfall over time, while the seasonal component captures periodic fluctuations associated with monsoon cycles. The irregular component accounts for unexpected variations caused by random or external factors.

$$Y_t = T_t + S_t + I_t$$

The trend component is estimated using the moving average method, which smooths short-term fluctuations and highlights long-term patterns. Seasonal indices are calculated to understand periodic variations, while the irregular component is obtained by removing trend and seasonal effects from the observed data. Graphical analysis is also used to visualize rainfall patterns and interpret results effectively.

V. Results and Discussion

The analysis of monthly rainfall data for the 2025 Southwest Monsoon shows a clear pattern of variation. Rainfall was relatively low in June, indicating a weak onset of the monsoon. It increased significantly in July and reached its peak in August, reflecting strong monsoon activity. A slight decline in September marks the transition toward the withdrawal phase of the monsoon.



The comparison between 2024 and 2025 reveals that while total rainfall remains high, its distribution has become uneven. The year 2024 exhibited consistently high rainfall, whereas 2025 showed fluctuations across months. This indicates increasing variability and reduced predictability.

Seasonal analysis confirms that the Northeast Monsoon continues to dominate rainfall patterns. However, there is evidence that the Southwest Monsoon is contributing more rainfall than before, suggesting a shift in seasonal distribution. The irregular component highlights sudden spikes in rainfall, which may be attributed to localized weather systems or broader climatic changes.

Overall, the results suggest that rainfall patterns in Chennai are becoming more intense and irregular. These changes have significant implications for flood risk, infrastructure planning, and water resource management.

VI. Conclusion

The study concludes that rainfall in Chennai during the 2024–2025 period exhibits strong seasonal characteristics combined with increasing variability. While monsoon patterns remain identifiable, the distribution of rainfall has become uneven, with more frequent extreme events. This growing unpredictability poses challenges for urban planning and necessitates improved forecasting systems and adaptive strategies.

The findings emphasize the importance of integrating time series analysis with climate studies to better understand rainfall behavior. Future research should focus on longer datasets and advanced modelling techniques to enhance prediction accuracy and support sustainable development.

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A COMPARATIVE STUDY OF SUPERVISED AND UNSUPERVISED METHODS FOR SENTIMENT ANALYSIS AT THE DOCUMENT LEVEL

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Abstract

The goal of global-level view mining which is familiar in digital forum analytics and user audit inquiry is to determine the all-inclusive tone of a narrative given the exponential growth of digital content data selecting a suitable analytical approach is crucial to achieving accurate emotion categorization this study compares the efficacy efficiency and real-world implementation of oversight and empowered techniques for record-level text analysis the learned approaches that have been investigated include standard cognitive computing techniques such as support vector machines svm naive bayes and logistic regression which generate discriminative sentiment features using labeled datasets conversely unlabeled data approaches do not need annotated data and instead infer opinion orientation using dictionary-based methods tokenization stop-word removal stemming and tf-idf feature extraction are all part of a consistent preprocessing pipeline that is used to ensure fair comparisons between models experiments on benchmark datasets demonstrate that labelled data models achieve higher stratification accuracy when there is an adequate amount of trained data available while unlabeled approaches perform worse in low-cost sequence of events due to their independence from supervised corpora and lower implementation costs this study assists practitioners in selecting the optimal survey analysis methods based on the needs of their utilization and the data availability by illuminating the trade-offs between classification accuracy and data dependency

Keywords: *Supervised learning, Unsupervised learning, Dictionary-based methods, Text preprocessing, Feature extraction*

Introduction

With the rapid growth of virtual content, investigating written content automatically has become very important. opinion mining is a part of text processing that helps us interpret, whether a piece of document represents beneficial or unfavorable. There are three stages of

emotion detection document level, sentence level, and aspect level. In this study, I focus on global level subjectivity analysis where the goal is to classify the aggregate feeling of a total file.

There exist two major techniques: -

Supervised learning- that utilizes annotated data

Unsupervised learning -that operates on unlabeled data

Basic Architecture of Sentiment Analysis System: -



LITERATURE REVIEW

In the early stages of sentiment analysis research,

- pang et al 2002 showed that machine learning techniques such as nave bayes and support vector machines can effectively classify sentiments in text around the same time.
- Turney 2002 introduced an unsupervised method using pointwise mutual information which helped in identifying whether words carry positive or negative meanings without using labelled data.
- later Liu 2012 focused on lexicon-based approaches and pointed out an important limitation these methods often depend heavily on the domain which affects their accuracy with advancements in deep learning.
- Kim 2014 proposed the use of convolutional neural networks which significantly improved performance in text classification tasks.
- Recently Devlin et al 2019 introduced Bert a powerful model that understands the context of words in a sentence bringing a major improvement in sentiment analysis.

Research Gap: -

Even though many frameworks comprise been developed, it consists of still several challenges. There is limited examination with respect to common approaches and grouping strategies. Very minimal study works targets merging dual techniques into assessable approaches. Various systems struggle to demonstrate accurately over multiple domains.

METHODOLOGY

Dataset used: -

For the current study I used two well-known data collection, the first one is imdb movie evaluation data samples that include client opinions about movie.

second data resources are amazon customer rating which includes customer feedback on various products these datasets help in analysing real-world opinions from different domains.

Data preprocessing: -

Before applying any framework, information needs should be filtered and prepared this process is called transformation. First text segmentation is performed where content was divided into elements such as units then irrelevant terms such as 'is, the, and, and', are removed because they contribute less to context next root extraction or base form. Conversion applied to normalise root form. Finally, the document is mapped into numerical form using techniques like tf-idf and feature representation, so that machine learning models can understand and process the data.

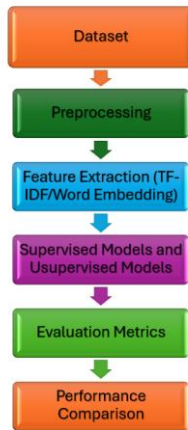
Supervised models: -

The algorithms are developed using pre-classified data that helps them learn patterns and that provide correct outputs. First naive bayes is a simple and widely used method it is based on likelihood and consider that data characteristics are unrelated to each other even with this assumption it performs well in many text categorization tasks. Next svm is a powerful procedure which perform by finding high accuracy known as hyperplane to divide various groups of data. In addition to these deep computational algorithms are also used convolutional neural architecture CNN help in capturing important local features from the text such as key phrases long short-term memory LSTM networks are useful for understanding the sequence and context of words in a sentence.

Unsupervised models: -

It does not require tagged data such techniques try to find trends explicitly from the content. An individual strategy is the lexicon-based procedure that uses pre-configured opinion word repositories such as words depending on the terms present in the text, It identifies if favourable or unfavourable another method is k-means grouping where alike documents are grouped together, after grouping polarity property is assigned using on the characteristics of each cluster.

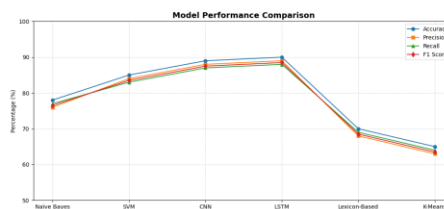
METHODOLOGY FLOW DIAGRAM



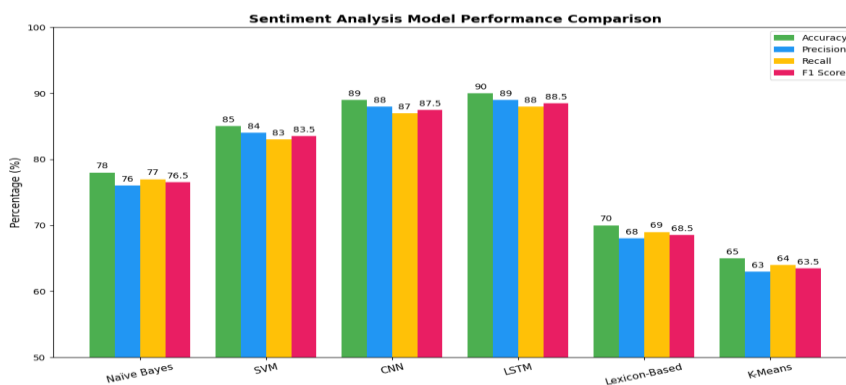
RESULTS

Sentiment Analysis Model Performance

	Naive Bayes	SVM	CNN	LSTM	Lexicon-Based	K-Means
Accuracy (%)	78	85	89	90	70	65
Precision (%)	76	84	88	89	68	63
Recall (%)	77	83	87	88	69	64
F1 Score (%)	76.5	83.5	87.5	88.5	68.5	63.5



Graphical Representation: -



DISCUSSION (Critical Analysis)

Supervised learning: -

Supervised learning models have bayes, svm, CNN, LSTM.

Strengths: -High accuracy they operate very effectively in selected AI-based neural systems like CNN and LSTM is designed to understand sophisticated structures able to interpret links in content.

Limitations: -Need annotated data you need a dataset with pre-defined emotion labels that may be time-consuming to create computationally high-cost advanced models require longer processing power and time.

Unsupervised learning: -

Strengths: -No need for labelled data can work even when you don't have pre-classified sentiment data easy to implement simple algorithms and less computational overhead.

Limitations: - lower accuracy generally less reliable than supervised methods field dependent efficiency may differ according to the category content otherwise input data implemented.

Key insights: -

AI models perform the best methods such as CNN and LSTM consistently achieve higher accuracy because they can capture complex relationships and contextual meaning in text better than traditional machine learning algorithms. lexicon-based methods face difficulty in sarcasm. since these models use predefined vocabulary lists, they also misinterpret sarcastic or ironic expressions leading to erroneous outcomes sentiment predictions hybrid approaches offer better results combining different methods.

E.g.- machine learning lexicon-based features can improve total performance by leveraging the strengths of each approach.

CONCLUSION

This study gives a comprehensive comparison between supervised and unsupervised methods at document-level sentiment analysis highlighting their strengths limitations and practical relevance. The findings clearly indicate that opinion mining techniques mainly advanced AI advanced models such as CNN also LSTM deliver superior performance across all performance indicators including accuracy precision recall and F1 score their ability to capture contextual

meaning sequential dependencies and complex linguistic trend makes them highly effective for analysing large volumes of textual input data.

Conversely traditional machine learning algorithm nave bayes, and support vector machines also demonstrate reliable performance especially when working with well-structured and moderately sized datasets while they may not match the effectiveness of deep learning models. They remain valuable due to their simplicity faster training time and lower computational requirements on the other hand unsupervised approaches along with lexicon-based procedures and data segmentation approaches such as k-means offer a different set of advantages this methods do not require tagged data collections making them suitable use case that annotated information is less or unavailable.

However, their performance is generally lower as they rely on predetermined rules or structure and lack the ability to fully understand context sarcasm and nuanced expressions in language.

Overall the study emphasizes that it can be observed that no one-size-fits-all solution the method selection depends primarily on factors such as data presence computational resources and the particular requirements of task while guided deep learning systems ideal for achieving high accuracy self-organizing methods remain useful for exploratory evaluation and low-resource environments.

In conclusion opinion mining is rapidly advancing as a dynamic sector and integrating multiple approaches while leveraging modern advancements in artificial intelligence will be key to achieving more accurate and meaningful insights from textual data

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சங்கஇலக்கியத்தில் சமூகவியல் நோக்கில் பெண்மொழி

முனைவர் ச.ப.சுபதி

உதவிப்பேராசிரியர்

தமிழ்த்துறை

செயின்ட்ஜேசுப் கல்லூரி (கலை & அறிவியல்)

முன்னுரை

சமூக அரங்கில் பெண்களுக்கு வழங்கப்பெறாத உரிமைகளை மீட்க வேண்டிய விழிப்புணர்வைப் 'பெண்ணியம்' பெண் விடுதலைக்கான சிந்தனையாக வெளிப்படுத்துகிறது. மேலை நாடுகளில் பெண்கள் சமூகப் பொருளாதார காரணங்களால் வெளியுலக வாழ்வில் பங்கேற்றபோது பழைய பாரம்பரியத்தையும் சமூக உறவுகளையும் மாற்றியமைத்தனர். அப்போது அவர்கள் தங்களின் தாழ்நிலையை உணர்ந்து போராடத் தொடங்கினர். அப்போராட்டம் பெண்ணியத்தைத் தோற்றுவித்தது. இதனால் பெண்களின் முன்னேற்றத்திற்குத் தடையாக இருந்த பல்வேறு கருத்துகள் மாற்றமடைந்தன. இம்மாற்றத்தைச் 'சமூகமயமாக்கம்' மற்றும் 'மொழி' யால் அறியலாம்.

சமூகப் பரப்பில் சிறுவயது முதல் ஆண்களுக்கும் பெண்களுக்கும் இருவேறு நடத்தை முறைகள் ஒழுக்க விதிகள் மொழி வழியாகக் கற்பிக்கப்பட்டதால் இருவேறு பண்பு நலன்கள் உருவாயின. இவ்வாறு உருவான கற்பிதங்களை அடுத்தடுத்த தலைமுறைக்குக் கொண்டுசெல்ல 'மொழி' முக்கிய கருவியாகச் செயல்பட்டுள்ளது. இம்மொழியைப் பெண்ணிய சிந்தனையாளர்கள் தங்களுக்கான மொழியாக மாற்றியமைக்கப் போராடியுள்ளனர். அதற்கான அடையாளங்களைப் பழந்தமிழ் இலக்கியங்களான சங்கப் பனுவல்களில் பரவலாகக் காணமுடிகிறது. அக்கால சூழலில் எழுதிய பெண் கவிதைகளின் கவிதைமொழி பெரும்பாலும் அவர்களின் உள்ளுணர்வை வெளிப்படுத்தும் வகையில் அமைந்திருப்பதை இதற்கான சான்றாகக் கொள்ளலாம். அதனடிப்படையில் இவ்வியல் சங்கக் கவிதைகளில் காணலாகும் பெண்மொழிக் கூறுகளையும் கருத்தியல்களையும் சமூகவியல் நோக்கில் ஆராய்கிறது.

சமூகவியல் பெண்மொழி

சங்க இலக்கியங்கள் சமூகம் சார்ந்த பண்பாட்டுப் பழக்கவழங்களோடு நெருங்கிய தொடர்பு கொண்டுள்ளன. அதன்வழியே பல சமூக அமைப்புச் சார்ந்த மாற்றங்களையும் அச்சமூக அமைப்பில் ஆண் - பெண் என்னும் இருபாலரின் சமூக இருப்புச் சார்ந்த தேவையையும் விளைவுகளையும் அவை விளக்கியுள்ளன. சமூக அமைப்பின் தலைமைப் பொறுப்பில் இருக்கும் பெண் அச்சமூகத்திற்கு

வாரிசுகளை உருவாக்கித் தரும் உற்பத்திக் கருவியாக இருந்துள்ளார். அதற்காக அவர் விருந்தினரை வரவேற்கவும் போரை மகிழ்ச்சியுடன் ஏற்றுக்கொள்ளும் மனநிலைக்கு உரியவராகவும் சித்தரிக்கப்பட்டுள்ளார். அது குறித்த எதிர்வினைகளையும் அவர்களின் மொழிவழியே அறியமுடிகிறது.

அதுமட்டுமின்றிச் சங்க இலக்கியத்தில் இடம்பெறும் பெண் இயற்கைப் புணர்ச்சி இரவுக்குறி பகற்குறி உடன்போக்கு உள்ளிட்ட இடங்களில் ஆணைச் சார்ந்து செயல்படுகிறார். அக்காலச் சமூகத்தில் பரத்தை உறவில் ஈடுபடும் தலைவனிடம் தலைவி (பெண்) ஊடல் கொள்வதற்கான வாயில்கள் இருந்துள்ளன. இவ்வாறு பெண் சார்ந்த உணர்வுகள் சங்ககால சமூகப் பதிவுகளாகப் பெண் கவிதைகளில் வெளிப்படும் தன்மையை ஆராயும் வகையில் 'சமூகவியல் பெண்மொழி' பதிவுகள் முக்கியத்துவம் பெறுகின்றன. இதற்குத் தாய்வழி சமூகமாகத் தொடக்கக் காலத்தில் வாழ்ந்த பெண்ணின் இருப்புக் குறித்தப் பார்வையை அறிந்துகொள்ளல் அவசியமாகிறது.

தொடக்க கால - பெண்ணின் இருப்பு :

மனித இன வரலாற்றில் தாய்வழிப் பெண் தலைமைச் சமுதாயம் வேளாண்மை உள்ளிட்ட சமூக மாற்றங்களால் தந்தைவழி சமூகமாகவும் ஆணாதிக்கச் சமூகமாகவும் ஆணை முதன்மையாகக் கொண்டு இயங்கும் சமூக அமைப்பாகவும் இன்றளவில் பரிணமித்துள்ளது. இந்த ஆதிக்கச் சமூக அமைப்பு எவ்வாறு தோற்றம் கொண்டது என்பதை ஆராய்வதற்கு முன் இ வரலாற்றைத் தழுவின பெண்ணின் தொடக்ககாலம் உலகளவில் எவ்வாறு இருந்தது என்பதைப் பற்றிய அறிதல் அவசியமாகிறது. அதனடிப்படையில் தான் தொடக்ககாலப் பெண்ணின் இருப்பை உறுதிபடுத்த இயலும். மேலும் பெண்களைத் தங்களுக்குக் கீழ்ப்படியச் செய்வதில் ஆண்கள் வெற்றிகண்ட விதம் அவ்வாறு ஆண்கள் வெற்றிப்பெற பெண்கள் இடமளித்ததற்கான காரணம் ஆகியவற்றை இதன்வழியே அறியமுடியும்.

தொடக்ககாலப் பெண் நிலை :

தொடக்ககால - பெண் வலிமையின் உச்சமாக இருந்து விடியல் முதல் பகல்பொழுது முடியும் வரை தொடர்ந்து உழைத்துள்ளார். வேட்டையாடுதல் அவர்களின் முக்கிய பணிகளில் ஒன்றாக இருந்திருக்கிறது. வரலாற்றுக்கு முந்திய காலத்தில் பெண்கள் குழந்தைகளுடன் அல்லது குழந்தைகள் இல்லாமல் உணவுக்காக ஆண்களைச் சார்ந்திருக்கவில்லை. அக்காலச் சூழலில் பெண்களுக்கே குழந்தையைப் பராமரிக்கும் பொறுப்பு இருந்ததால் அதற்கான போராட்டமும் அவர்களுக்கு உரியதாக இருந்திருக்கிறது. அப்பொழுது வேட்டையாடலில் 'உணவு சேகரிப்பு' மட்டுமே குறிக்கோளாக இருந்தது. அப்பெண்கள் உணவுக்காகக் கொடிய விலங்குகளின் இருப்பிடங்களுக்குள் (குகை) சென்று உணவைச் சேகரித்துக்கொண்டு திரும்பும் பொழுது

விலங்குகள் எதிர்பட்டால் அவற்றிடமிருந்து தற்காத்துக்கொள்ள ஆயுதங்களைப் பயன்படுத்தியுள்ளனர். அப்பொழுது உணவு சேகரிக்கச் சென்ற தாய் ஒருபோதும் தனக்கு உணவை வழங்கிய இயற்கையை அல்லது விலங்கினங்களை அழிக்கவில்லை. பிற்காலத்தில் வந்த தந்தைவழி சமூகமும் அதன்பாலான உணவு சேகரிப்பு முயற்சியும்தான் உயிரினங்களைக் கொன்று வேட்டையாடும் மரபைத் தோற்றுவித்துள்ளன.

பரிணாம வளர்ச்சியில் பெண்களின் பங்களிப்பு :

தொடக்கத்தில் வாழ்ந்த பெண் தனக்கு மட்டுமின்றித் தன் குழந்தைக்குமான உணவு சேகரித்தப் பணி தவிர்க்க முடியாததாகவும் பரிணாம வளர்ச்சிக்கு உரியதாகவும் ஏற்றுக் கொள்ளப்பட வேண்டியதாகிறது. அதன்வழியே நம்மில் பலருக்கு 'வலதுகை வாகு' ஏற்பட்டுள்ளது. கணக்கிட்டுச் சொல்ல முடியாத காலந்தொட்டுப் பெண் தன் குழந்தையை இடதுபுற இடுப்பில் தூக்கிச்செல்வதையே வழக்கமாகக் கொண்டுள்ளார். அவ்வாறு செய்ததன் வழியே அவர் தனது இருதயத் துடிப்பினால் குழந்தையை ஆறுதலடையச் செய்தார் என்பதுடன் - அவரது வலதுகை வேறு வேலைகளுக்குப் பயன்படுத்தப்பட்டது என்பதும் கவனிக்கத்தக்கது. இச்செயல்முறை 'போலச்செய்தல்' மூலம் பரவி இன்றுவரை பெரும்பாலும் வலதுகை வாகுடையவர்களின் பரிணாம வளர்ச்சிக்குத் தேவையான உந்து சக்தியாக இருந்து வருகிறது. மேலும் பெண்ணின் உடல்கூறு பின்னாளில் ஏற்பட்ட பரிணாம வளர்ச்சியின் வெற்றிக்குப் பெரும் பங்காற்றியது குறிப்பிடத்தக்கது. எடுத்துக்காட்டாக

"தனது விளக்கப்பட முடியாத மாதவிடாய்களையும் புதிய உயிரைப் படைக்கும் சத்தியையும் கொண்ட பெண்தான் ஆதிமனித குலத்திற்குப் புனிதமான புதிராக இருந்தாள். அதோடு இவள் மிகவும் வியக்கத்தக்கவளாகவும் சக்தி வாய்ந்தவளாகவும் இருந்ததினால் பெண் ஆணைக் காட்டிலும் மேலானவளாக - மனிதப் பிறவியைக் காட்டிலும் மேலானவளாக இருக்க வேண்டியிருந்தது. அதேப்பெண் தெய்வமான போதும் அவள் அதற்கு முன்னிருந்ததிலிருந்து சற்றும் குறைவில்லாமல் இருந்திருக்கிறாள்" 1

எனவேதான் மாபெரும் முதல் கடவுளாகப் பெண்ணை ஆதிக்கச் சமூகம் இன்றளவும் முன்னிருத்தியுள்ளது. இதனடிப்படையிலேயே பிற்காலத்தில் எழுந்த பெண்தெய்வ வழிபாடு குறித்த வருணனைகள் அனைத்தும் கட்டுக்கதைகள் அல்லது வழிபாட்டு மரபுகள் என்று நிராகரிக்கப்பட்டுள்ளன. ஆனால்

"இருபதாம் நூற்றாண்டின் தொடக்கத்தில் அழிந்துபட்ட மினோவன் நாகரீகத்தைக் கண்டுபிடித்த 'சர்ஆர்தர் இவான்' தான் கண்டுபிடித்த எண்ணற்ற பெண்தெய்வ உருவங்கள் யாவும் ஒரே ஆற்றல் மிக்க அன்னையையே பிரதிநிதித்துவப்படுத்தின. பல்வேறு பெயர்களிலும் பட்ட பெயர்களிலும் அவளுடைய வழிபாடு ஆசியா மைனரின் மையப்பகுதி மற்றும் அதற்கு அப்பாற்பட்ட பிராந்தியங்களிலும் பரவி இருந்தது" 2

என்று குறிப்பிட்டுள்ளார். ஆற்றல்மிக்க பெண் தெய்வம் கணவன் இல்லாத பூர்வீகத் தாயாவாள். அவர் எல்லாப் புராணத் தகுதிகளையும் தன் முழுக்கட்டுப்பாட்டின்கீழ் வைத்திருந்தார். இஃது உலகம் தழுவிய உண்மை என்பதை நவீனகாலக் கற்றறிவாளர்கள் ஏற்றுக்கொண்டவர். எடுத்துக்காட்டாக

“கி.மு.25000-15000 ஐரோப்பாவில் கல்லிலும் தந்தத்திலும் செதுக்கப்பட்ட 'வீன்ஸ்' (காதல் தெய்வத்தின்) உருவங்கள் எகிப்தில் நையில் நதி தீரத்தின் மண்ணால் செய்யப்பட்ட இந்த உருவங்கள் ஆற்றல் மிக்க அன்னை - ஆண்களின் உலகின் மீது மிகப்பெறும் அளவில் முழுமையாகவும் முழு நிறைவாகவும் வெடிகிறது” 3

“கி.மு.12000-9000 செக்கோஸ்லோவாகியாவில் தோல்னி வெஸ்டோனியாவிலும் ஈராக்கில் ஷானிடரிலும்இ மஞ்சட் காவி மண்ணினால் பூசப்பட்டு சடலங்கள் சடங்குகளுடன் அடக்கம் செய்யப்பட்டதான நிகழ்வு பெண்தெய்வ வழிப்பாட்டுடன் தொடர்புபடுத்தப்படுகிறது.

“கி.மு.7000 - ஜெரிக் கோவில் பெண்தெய்வ அன்னைக்கு முதல் முதலாகக் கோயில் கட்டப்பட்டுள்ளது. அதேபோலஇ கி.மு. 6000 துருக்கியில் காடல் ஹூயூக்கில் - பெண் தெய்வக் குகைக்கோயில் உள்ளது.

“கி.மு. 3000 உலக முழுவதிலும் பெண் தெய்வத்துக்குச் சிறு உருவம் தரப்பட்ட ஆவணங்கள் கிடைத்துள்ளன. அதேபோல கி.பி. 200 - அவுரேலியா எமிலியானா கல்வெட்டுகள் கிடைத்துள்ளன. கி.பி500 - கிறிஸ்து சக்கரவர்த்திகள் சமைத்தப் பெண்தெய்வ கோயில்கள் உருகொண்டுள்ளன” 4

என்னும் வரலாற்றுக் குறிப்புகளைக் குறிப்பிடலாம். இதனடிப்படையில் தமிழ்ச்சமுகம் தலையாயக் கடவுளாகப் பெண் இருப்பதற்கான கலாச்சார குவிமையத்தை அவர்மீதே சாட்டியிருக்கக் காணலாம். அதனால்இ இச்சமுகம் தனக்கான கட்டுமானங்களையும் அழகியலையும் பெண்களிடமிருந்தே பெறவேண்டியுள்ளது. தொடக்கத்தில் 'பெண்' சுதந்திரமானவராக இருந்ததே அவருக்கான தெய்வ முன்னிலைக்குரிய அடிப்படைக் காரணி எனலாம்.

பெண்ணின் தன்னிச்சைச் சுதந்திரம்

பெண்கள் தொடக்கக் காலத்தில் பெற்றிருந்த தன்னிச்சையான பாலினச் சுதந்திரமும், மாதவிடாய் போக்கும், புதிய உயிரைத் தோற்றுவிப்பதற்கு ஏற்ற உடல்வாகும் அவர்களை முதன்மையாக்கின. பிற்காலச் சூழலில் பெண்ணின் இத்தகைய இயற்கை அமைவுகள் மற்றும் மாதாந்திர இரத்தப்போக்கு ஆகியன ரகசியங்களாகவும் அவமானச் சின்னங்களாகவும் மாறியது வியப்புக்குரிய முரணாகும். இன்னும் பல உலக வரலாற்றுப் புனைவுகள் பெண்ணை முதன்மைப் படுத்தியிருந்தத் தொடக்கக்கால சமுகத்தைச் சுட்டிக்காட்டுகின்றன. குறிப்பாக 'யூத'

வரலாற்றில் இத்தகைய சக்தி வாய்ந்த மற்றும் புகழ் வாய்ந்த பெண்கள் பற்றியக் குறிப்புகள் நிறையக் கிடைப்பதாக வரலாற்று ஆய்வுகள் குறிப்பிடுகின்றன.

“பெண்கள் பணமும் சொத்தும் உடைமையாகக் கொண்டிருந்தனர். அவற்றின் மீது ஆதிக்கம் வகித்திருந்தனர்.

திருமண ஒப்பந்தங்கள் தனி நபர்கள் என்ற முறையில், பெண்களின் உரிமைகளை மதித்தன. வாழ்க்கைத் துணைவிகள் என்ற முறையில் அவர்கள் கௌரவிக்கப்பட்டனர்.

“பெண் படைப்பாளியாக இருந்து ஆண்களைப் போல போரிட்டுள்ளாள்” 5

இது மட்டுமின்றி மத்திய தரைக்கடலைச் சுற்றியுள்ள பிரதேசங்களிலும் அண்மைக் கிழக்குப் பிரதேசங்களிலும் பெண் போராளிகளைப் பற்றியக் கதைகள் இன்றும் நிலவுகின்றன. அதேபோல

“ஆரம்பகாலம் முதற்கொண்டே எழுதப்பட்ட குறிப்புகளும்; வாய்மொழியான தகவல்களும் அமேஸான்கள் என்று வரலாற்றில் அறியப்பட்ட பெண் போராளிகளின் ஒரு பழங்குடியினர் இருந்ததைப் பதிவு செய்துள்ளன” 6

இப்படி பெண்களின் உச்சக்கட்டத்திலும் இறுதி நிலையிலும் உடலளவிலான சுதந்திரம் ஆழமானதாகிறது. அஃதுவே இன்று ஆண்களால் பொருத்துக்கொள்ள முடியாதாக நிலையிலுள்ளது. இச்சுதந்திரம் தொடக்கக் காலத்தில் நாட்டுக்கும், குலத்துக்கும் பழக்கவழக்கப் பண்பாட்டிற்கும், ஏற்ப மாற்றம் அடைந்திருக்கிறது. அதன்கீழ் அக்காலப் பெண்கள் தன்னடக்கத்தின் மீதான கட்டுப்பாட்டிலிருந்தும், கற்புடைமையின் மீதான கட்டுப்பாட்டிலிருந்தும் அதிக அளவிலான சுதந்திரத்தைப் பெற்றவளாக இருந்துள்ளனர். தொடர்ந்து பல்வேறு மாற்றங்களுக்குப் பின் தமிழகத்தில் ஏற்பட்ட பொருளாதாரச் சூழல், அவ்வாறு இருந்த பெண்களை இரண்டாந்தர நிலைக்கு உரியவர்களாக மாற்றியதைப் பிற்காலப் பெண்ணிய வரலாறுகள் விவரிக்கின்றன.

பெண் அடிமையாதல் :

பெண்கள் பற்றி இதுவரை வெளிவந்துள்ள எழுதப்படாத ஆவணங்களிலிருந்தும் காப்பியங்களில் வரலாறுகள் மனித இனவரலாற்று ஆய்வுகள் தொல் பொருளாய்வுச் சான்றுகள் என்று அனைத்து விதமான ஆய்வு முடிவுகளிலிருந்தும் பாலியல் தாக்குதல்களில் பெண்கள் கொடூரமாகத் தாக்கப்படுவதை அறிய முடிகிறது. இதுமட்டுமின்றி பெண்கள் விலை பேசப்படுவது அடிமைப் படுத்தப்படுவது கற்பழிக்கப்படுவது பரத்தையராக விற்பனை செய்யப்படுவது அவளது தலைவன் எதிர்பாராமல் இறந்து போனால் படுகொலைச் செய்யப்படுவது எனப் பல்வேறு நிலைகளில் இழிவுபடுத்தப்பட்டுள்ளனர். இச்சூழல் வளர்ந்து 'இனி ஒருபோதும் பெண்கள் புனிதமானவர்களாகக் கருதப்படமாட்டார்கள் என்று தெரிந்தபோது அவர்கள் முற்றிலும் கழித்துக்கட்டப்பட வேண்டியவர்களாயினர்.

“இதற்குக் காலந்தோறும் எழுந்த சடங்குகள் பெருமளவில் துணைநின்றன” 7

பெண் வேண்டாத இனமாகக் கருதப்பட்டதன் விளைவாகவே ‘உடன்கட்டை ஏறுதல்’ என்னும் வழக்கம் உருவானது. இவ்வாறு பெண்களை ஒழித்துக்கட்டும் ஆதிக்கப் போக்கு இந்தியா சீனா ஐரோப்பா மத்தியகிழக்கு நாடுகள் என மானிட குடியிருப்புகளுள் பரவலாகப் பரவின். ஆனாலும் ஆண்களால் உருவாக்கப்பட்ட இந்தப் பழிக்கோலச் சூழ்ச்சியால் பெண்களை ஒழித்துக்கட்ட முடியாமல் போனது தொடர்ந்து பெண்கள் அழிவுகளைத் தாண்டி வரலாற்றில் நிலைபெற்றனர். அதற்கான இருப்பையும் பெண்ணியம் இருபாதம் நூற்றாண்டுப்பின் விரிவாக விளக்கும் வகையில் வளர்ச்சி அடைந்திருக்கிறது. அதன் நீட்சியாகத்தான் பெண்ணிய சிந்தனைகளையும் இலக்கியங்களில் காணலாகும் பெண்மொழி குறித்தச் சமூகவியல் பதிவுகளையும் ஆராய வேண்டியச் சூழல் ஏற்பட்டுள்ளது.

சங்க இலக்கியத்தில் பெண் மொழிக்கான இடம் :

சங்க அகக்கவிதைகளில் பெண் கவிகளின் கவிதைகளையும் பெயர் சுட்டப்பெறாதக் கவிதைகளையும் தனியாகப் பிரித்துப் பார்க்கும் பொழுது பெண்கள் அவர்தம் உடல் மற்றும் மன உணர்வுகளை வெளிப்படையாகப் பதிவு செய்துள்ளதை அறியலாம். மேலும் தொல்காப்பியம் குறிப்பிட்டுள்ள விதி மீறல்களையும் பெண் கவிஞர்கள் இயல்பான மொழியில் வெளிப்படுத்தியுள்ளனர்.

பொதுவாகப் பெண்ணிய திறனாய்வாளர்களும் அதற்கு எதிரான ஆய்வாளர்களும் கவிதைகளில் வெளிப்படும் உணர்வுகளைக் கதாப்பாத்திரங்களின் உணர்வுகள் எனக் கருதுவர். அதை விடுத்து அக்கதாப்பாத்திரத்தைப் படைத்தளித்த கவிஞரின் உணர்வாக ஏற்பதில்லை. ஆனால் ‘பெண்ணிலைவாதம்’ கண்ணுக்குப் புலப்படாதக் கூற்றுமுறை என்று குறிப்பிடும் கதாப்பாத்திரங்களின் கூற்று முறைகளைத் ‘தன்னிலைக் கூற்று’ என்றே குறிப்பிடுகிறது. அதனால்

“பெண்ணின் இருப்பு விழிப்பு அவர்களுக்குள் ஏற்பட்டுள்ள மாற்றங்கள் எதிர்நிலை உணர்வுகள் அக மற்றும் புற ஆசைகள் எனப் பெண்ணைச் சுற்றி எழுதும் பெண்ணியப் படைப்பு அதிகம் தன்மைக் கூற்றைத் தனக்கான வடிவமாகக் கொள்கிறது. எதிர்நிலைகளைப் பேசும்போது மட்டும் முன்னிலைக் கூற்றையும் தனக்கான ஆசைகளையும் விருப்பங்களையும் பேசும்போது படர்க்கைக் கூற்றையும் அம்மொழி ஏற்றுக் கொள்கிறது” 8

என்று பெண்ணிலை வாதத்தை ஏற்கும் தன்னிலை கூற்றுக் குறித்து ஆய்வாளர்கள் விளக்கமளித்துள்ளனர்.

சங்க அகக்கவிதைகளில் பெண்கள் எழுதிய கவிதைகள் அனைத்துமே தன்னிலை வெளிப்பாட்டை மையப்படுத்திய தன்மைக் கூற்றையும் முன்னிலைக் கூற்றையும் சார்ந்தவைகளாக உள்ளன. அதேபோல பெயர் சுட்டப்பெறாத கவிதைகளிலும் இக்கூற்று முறையிலான

கவிதைகளே அதிகம் உள்ளன. இக்கூற்று முறை உடல் மற்றும் மனத்தின் ஆற்றாமையையும் வலிமையையும் வெளிப்படையாகப் பேசும் குரலையும் மொழியையும் கொண்டுள்ளது. இதிலிருந்தே தொல்காப்பியர் காலத்திற்கு முன் பெண் கவிஞர்களின் கலைக் கோட்பாடாகத் 'தன்னிலை எழுதும் முறை' இருந்ததை அறிய முடிகிறது.

'தன்னிலையை எழுதுதல்' வெறும் மனத்தை எழுதுதல் மட்டுமல்ல உடலையும் சேர்த்தே எழுதுதல் என்பதாகக் கருதப்பெறுகிறது. பெயரைக் குறிப்பிட்டு எழுதிய பெண் கவிஞர்கள் தன்னிலைக் கவிதைகளை எழுதியுள்ளனர். பெயரைக் குறிப்பிடுவதை தவிர்க்க நினைத்தக் கவிஞர்களும் தன்னிலைக் கவிதைகளை இயற்றிவிட்டு தன் அடையாளத்தை அழித்துக்கொள்ள முயன்றுள்ளனர். இத்தன்மையைத் தொல்காப்பியம் முதலான இலக்கண நூலாசிரியர்கள் மறைக்கவே முயற்சித்துள்ளனர். இது குறித்த விவாதங்களைப் பெண்ணிய சிந்தனையாளர்களும் ஆய்வாளர்களும் எழுப்பியுள்ளனர். அத்தன்மையை

"சமஸ்கிருத மரபை ஓரளவு உள்வாங்கியச் சூழலில் தமிழ் நிலப்பரப்பில் வாழ்ந்தவர்களை அரசர் அந்தணர் வணிகர் வேளாளர் என்னும் பாகுபாட்டுக்குள் அடங்கிய தொல்காப்பியம் மரபியல் அறிவுப் புலத்திலிருந்து பெண்களை விலக்கி வைக்கும் இலக்கியக் கோட்பாட்டையும் உள்வாங்கிக் கொள்ளத் தயாராகவே இருந்திருக்க வாய்ப்புண்டு. அத்தகைய வரையறைகளை உருவாக்கியவர்கள் தொல்காப்பியப் பனுவலுக்குள் இவற்றையும் சேர்த்திருக்கலாம்.

தொல்காப்பியம் என்னும் இலக்கணப் பனுவல் ஒருவர் எழுதியதா? இருவர் எழுதியதா? அல்லது இடைச்செருகல்கள் கொண்ட பனுவலா? என்ற விவாதங்கள் ஏற்கனவே நிகழ்ந்துள்ளன. பெண்ணியம் சார்ந்த பார்வை அந்த விவாதத்திற்கு மேலும் வலுவூட்டுவதாக அமைந்துள்ளது. அத்துடன் தொல்காப்பியம் எனும் பனுவல் சங்க இலக்கியத்தில் கிடைக்கும் பெண்கவிகளின் கவிதைகளுக்குப் பின்னால் தோன்றி - ஆண் மையச் சிந்தனையை உள்வாங்கி - விதிகளை உருவாக்கியுள்ள ஒரு பனுவல் என்ற விவாதத்தையும் இத்துடன் சேர்த்துப் பார்க்க வேண்டிய நெருக்கடியைப் பெண்ணியவாதம் உருவாக்கியுள்ளது" 9

தாய் என்னும் தாயம் :

தமிழில் கொற்றவை வழிபாடு ஆதித்தாய்த் தெய்வ வழிபாடாகிறது. 'கொல்தவ்வை' என்னும் சொற்களின் கூட்டமைப்பிலிருந்து 'கொற்றவை' என்னும் சொல் பிறக்கிறது. இச்சொல் தவ்வை மூத்தவள் முதியோள் எனப் பொருள்படுகிறது. அச்சம் தரத்தக்கப் போர்க்கடவுள் எனவும் இச்சொல்லைச் சிலப்பதிகாரம் முதலான காப்பிய நூல்கள் குறிப்பிடுகின்றன. பின்னாளில் இச்சொல் சிவன் திருமாலுடன் இணைந்து ஆண்வழித் தலைமைக்கான தெய்வங்களைக் குறிப்பிடும் சொல்லாக மருவியுள்ளது. இதனைப் புரிந்துகொள்ள 'தாயம்' என்னும் சொல்லின் பழம்பொருளை விளங்கிக்கொள்ள வேண்டியுள்ளது.

‘தாயம்’ என்னும் சொல் நாடு தழுவிய அரசரிமையைக் குறிக்கும் சொல்லாகும். தாயம் ‘உரிமை’ என்ற பொருளில் வழங்கும். அதே வேளையில் அச்சொல் ‘தாய்’ என்னும் அடிச் சொல்லில் இருந்து பிறந்து ‘அம்’ விசுதிப் பெற்றுள்ளது அதனால் தாய்வழி உரிமையை இச்சொல் குறிப்பிடுவதாக அமைந்திருக்கிறது. இதனை

“மூத்தோர் மூத்தோர்க் கூற்றம் உய்த்தென

பால் தர வந்த பழ விறல் தாயம்

எய்தினம் ஆயின்ன எய்தினம் சிறப்பு” 10

என்னும் புறநானூற்றுப் பாடலடிகள் வழியே சோழன்நலங்கிள்ளி குறிப்பிட்டுள்ளார். இதில் ‘மூத்தவர்கள் இறந்த பின்னர் வழிவழியாகப் பெறப்படும் அரசுப் பேற்றினைச் சிறியோர் பெறுதல் முறையன்று’ எனும் பொருள்பட இச்சொல் பயன்பட்டுள்ளதைக் காணலாம். இதிலிருந்து ‘தாயம்’ என்னும் சொல்லின் வரலாற்றைப் புரிந்துகொள்ளலாம். இங்குத் தாய்வழி உரிமையாக இருந்த எல்லாவும் இன்று தந்தை வழிக்கு உரியதாக மாறியிருக்கும் இம்மாற்றம் படிபடியாக நிகழ்ந்துள்ளது. இவ்வாறு இம்மாற்றம் நிகழ்ந்ததற்குப் பிறகு அது விதிகளோடு சார்ந்து சமயத் தன்மைக்கு ஏற்றப் பொருளில் ‘பால் மடைமாற்றம் செய்யப்பட்டுள்ளது இந்தப் புள்ளியிலிருந்தே தாய்வழி சமூகத்தின் வழிவந்த பெண்களின் செயல்பாடுகள் மற்றும் புலப்பாட்டுத் தன்மைகள் ஆகியவற்றை அணுக வேண்டியுள்ளது.

முடிவுரை

பெண்ணிய சமூகவியல் ஆய்வில் ‘பெண்மொழி’ குறித்தப் பதிவுகள் முக்கிய பங்கு வகிக்கின்றன. பெண்ணிய வரலாற்றில் தாய்வழி சமூகம் தந்தைவழி சமூகமாகவும் ஆணாதிக்கச் சமூகமாகவும் மாறிய பிறகு ஆண் கடவுள் வழிபாட்டு முறைமை ஆண்களின் அரசரிமை அதிகார சமூக உருவாக்கம் உள்ளிட்ட மாற்றங்கள் நிகழ்ந்துள்ளன. இதனை இலக்கியங்களும் காப்பியங்களும் ‘கற்புடைமை’ ‘உடன்கட்டை ஏறுதல்’ உள்ளிட்ட பொருண்மைகளாகப் பதிவு செய்துள்ளன. அதனை எதிர்த்தே பெண்ணியக் கருத்தியல் பெண்மொழிப் புலப்பாடகச் சங்க கவிதைகளில் வெளிப்பட்டுள்ளன.

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கோவூர் சென்னை 600128

முன்னுரை :

இருபதாம் நூற்றாண்டின் தொடக்கத்தை மறுமலர்ச்சி என்பர். பழமையை புறந்தள்ளி விடாது புதுமைக்கு வழிவகுக்கும் யுகமே மறுமலர்ச்சி யுகம் எனப்படுகிறது. பாரதியின் கவிதை மொழியானது எளிமையான பாமர மக்களும் புரியும் வண்ணம் இருந்தது. இந்தியாவில் புற உலகையும், அக உலகையும் தனது படைப்புகளின் வழியே ஊடுருவிப் பார்த்தவர் பாரதி. திருக்குறள் வாழ்வின் எல்லா நிலைகளிலும் எடுத்துக்காட்டுவது போல சாதி, மதம், அரசியல் முடநம்பிக்கைகள், வறுமை, பெண்விடுதலை போன்றவற்றையெல்லாம் தம் படைப்புகளின் வழியாக வெளிப்படுத்தினார் பாரதி. பாரதியின் வழியைப் பின்பற்றி இருபதாம் நூற்றாண்டுக் கவிஞர்கள் படைத்தக் கவிதைகளை ஆராய்வதாக இக்கட்டுரை அமைகின்றது.

அப்துல் ரகுமான் கவிதைகளில் அரசியல் சிந்தனை :

சுதந்திரம் அடைந்த பின்பும் சோக வாழ்க்கையை மக்களுக்கு அளித்தது. இத்தகு உணர்வு புதுக்கவிஞர்களின் உள்ளத்தினைப் பெரிதும் பாதித்தது. புதுக்கவிஞர்கள் வரிசையில் இடம்பெற்ற அப்துல்ரகுமானும் தமது கவிதையின் வழியே,

“சுதந்திரம் அங்கே

சுவாசமாய் இருக்கும்

பிறந்த வாங்கும் பிச்சையாய் இராது

கடமை அங்கே கவரவம்

சத்யம் அங்கே சமயம்

உரிமை அங்கே ஊதியம்

இதயம் அங்கே முகவரி

புன்னகை அங்கே பொது மொழி”

என்ற கவிதையின் வழியாக தான் விரும்பும் சுதந்திர நாடு எவ்வாறு அமைய வேண்டும் என்பதைக் கூறுகிறார்.

மேலும் கூறுகையில், பாரதியார் காலத்தில் தேசியக் கொடியானது எல்லோராலும் போற்றப்பட்டது. ஆனால் இக்காலத்தில் அரசியல் வாதிகள் எண்ணற்ற கொடிகளைக் கம்பத்தில் புறக்க விட்டுள்ளனர். மக்கள் உடுக்க உடையின்றி அலைந்துத்திரிகின்ற வேளையில் கொடிக்கம்பத்திற்கு ஆடை உடுத்தி உயரே புறக்க விடுகின்றனர் என்பதை,

“கம்பங்களுக்கு ஆடை

மனிதர்களுக்கு நிர்வாணம்

விசித்திரமான தேசம்”

என்று சாடுகிறார் அப்துல்ரகுமான்.

பெண்ணியச் சிந்தனை :

சமுதாயத்தின் ஆணிவேராகவும், மானுட வளர்ச்சிக்கு ஆக்கமளிப்பவராகவும் இருப்பவள் பெண் ஆவாள். மனித வாழ்வின் பிறப்பு முதல் இறப்பு வரை பெண்ணின் செயல்பாடு குறிப்பிடத்தக்கதாகவும் உள்ளது. பெண்ணுக்கான சுதந்திரத்தை பெறவிடாமல் பெண்ணை அடிமையாகவே நடத்தும் ஆண் ஆதிக்கத்தைக் கட்டுடைக்க முடியாமல் இருக்கும் பெண்ணினத்தின் இயலாமையை கூறுகையில்,

‘இலங்கையில் ஒருமுறை

அவளுக்காக வாதாடிப் பார்த்து
 மதுரையில் ஒரே முறை
 நீதிபதியானது
 ஆனால் அதிகமாக
 குற்றவாளிக் கூண்டிலேயே
 நிற்கிறது”

என்று பாடுகிறார். இதன்மூலம் ஆண்களுக்குக் கட்டுப்பட்டு வாழும் பெண்களின் அவல நிலையைக் கவிஞர் வெளிப்படுத்துகிறார்.

வறுமை ஒழிப்பு :

வறுமை ஒழிய வேண்டும் வயிற்றுக்குச் சோறிடல் வேண்டும். இங்கு வாழும் மனிதர்களுக்கு எல்லாம் என்பது பாரதியின் எண்ணம் இதனை உணர்ந்த அப்துல்ரகுமான் தமது கவிதைகளில் குறிப்பிடுகையில்,

“பசித்த வயிற்றில்
 படுக்கைகளைப் போடுபவன்
 எவனோ அவனே
 மிகவுயர்ந்த பக்தன்”

என்று பாடுகிறார்.

நா. காமராசனின் கவிதைகளில் பொதுவுடைமை சிந்தனை :

நா. காமராசன் பொதுவுடைமைச் சிந்தனை மிக்கவர். எனவே அவர் எங்கெல்லாம் வர்க்கப் புயல் வீசுகிறதோ அங்கெல்லாம் நான் பொதுவுடைமைப் படகின் துடுப்பாக நிற்பேன் என்று பாடுகின்றார். இதனை,

“எங்கெல்லாம் வர்க்கவெறிப் புயலிடையோர்
 இளம்படகு தவழ்கிறதோ அங்கெல்லாம்

என்னுடைய துடுப்புகளில் நான்துடிப்பேன்”

என்னும் கவிதையின் வழியாக பாடியுள்ளார்.

ஈரோடு தமிழன்பின் கவிதைகளில் சமுதாயச் சிந்தனை

கவிஞர் தமிழன்பன் தமது கவிதையில் சாதி, சமயம், இரண்டையும் ஒருங்கே எதிர்க்க வேண்டியன் தேவையை வலியுறுத்துகிறார்.

“சாதி சமயங்கள்

சமதர்மக் கிரகத்தை

மோதிக்கிரங்கடிக்க

முன் வரலாம் தயங்காதே”

என்னும் கவிதையின் வழியாக புலப்படுத்துகிறார்.

கவிஞர் சிற்பியின் கவிதைகளில் மொழிப்பற்று

பன்மொழியிலும் சிறந்து விளங்கினார். பாரதிக்குக் கிடைத்தது. காசி வாசத்தில் சமஸ்கிருதம், உருது மொழிகளும், புதுச்சேரியில், பிரெஞ்சும், ஆங்கிலமும் கற்றார். எனவேதான் அவரால் தமிழ்மொழி போல் இனிதாவது எங்கும் காணோம் என்று கூற முடிந்தது.

“இனிது என் தாய்மொழி

எனும் உணர்வைப் பெற

பன்மொழி பயின்றேன்”

என்று தன்னுடைய கவிதையின் வழியாக தமிழ்மொழிப் பற்றி எடுத்துக்கூறியுள்ளார்.

மு. மேத்தாவின் கவிதைகளில் உழவர் நிலை

உலகினுக்கே உணவிடும் விவசாயிகளின் நிலை இன்று அவலத்தை சந்தித்து உள்ளது. ஒரு காலத்தில் மகிழ்ச்சியாக விவசாயம் செய்த விவசாயிகளின் இன்றைய நிலை மாறியுள்ளது. இதனை,

“ஊருக்கெல்லாம்

சோறு போட்டவனுக்கு

இப்போது ஊர்கடி

சோறு போடுகிறதாம்

அரிசி வேகவில்லை

முட்டிய நெருப்பில்

உயிரிழந்த உழவர்கள்

காவிரியில் தண்ணீர் வரவில்லை

மயானத்திலும் பொங்கல் வந்துவிட்டது”

என்ற கவிதையில் விவசாயிகளின் நிலையைப் பதிவு செய்துள்ளார்.

கவிஞர் வைரமுத்துக் கவிதையில் முதலாளித்துவம்

இன்றைய உலகில் பெரும்பாலும் முதலாளிகளின் ஆதிக்கம் காரணமாக ஏழைகளின் உழைப்பை சுரண்டி வாழ்கிறார்கள். இருந்த போதிலும் ஏழைகளின் உழைப்பிற்கு ஏற்ற ஊதியம் கிடைப்பது இல்லை இதனை,

“நிலப்பிரபுக்களின்

மதுக்கிண்ணங்களிலோ

சாராயத்தோடு சோடா அல்ல

உழைப்பவன் வேர்வையே

கலக்கப்படுகிறது”

என்று ஏழைகளின் உழைப்பைச் சுண்டும் முதலாளி வர்க்கத்தின் கொடுரத்தை கவிஞர் வைரமுத்து சித்தரித்துக் காட்டியுள்ளார்.

மீரா கவிதைகளில் சாதி

சாதி நமது சமூகத்தில் தீர்க்க முடியாத பிரச்சனையாக உள்ளது. எனவே சாதி சமூகத்தின் தீமைகள் பற்றிச் தமது கவிதைகளில் பதிவு செய்துள்ளதை,

“மார்கழி மாத விடியல்

குளித்து முடித்துக்

குங்குமப் பொட்டிட்டு

மலம் அள்ள வந்தாள்

தோட்டி மகள்”

என்று விளக்குகையில் மார்கழி மாதமாயினும் அப்பெண் தன்னுடைய வேலையைத் தொடர வேண்டிய நிலையிலிருப்பதை இக்கவிதையின் மூலம் வெளிப்படுத்துகிறார் மீரா.

முடிவுரை :

இவ்வாறு பாரதியாரின் கவிதைகளில் வெளிப்படுத்திய அரசியல் சிந்தனை, பெண்ணியச் சிந்தனை, வறுமையொழிப்பு சிந்தனை, பொதுவுடமை சிந்தனை, சமுதாயச் சிந்தனை, மொழிப்பற்று சிந்தனை, உழவர்களின் நிலைப்பாட்டுச் சிந்தனை, முதலாளித்தவச் சிந்தனை, சாதி சிந்தனை ஆகியவை நவீன இலக்கியங்களில் தடம்பதித்துள்ளவற்றை அறியமுடிகிறது.

முக்கூடற்கண் மருத்துவம் செய்த காதையில் புலவர்

காசமானின் மருத்துவப் புலமைகள்

முனைவர். தே. ஜெய சோபியா,
உதவிப்பேராசிரியர்,
தமிழ்த்துறை,
மரியா பெண்கள் கலை மற்றும்
அறிவியல் கல்லூரி, வள்ளியூர்.

ஆய்வுச் சுருக்கம் :

இந்திய மருத்துவங்களை சித்தம், ஆயர்வேதம், யுனானி என்பர். அந்தந்த நாட்டிலுள்ள சிறந்த நாட்டு மருந்துகளை ஏற்றுக்கொண்டு ஒவ்வொன்றும் வளர்ந்து வருகின்றன. இம்மருத்துவ முறைகளின் ஆதாரமான நாட்டுப்புற மக்களிடையே வழக்கிலுள்ள மருத்துவத்தை நாட்டு மருத்துவ முறையாகக் கருதலாம். நாட்டு மருத்துவத்தின் எளிமை, மேன்மையை அறியவும், நம் முன்னோர்களின் இயற்கையோடு இயைந்த வாழ்க்கை முறை, பாரம்பரியம் போற்றும் பண்பு ஆகியவற்றை இனங்காட்டவும் இம்மருத்துவம் வழிவகைச் செய்யும்.

முன்னுரை :

இயற்கையோடு இயைந்து வாழ்வு நடத்தியவர்கள் பண்டைக்காலத் தமிழர்கள். உடலுக்கும், உள்ளத்திற்கும் ஏற்படும் நோய்களைத் தடுப்பதும், நீக்குவதுமான பொருளை மருந்து என்ற அழைக்கலாம். நோய்களைப் பற்றியும், நோய் தீர்க்கும் முறைகளைப் பற்றியும் தமிழர்கள் பன்னெடுங் காலத்திற்கு முன்பு உணர்ந்திருந்தன என்பதற்கு சங்க இலக்கியங்களும் சான்று பகர்கின்றன. சங்க காலத்தில் மருந்து என்ற சொல்லிற்கு அமுதம், ஓடைதம் என்னும் பொருள் தரப்படுகின்றன. புலவர் காசமான் அவர்கள் எழுதிய முத்தாரம் என்ற நூலில் முக்கூடற்கண் மருத்துவம் என்ற காதையில் பிணிகளும், பிணி தீர்க்கும் முலிகைகள் பற்றியதான செய்திகளும் இடம் பெற்றிருப்பதை இதன்வழி அறியலாம்.

பிணிகள் :

உயிருடன் வாழக்கூடிய மனிதர்கள் ஒவ்வொருவரும் உயர்வினை அடைய வேண்டுமானால் அவனது உள்ளமும், செயலும், உடலும் திறம்பட செயல்பட வேண்டும். அப்போது தான் அவன் பிணி என்ற துன்பத்தை அடையாமல் நல்வாழ்வு வாழ முடியும். அவ்வாறு வாழ்வவன் தான் சிறந்தவன் என்பதை.

“வையத்துள் வாழ்வாங்கு வாழ்பவன் வானுரையும்

தெய்வத்துள் வைக்கப்படும்” (குறள் 50)

என்கிறார் வள்ளுவர்.

இயற்கை மருத்துவம் :

இந்த உலகத்தில் வாழும் மனித வாழ்க்கைக்கு இயற்கையில் கிடைக்கக்கூடிய இயற்கை மருத்துவமே ஏற்படையது என்று சித்தர்கள் கண்டனர். இயற்கையோடு இயைந்த சித்தி பெற்றவர்கள் அவர்கள். மனதை செம்மைப்படுத்த உடல் ஆரோக்கியம் மிகவும் அவசியமானதாகும். இதனையே,

“உடம்பார் அழியில் உயிரார் அழிவர்

திடம்பட மெய்ஞ்ஞானம் சேரவும் மாட்டார்

உடம்பை வளர்க்கும் உபாயம் அறிந்தே

உடம்பை வளர்த்தேன் உயிர் வளர்த்தேன்” (திருமந்திரம் 724)

என்று திருமூலர் உடம்பை காப்பாற்றி உயிரைத் தக்கவைத்து மெய்ஞ்ஞானம் பெற வேண்டும் என்றும் கூறுகிறார். அந்த வகையில் புலவர் காசுமான் அவர்களும் முக்கூடற் கண் மருத்துவம் செய்த காதையில் மருத்துவக் குணங்கள் அடங்கிய செடி, கொடி, தாவர வகைகளைக் கொண்டு நோய்களைப் போக்கும் மருத்துவ முறைகளை விளக்கிக் கூறியுள்ளார்.

முக்கூடற்கண் மருத்தும் செய்த காதையில் நோய்களும் மருத்துவமும்

நாட்டுப்புற வைத்தியம் :

நாட்டுப்புற வைத்திய முறைகளில் கைப்பக்குவம் என்பது முக்கிய இடம் பெறுகிறது. மூலிகைகளை இடித்து மருத்துப் பொருட்களாக மாற்றுவதும், அரைப்பதும் மருத்துவச் செயல்களாக உள்ளன. மருந்தின் அளவை ஒருகைப்பிடி, ஒரு சிரங்கை, ஒரு சிட்டிகை என்று அழைக்கும் முறையை கிராமப்புறங்களில் இன்றும் காண முடியும்.

“உனவே மருந்து என்பது அனுபவமொழி”

“நோயற்ற வாழ்வே குறைவற்ற செல்வம்”

“நோய்க் இடங் கொடேல்” (பழமொழி)

எவ்வளவுதான் ஒருவனிடம் செல்வம் இருந்தாலும் அவன் நோய் உள்ளவனாக இருந்தால் அவனுக்கு எந்த பலனும் இல்லை. சேர்த்த செல்வமும் கொஞ்சம் கொஞ்சமாக குறையும். எனவே நோயில்லாத வாழ்வு வாழ அன்றாட நாம் உணவில் கக்கு, மிளகு, இஞ்சி, மஞ்சள் மற்றும் கீரை வகைகள் போன்ற மருந்து உணவுகளை எடுத்துக் கொள்ள வேண்டும்.

இருமல் :

புகைச்சலோடிருக்கும் இருமல் ஏற்பட்டால் முச்சுவிடுவதற்கு சிரமமாக காணப்படும். ஒழுங்கற்ற இருமலால் முச்சுக்குழலில் தொற்று ஏற்படும். தொண்டையில் எரிச்சல் ஏற்பட்டுக் கொண்டேயிருக்கும்.

இந்நோயை விரட்டியடிக்க,

“புகைச்சலோடிரு மலுக்குப்

பொரிகாரம் மதுர மொடும்

மிசுகபம் இளகிற் தள்ளும்

வெள்ளிய மிளகி னோடும்

மிக்க சோற்றைக் கொண்ட

வலிவுசெய் குமரிச் சாற்றில்

வகையாய் அரைத்துச் செய்த

மாத்திரை கொடுத்தன் நன்றே”

பொரிகாரம், கல்கண்டோடு, வெள்ளை மிளகை சேர்த்து அரைத்து சாப்பிட்டால் கபம் வெளியேறும். வேளா வேளைக்கு இதை எடுத்துக் கொள்ள வேண்டும் என்றும் அறிவுறுத்துகிறார்.

கால் ஆணி :

கால் ஆணி வந்தால் முதலில் ஒரு வித அழுத்தம் தருவது போல் இருக்கும். கவனிக்காமல் விட்டு விட்டால் பாதத்தை தரையில் ஊன்ற முடியாத அளவிற்கு வலி ஏற்படும். கால்ஆணியின் முதல் அறிகுறியாக பாதத்தின் தோல்பகுதி கடினமானதாக காணப்படும்.

“வசம்பொடு மஞ்சள் துண்டும்
 வலியினைத் தீர்த்து வைக்கும்
 அசல்கற் பூரத் துண்டும்
 அரிவையர் நகத்திற்போடும்
 பசிய மருதோன்றி யிலையும்
 பழுதற அரைத்துக் காலின்
 தசையொடு அழுத்தி நன்று
 தீர்க்கமாய் கட்டி விட்டான்”

காலில் ஆணி ஏற்பட்டால் வலி மிகுந்து காணப்படும். இதனைத் தீர்த்து வைக்க கற்பூரம், நகத்தில் போடும் மருதோணி இவற்றை சுத்தமாக எடுத்து அரைத்துக் காலின் தசையொடு அழுதி விட்டு அரைத்த விழுதை வைத்து நன்றாகக் கட்டி விட வேண்டும். அப்படி கட்டிவிடும் போது வலி மறைந்து விடும்.

சிறுநீர் கழித்தலில் இரத்தம் வெளியேறுதல் :

சிறுநீர் பாதையில் தொற்று ஏற்பட்டால் சிறுநீர் கழிக்கும் போது எரிச்சல் ஏற்பட்டு சிறுநீருடன் ரத்தம் வெளியேறும். இது அரிதாக குழந்தைகளையும், பரம்பரை காரணங்களால் இளைஞர்களையும் பெரும்பாலும் முதியவர்களை மட்டுமே தாக்குகின்றது.

“பெரு நெஞ்சி, கீழ்க்காய் நெல்லி
 பித்தத்தை ஒழிக்க வல்ல
 அருகன் புல் லென்று மூன்றை
 அம் மெனவே அரைத்துக் கொண்டும்
 அருமையாய் மோரிந் கலந்தும்
 அன்றைக்கே குடிக்கச் செய்தோன்
 கருத்தாக ஏழுநாள் வந்து
 கண்டிப்பாய்க் குடிக்கச் சொன்னான்”.

பெருநெருஞ்சி, கீழ்க்காய் நெல்லி, அருகன்புல் ஆகிய மூன்றையும் எடுத்து அம்மியில் வைத்து அரைத்து அரைத்த விழுதை மோரில் கலந்து அன்றைய தினமே குடிக்க வேண்டும். தொடர்ந்து ஏழுநாள் குடித்து வர இந்நோய் மாறும்.

கர்ப்பான்

குழந்தைகளுக்கு வரும் தோல் நோய்களில் ஒன்றுதான் கர்ப்பான். இரத்தத்தில் அகத்தம் அதிக அளவுக்கு சேர்வதால் இந்நோய் உண்டாகிறது. பெற்றோருக்கு இந்நோய் இருந்தால் பரம்பரையாக தொடர்ந்து குழந்தைகளுக்கும் ஏற்பட வாய்புகள் உண்டு. தோல் அரிப்பு அதிகமாகவும், மூக்கை சுழிக்கும் விதத்தில் சஞ்சலமாய் இந்நோய் காணப்படும்.

“ஒரு பிடி நற்சங் கனிலையும்

ஒருடிடி ஆடா தோசையும்

அரிந்து சட்டியிற் போட்டே

அதனின் மேலிரு குவளை

அருமையாய்த் தண்ணீர் விட்டதை

நெருப்பினால் அரைப்பங் காகச்

கருக்கியே இரண்டு வேளை

தினமும் குடிக்கத் தந்தான்

கர்ப்பான் என்னும் நோய் ஏற்பட்டவர்களுக்கு நற்சங்கனி இலையும், ஆடா தோடா இலை ஒரு கைப்பிடி அளவு, எடுத்து அதனை பொடியாக நறுக்கி பாணையில் நிறைய தண்ணீர் வைத்து பகுதியாக வற்றி வரும் வரையில் நன்றாக காய்ச்சி அதனை தினமும் இரண்டு வேளை இந்நோயினால் பாதிக்கப்பட்டவர்களுக்கு கொடுத்தால் இந்நோய் குணமாகும்.

முடிவுரை :

சங்ககாலங்களில் மருத்துவ முறையானது இயற்கையுடன் இணைந்து காணப்பட்டது. இன்றைய சூழலில் மனிதனை நோய் எளிதாக தாக்குகின்றது. அதற்கான தீர்வுகளுக்கு புலவர் காசுமான் தன்னுடைய படைப்புகளில் சில வித நோய்களுக்கான இயற்கை மருத்துவத்தை கடைப்பிடித்த நாம் ஆரோக்கியமாக வாழமுடியும் என்ற கருத்தை வலியுறுத்துவதாக அமைகிறது. எனவே மூலிகைகளை நாம் வீட்டில் வளர்த்து அதனை பயன்படுத்த வேண்டும். அப்போது நமது உடல் ஆரோக்கியமாக பிணியின்ற நலமுடன் பலகாலம் வாழமுடியும்.

சோளகர் பழங்குடி மக்களின் தொழில்கள்

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முன்னுரை

உலகின் பல்வேறு பகுதிகளில் பழங்குடி மக்கள் உயர்ந்த மலைப் பகுதிகளிலும், சமவெளிப்பகுதிகளிலும், காடுகளிலும், குகைகளிலும் வாழ்கின்றனர். இவர்கள் தங்களின் மரபுகள், பண்பாடு, பழக்கவழக்கங்களையும் இன்றளவும் கடைபிடிக்கின்றனர். இன்றைய தலைமுறை சிலரிடையே நாகரிக வாழ்வியல் தாக்கம் ஏற்படுவதை காணமுடிகிறது. தமிழகத்தைப் பொறுத்தவரையில் மேற்குத் தொடர்ச்சி மலை மற்றும் கிழக்குத் தொடர்ச்சி மலைகளில் பல்வேறு பழங்குடி மக்கள் வாழ்கின்றனர். தமிழகத்தின் மக்கள் தொகையில் இவர்களின் எண்ணிக்கை ஒரு சதவிகிதத்திற்கும் குறைவே. இவர்களின் வாழ்வில் இயற்கைக்கு முக்கிய இடம் கொடுக்கின்றனர். சோளகர் தொட்டி நாவலில் சோளகர் பழங்குடி மக்களின் மரபு சார்ந்த தொழில்கள் குறித்து ஆய்வதாக இக்கட்டுரை அமைகிறது.

சோளகர் பெயர்க்காரணம்

சோளகர் என்றால் சோலைகளை ஆள்பவர் என்று பொருள். சோலை என்றால் காடு என்று பொருள். சோளகர் பழங்குடி மக்கள் தன்ஹகளிக்கென தனி நாகரிகம், பண்பாடு, கலாச்சாரம் கொண்டவர்கள். பிற பழங்குடி மக்களைப் போல் அவர்களிக்கென்று தனி பாரம்பரிய உடைகள் ஏதுமில்லை. சாதாரண மக்களைப் போன்று சேலையையும், வேட்டியையும் மட்டுமே அணிகின்றனர். இயற்கையோடு இணைந்து ஆடம்பரங்களை விரும்பாமல் எளிய வாழ்க்கை முறையைப் பின்பற்றி வாழ்கின்றனர். சோளகர் பழங்குடி மக்கள் இயற்கையைத் தங்களின் தெய்வமாகக் கருதி வாழ்கிறார்கள். சோளகர் தங்களின் தெய்வமாகக்

கருதி வாழ்கிறார்கள். சோளகர் மக்கள் தாங்கள் வசிக்கும் பகுதியினைத் “தொட்டி” என்று அழைக்கின்றனர். சோளகர் பழங்குடி மக்கள் மேற்குத்தொடர்ச்சி மலையிலுள்ள தங்களின் கடவுளான மாதேஸ்வரனை வணங்குகின்றனர். வருடத்தில் ஒரு முறையாவது மாதேஸ்வரன் மலைக்குச் சோளகர் மக்கள் குடும்பமாகச் சென்று பொங்கல் வைத்து வழிபாடு செய்கின்றனர். மேலும் தங்கள் வசிக்கும் தொட்டியின் முன் சிறிய கோவில்களைக் கட்டித் தினமும் சிறு தெய்வ வழிபாடு செய்கின்றனர். சோளகர் மக்கள் இறைவனைத் தங்களில் ஒருவனாகக் கருதி இறைவனிடம் வேண்டுகலை முன்வைக்கின்றனர். வேண்டுகல் நிறைவேறவில்லை என்றால் இறைவனிடம் கருணை முறையில் முறையிடுகின்றனர்.

வாழ்விடங்கள்

ஈரோடு மாவட்டம், அந்தியூர் வட்டத்திற்கு உட்பட்ட பர்கூர், தாமரைக்கரை, ஈரெட்டி, ஒந்தனை, பெஜலட்டி, தேவர் மலை, கத்தரி மலை, ஊசி மலை, சோளகனை முதலிய இருபதுக்கும் மேற்பட்ட கிராமங்களில் எண்பதுக்கும் மேற்பட்ட குடும்பங்கள் வசிக்கின்றன. இப்பகுதியில் உள்ள சோளகர் மக்கள் தமிழ் மற்றும் கனடா, தெலுங்கு மொழியை கலந்து பேசுகின்றனர். எழுதுவதற்கு தமிழ் மொழியைப் பயன்படுத்துகின்றனர்.

தொழில்கள்

பிற்காலம் முதல் இப்பொழுது வரை சோளகர் மக்கள் பெரும்பாலும் இயற்கையையும், வனத்தையும் சார்ந்த தொழில்களையே பின்பற்றினர். அதற்கான காரணம் அவர்கள் வாழும் நிலப்பகுதியே ஆகும். சோளகர் மக்கள் உயரமான மலைத்தொடர் மற்றும் அடர்ந்த காட்டுப்பகுதியில் இருப்பதால் அவர்களின் வாழ்விற்கும் வேறு எந்த தொழிலும் தெரியாது. பெரும்பாலான சோளகர் மக்கள் கூலிவேலைக்குச் செல்கின்றனர்.

சோளகர் பழங்குடி மக்களின் வேளாண்மை

சோளகர் பழங்குடி மக்கள் வருடத்திற்கு ஒரு போகம் மட்டுமே ராகி, அவரை, கடுகு, தட்டைப்பயிர் மற்றும் உளிந்து முதலியவற்றைப் பயிரிடுகின்றனர். பயிரிடும்போது விதைவிதைப்பு பாடலான,

"காத்தவர் தின்னது போக

கண்டவர் தின்னது போக

கள்வர் தின்னது போக

விளையனும் சாமி விளையனும்"

எனக் கும்பிட்டு தனியங்களை விதைக்கும் பரந்த மனம் கொண்டவர்களாக சோளகர் பழங்குடி மக்கள் உள்ளனர் என்பதை சோளகர் தொட்டி நாவலின் வழியே அறியமுடிகிறது.

பர்கூர் பகுதியில் வசிக்கக்கூடிய சோளகர் மக்கள் அடர்ந்த மலைப்பகுதி மற்றும் பாதுகாக்கப்பட்ட வனப்பகுதியில் நிபந்தனை பட்டா மூலம் வசிக்கின்றனர். இவர்களுக்கு சொந்தமாக விளைநிலம் ஏதும் இல்லை. அரசாங்கம் இவர்களின் வாழ்வாதாரம் மற்றும் பொருளாதாரத்தைக் கருத்தில் கொண்டு இவர்கள் வசிக்கக்கூடிய பகுதியிலேயே சிறுசிறு நிலங்கள் பிரிக்கப்பட்டு தொட்டியில் உள்ள அனைத்து சோளகர் மக்களுக்கும் பகிர்ந்து அளிக்கப்பட்டு அரசின் நிபந்தனையுடன் வேளாண்மை செய்கின்றனர். தமரைக்கரைப் பகுதியில் உள்ள சோளகர் மக்கள் ஆடி பட்டம் தேடி விதை எனும் பழமொழிக்கு ஏற்ப ஆடி மாதத்தில் தங்கள் நிலத்தை உழுது சுத்தம் செய்து சமன்படுத்தி ராகி, அவரை, கடுகு, முதலிய தனியங்களைப் பயிரிடுகின்றனர். ஆடிமாதம் பருவ மழை தொடங்கியவுடன் தங்களுடைய பணியைச் செய்கின்றனர். விவசாயத்திற்கு இயற்கை உரமாக ஆடு, மாடு சாணத்தையும் உப்பு மற்றும் செயற்கை உரம் சிறிதளவு மட்டுமே பயன்படுத்துகின்றனர். கார்த்திகை மாதத்தில் தங்களுடைய அறுவடைப் பணியைத் தொடங்கி தனியங்களை அறுவடை செய்கின்றனர்.

ஈரெட்டி மற்றும் ஒந்தனை பகுதி சோளகர் தட்டைப்பயிர், உளுந்து, ராகி முதலிய தானியங்களை ஆடி மாதம் பயிரிட்டு கார்த்திகை மாதத்தில் அறுவடை செய்கின்றனர். அறுவடை செய்த தானியங்களின் விளைச்சல்

அதிகமாக இருந்தால் கடுகு, அவரை, தட்டைப்பயிர், உளுந்து முதலிய தானியங்களை மட்டுமே வார சந்தைக்கு இடைத்தரகர்கள் மூலம் குறைந்த விலைக்கு விற்பனை செய்கின்றனர். ராகி மட்டும் அளவுக்கு அதிகமாக விளைச்சல் தந்தாலும் ராகியை விற்பனை செய்வதை அவர்கள் விரும்புவதில்லை. ராகி என்பது சோளகர் மக்களின் உணவாக மட்டும் இல்லாமல் உணர்வாகவும் அடையாளமாகவும் உள்ளது.

கால்நடைகளை வளர்த்தல்

கால்நடை வளர்ப்பு சோளகர் மக்களின் வாழ்வில் ஒரு அங்கமாக உள்ளது. தங்களுடைய வாழ்வில் கால்நடைகளுக்கு இப்பழங்குடி மக்கள் மிக முக்கிய பங்கு கொடுக்கின்றனர். கால்நடைகளை வெறும் விலங்காக மட்டும் கருதாமல் தங்கள் குடும்ப உறுப்பினராக மிகுந்த பாசத்துடன் சோளகர் பழங்குடி மக்கள் தங்களின் கால்நடைகளுடன் பழகுகின்றனர். இவர்களுடைய வாழ்விலும் கால்நடைகள் முக்கிய பங்கு வகிக்கின்றன. சோளகர் மக்களின் திருமணத்திலும் கால்நடைக்கு முக்கிய இடம் கொடுக்கின்றனர். திருமணம் செய்யும் பொழுது மணமகள் வீட்டில் இருந்து ஆட்டுக்குட்டிகள் மணமகனுக்கு திருமணச் சீராக வழங்கப்படுகிறது. பிறந்த வீட்டிலிருந்து புகுந்த வீட்டிற்குச் செல்லும் மணமகளுக்கு கால்நடைகளை ஒரு உறவாக கருதி மணமகளுடனே அனுப்பி வைக்கின்றனர். தொட்டியில் உள்ள சோளகர் மக்கள் அனைவரும் தங்களுடைய கால்நடைகளுடன் அருகில் உள்ள மலைகளுக்குக் காலை சென்றால் மாலை முழுவதும் தங்களுடைய கால்நடைகளுடனே ஆடிப் பாடி மகிழ்ந்து நாளை கழிக்கின்றனர்.

முடிவுரை

தற்கால வாழ்க்கையில் ஒரு மனிதனுக்கு அடிப்படை தேவைகளில் மிக முக்கியமான ஒன்று தொழில். தற்பொழுது சமவெளிப் பகுதியில்

வேலையின்மை என்பது அதிகரித்துக்கொண்டே செல்கிறது. அப்படி இருக்கையில் சோளகர் மக்கள் உயர்ந்த மலைகளில் இருப்பதால் அங்கே அவர்களுக்கான வேலைகள் என்பது மிகவும் குறைவு. பெரும்பாலான மக்கள் விவசாயத்தை நம்பி உள்ளனர். மழை பெய்யவில்லை என்றால் அதுவும் கேள்விக்குறியாகி விடும். மேலும் கூலித் தொழிலுக்காக செல்லும் மக்களுக்கு கூலி என்பது மிகவும் குறைவு பெரும்பாலான பெண்கள் அரசின் 100 நாள் வேலை திட்டத்தினையே நம்பியுள்ளனர். அதுவும் இப்போது கிடைப்பதில்லை. சோளகர் குடும்பங்கள் பெரும்பாலும் அரசின் நியாய விலைக் கடைகளையே நம்பி இருக்கின்றனர். மேலும் தினக்கூலி வேலையில் கிடைக்கும் வருமானம் மிகவும் குறைவு என்பதால் குடும்ப சூழ்நிலை கருதி தங்களுடைய பிள்ளைகளையும் வேலைக்கு அழைத்துச் செல்கின்றனர். வேலை வாய்ப்பு குறைவு மற்றும் வருவாய் இன்மை போன்ற பல்வேறு காரணங்களினால் சோளகர்களின் வாழ்வாதாரம் பெரிதும் பாதிப்புக்கு உள்ளாகிறது. எனவே அரசு சோளகர் மக்கள் வசிக்கும் பகுதிகளிலேயே அவர்களுக்கான வேலை வாய்ப்பினை ஏற்படுத்தித் தர வேண்டும். அரசின் 100 நாள் வேலை திட்டம் வருடம் முழுவதும் கிடைக்குமாறு ஏற்படுத்திக் கொடுப்பது போன்ற உதவிகளை இம்மக்களுக்குச் செய்வதன் வாயிலாக இம்மக்களின் பொருளாதாரம் மேம்படும்.

HUMAN-LIKE EMOTIONAL INTELLIGENCE IN ARTIFICIAL INTELLIGENCE: EXPLORING FUTURE POSSIBILITIES, ETHICAL IMPLICATIONS, AND SOCIETAL CHALLENGES

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Abstract

Artificial Intelligence (AI) is evolving beyond logical computation toward systems capable of simulating human-like emotions. This emerging domain, often referred to as Emotional AI or Affective Computing, aims to enhance human-machine interaction by enabling machines to perceive, interpret, and respond to human emotions. While such advancements promise transformative applications in healthcare, education, and communication, they also raise significant ethical and societal concerns. This paper explores the future possibilities of emotionally intelligent AI, examines ethical challenges such as privacy, bias, and manipulation, and analyzes the broader societal implications including human dependency, pseudo-intimacy, and trust issues. The study concludes by proposing guidelines for responsible and human-centered development of emotional AI systems.

Keywords: *Artificial Intelligence, Emotional AI, Affective Computing, Ethics, Human-Machine Interaction, Society*

1. Introduction

Artificial Intelligence has rapidly progressed from rule-based systems to advanced machine learning models capable of understanding complex human behaviors. A new frontier in AI research focuses on integrating human-like emotions into intelligent systems.

Emotions play a crucial role in human cognition, influencing decision-making, communication, and social bonding. Researchers are now attempting to replicate these emotional processes within AI systems to create more natural and intuitive interactions. However, defining and implementing “emotion” in AI remains an open challenge due to the lack of a clear operational definition of emotions in machines.

2. Concept of Human-Like Emotions in AI

Human-like emotional AI involves three major capabilities:

- Emotion recognition (facial expressions, voice, text)
- Emotion interpretation (contextual understanding)

- Emotion generation (empathetic responses)

Modern AI systems use techniques such as:

- Natural Language Processing (NLP)
- Computer Vision
- Deep Learning

These technologies enable AI to simulate empathy and emotional responses, although such emotions are not “felt” but computationally modeled.

3. Future Possibilities of Emotional AI (Extended)

3.1 Healthcare Applications

- **AI-driven Psychotherapy:** Emotion-aware chatbots providing Cognitive Behavioral Therapy (CBT)-based interventions.
- **Real-time Emotion Monitoring:** Wearables + AI detecting stress, anxiety, depression patterns.
- **Elderly Care Systems:** Companion robots reducing loneliness and cognitive decline.
- **Early Diagnosis Systems:** Detecting disorders like depression, autism, PTSD using speech and facial cues.
- **Emotion-aware Telemedicine:** Doctors receiving emotional insights of patients during virtual consultations.

3.2 Education

- **Adaptive Learning Environments:** AI modifies teaching style based on student engagement and emotional state.
- **Emotion-Sensitive Tutoring Systems:** Detects frustration/confusion and adjusts difficulty level.
- **Student Mental Health Support:** AI systems identifying burnout or stress in learners.
- **Gamified Emotional Learning:** Learning platforms integrating motivation and emotional rewards.

3.3 Human-Computer Interaction (HCI)

- **Empathetic Virtual Assistants:** Systems like voice assistants responding with emotional awareness.
- **Emotion-Aware User Interfaces:** Interfaces adapting color, tone, or complexity based on user mood.
- **Customer Experience Enhancement:** AI detecting dissatisfaction in real time and improving service delivery.

- **Immersive Technologies:** Emotional AI in AR/VR for realistic simulations and training.

3.4 Artificial General Intelligence (AGI)

- **Emotion as Decision Parameter:** Simulated emotions influencing rational decision-making.
- **Self-Regulating AI Systems:** Internal emotional states guiding behavior adaptation.
- **Human-like Social Intelligence:** AI capable of nuanced social interactions.

3.5 Business and Marketing

- **Emotion-Based Advertising:** Personalized ads based on user emotional state.
- **Customer Sentiment Analysis:** Real-time emotion detection in feedback systems.
- **Brand Loyalty Enhancement:** Emotional engagement through AI-driven personalization.

4. Ethical Implications (Extended)

4.1 Privacy and Data Security

- Collection of biometric emotional data (facial expressions, voice tone).
- Risk of unauthorized surveillance and emotional profiling.
- Need for strict data protection regulations (GDPR-like frameworks).

4.2 Algorithmic Bias and Fairness

- Cultural misinterpretation of emotions.
- Gender and racial bias in emotion recognition datasets.
- Ethical need for inclusive and diverse training data.

4.3 Manipulation and Behavioral Influence

- AI exploiting emotional vulnerabilities (e.g., targeted ads).
- Political persuasion using emotional profiling.
- Ethical concerns in persuasive technologies.

4.4 Transparency and Explainability

- “Black-box” nature of deep learning systems.
- Need for Explainable AI (XAI) models in emotional systems.
- User awareness about AI decision-making processes.

4.5 Authenticity and Moral Concerns

- Difference between simulated and real emotions.
- Ethical dilemma of machines mimicking empathy.
- Questions about moral agency in AI systems.

4.6 Consent and User Awareness

- Users may not know their emotions are being tracked.
- Importance of informed consent in emotional data usage.

5. Societal Challenges (Extended)

5.1 Human Dependency on AI

- Reduced human emotional intelligence due to over-reliance.
- Substitution of human relationships with AI interactions.

5.2 Pseudo-Intimacy and Emotional Attachment

- Formation of emotional bonds with machines.
- Risk of social isolation and detachment from real relationships.

5.3 Trust and Over-Reliance

- Users trusting AI beyond its actual capabilities.
- Blind reliance in sensitive domains like healthcare.

5.4 Impact on Mental Health

- Positive: Reduces loneliness and stress.
- Negative: Creates unrealistic emotional expectations.

5.5 Cultural and Social Diversity Issues

- Emotional expressions differ across cultures.
- AI struggling with cross-cultural emotional understanding.

5.6 Workforce and Employment Impact

- Replacement of human roles in counseling, customer service.
- Need for reskilling workforce for AI collaboration.

5.7 Digital Inequality

- Unequal access to emotional AI technologies.
- Risk of widening socio-economic gaps.

6. Challenges in Implementation (Extended)

6.1 Technical Challenges

- Lack of universal emotional models.
- Difficulty in multimodal emotion detection (voice + face + text).
- Real-time processing limitations.

6.2 Data Challenges

- Limited labeled emotional datasets.
- Data privacy restrictions.

- Imbalanced datasets affecting accuracy.

6.3 Contextual Understanding

- Same emotion can have different meanings in different contexts.
- Sarcasm, irony, and mixed emotions are difficult to detect.

6.4 Ethical Integration

- Embedding ethical reasoning into AI systems.
- Balancing performance vs ethical compliance.

6.5 Computational Complexity

- High processing power required for real-time emotional analysis.

7. Recommendations for Responsible AI (Extended)

7.1 Ethical Framework Development

- Establish global standards for Emotional AI.
- Implement fairness, accountability, and transparency principles.

7.2 Explainable and Transparent Systems

- Develop interpretable AI models.
- Provide users with clear explanations of AI decisions.

7.3 Human-in-the-Loop Systems

- Ensure human oversight in critical applications (healthcare, law).
- Combine human empathy with AI efficiency.

7.4 Data Governance and Privacy Protection

- Strong encryption and anonymization techniques.
- User-controlled data access mechanisms.

7.5 Inclusive and Diverse Datasets

- Representation of multiple cultures, languages, and demographics.

7.6 Interdisciplinary Collaboration

- Integration of AI with psychology, neuroscience, and ethics.

7.7 Public Awareness and Education

- Educating users about Emotional AI capabilities and risks.

7.8 Policy and Regulation

- Government policies to regulate emotional AI usage.
- Ethical audits and compliance checks.

8. Conclusion

Human-like emotional intelligence in AI represents a significant advancement in technology, offering immense potential to transform industries and improve human life. However, it also introduces complex ethical and societal challenges that must be carefully managed. Emotional AI should be developed with a strong focus on human values, ensuring that it enhances human well-being without compromising privacy, fairness, or social integrity.

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INNOVATION & TECHNOLOGY FOR EMPLOYEE PERFORMANCE IN CBSE SCHOOLS

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ABSTRACT

Technology and innovation are now crucial elements of contemporary educational establishments. Innovative techniques and the use of digital tools are crucial for improving employee performance in CBSE schools, especially for teachers and administrative staff. Effective communication, better instructional strategies, better data management, and improved decisionmaking processes are all made possible by technology. This study investigates the ways in which technological tools and innovation enhance worker performance in CBSE schools. Digital teaching tools, learning management systems, HR analytics, teacher training platforms, and administrative technology are some of the topics covered by the research. The study uses both primary and secondary data sources and employs a descriptive research design. The results imply that

the use of technology enhances employees' overall productivity at educational institutions as well as their work efficiency, professional growth possibilities, and quality of instruction, according to the study's findings, schools that use cutting-edge technology have greater organizational performance, increased employee engagement, and superior teaching results. In order to improve staff performance and institutional growth, CBSE schools should promote the incorporation of contemporary technologies and ongoing innovation.

Keywords: *Innovation, Technology, Employee Performance, Digital Education, CBSE Schools, HR Analytics*

1. Introduction

Innovative teaching strategies and technological breakthroughs have caused the education sector to rapidly change. Digital platforms are being used by educational institutions more frequently to increase administrative effectiveness and teaching quality.

Technology is increasingly being used in CBSE schools as a vital tool to support staff members and teachers in their professional tasks. The efficacy of educators, administrators, and suppo

rt personnel has a significant impact on employee performance in educational institutions. Learning management has been integrated with smart classrooms.

Employees are able to carry out their tasks more effectively thanks to systems and digital communication technologies. Additionally, technological advancements enable teachers to present interactive classes and foster collaborative learning settings. Teachers can also improve their professional competencies through webinars and online training programs. Administrators can efficiently handle student information, attendance, payroll, and academic data with the help of school management software. Employee productivity and organizational performance are enhanced by these technology advancements.

3. Review of Literature

According to Drucker (2007), innovation has a crucial role in raising organizational performance and productivity. Selwyn (2011) talked about how digital technology changes how schools educate and learn.

According to Armstrong (2014), technology-driven HR systems assist businesses in efficiently managing employee performance. Digital learning tools increase student engagement and instructional effectiveness, according to Bates (2015).

According to the OECD (2020), schools that use technology-based teaching strategies have higher staff productivity and better learning results. These studies demonstrate that technology and innovation play a major role in enhancing organizational performance, particularly that of educational institutions.

4. Research Methodology

Research Design

The study examines how innovation and technology affect staff performance in CBSE schools using a descriptive research approach.

Data collection

The research is predicated on:

Primary Data: Surveys and questionnaires given to administrators, teachers, and principals.

Books, scholarly publications, official documents, and instructional websites are examples of secondary data.

Sampling Method

Responses from staff members employed by CBSE schools are gathered using a straightforward random sample technique.

Sample Size

Teachers, principals, viceprincipals, and administrative personnel from Pune's CBSE schools are included in the study.

Tools for Data Analysis

- Percentage analysis
- Charts and tables
- Descriptive statistical methods

5. Role of Innovation and Technology in Employee Performance

5.1 Smart Classrooms

Teachers can enhance classroom engagement and deliver lessons more successfully with the use of smart boards, digital projectors, and multimedia technologies.

5.2 Learning Management Systems (LMS)

Teachers can effectively manage assignments, tests, and student interactions with the use of platforms like as Google Classroom and other LMS applications.

5.3 School Management Software

Technology increases administrative efficiency by managing student records, payroll, attendance, and academic reports.

5.4 Online Training and Professional Development

To improve their teaching abilities and expertise, educators might participate in webinars, workshops, and online courses.

5.5 HR Analytics in Schools

Administrators may monitor worker performance, training requirements, and productivity levels with the use of HR analytics.

6. Benefits of Innovation and Technology in Schools

- Increases the efficacy of instruction
- Increases worker productivity
- Encourages improved staff communication
- Makes data-driven decision-making easier
- Promotes ongoing professional growth
- Enhances learning outcomes for students

7. Challenges in Implementing Technology

- Inadequate infrastructure for technology
- Teachers' inadequate training
- Employee resistance to change
- The high expense of implementing technology
- Insufficient technical assistance

8. DISCUSSION

The study's conclusions demonstrate how important innovation and technology are to improving worker performance in CBSE schools connected to the Central Board of Secondary Education. In educational institutions, the use of digital technologies, smart classrooms, and administrative software has revolutionized management and instructional strategies.

The findings show that teachers who actively employ technology resources like learning management systems, digital boards, and multimedia presentations exhibit increased classroom engagement and instructional efficacy. In the end, technology improves student learning outcomes

by allowing teachers to convey difficult ideas in a more engaging and intelligible way. Additionally, using digital resources enables educators to adopt cutting-edge teaching techniques and access current academic materials. Technological advancements also assist administrative staff. Administrative tasks including payroll processing, record keeping, attendance tracking, and parent and student communication are made easier by school administration systems. Employees can concentrate on more strategic and instructive jobs as a result of the decreased physical labor and increased operational efficiency. The report also emphasizes the value of professional development through webinars, digital workshops, and online training courses. These resources support educators in continuously improving their expertise and pedagogical abilities.

Teachers who receive technology-based professional development are better able to adjust to new trends in education and are encouraged to pursue lifetime learning. Inadequate digital equipment and poor internet access are two examples of the infrastructure constraints that some institutions must deal with. Additionally, teachers may find it challenging to adapt new technology tools if they are not properly trained. The process of integrating technology is also slowed down by some employees' resistance to change. Despite these obstacles, the aggregate results show that innovation and technology improve worker productivity. Higher levels of organizational performance are more likely to be attained by schools that successfully use technology into their administrative and academic processes. As a result, educational authorities and school administration should make investments in technology infrastructure, offer ongoing training programs, and promote an innovative culture. Employees will be able to use technology more efficiently thanks to these measures, which will also help to raise the standard of instruction in CBSE schools.

10. CONCLUSION

In today's educational institutions,

Innovation and technology are essential to raising employee performance.

Employee productivity and efficiency are greatly increased in CBSE schools through the use of digital tools including learning management systems, smart classrooms and administrative software.

According to the study's findings, technology integration enhances instructional effectiveness, administrative effectiveness, and school staff members' chances for professional growth. However, adequate organizational support, training, and infrastructure are necessary for success.

successful implementation. Educational institutions must invest in technological advancements and promote continuous innovation to achieve sustainable development and maintain high educational standards.

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CONFERENCE PROCEEDING

INTERNATIONAL CONFERENCE ON SMART INNOVATION TECHNOLOGIES & ARTIFICIAL INTELLIGENCE FOR SUSTAINABLE DEVELOPMENT (ICSAS-2026)

ABOUT THE COLLEGE

St. Joseph's College (Arts & Science) is a co-educational Christian institution run by the management of Society for Education for Life. This college has been established in 1994 and has been taken over by Rev.Fr.Dr.J.E.Arul Raj and managed by DMI Sisters from 2004. This college is Approved by Govt. of Tamilnadu, Affiliated to University of Madras, Accredited by NAAC with "A" Grade, 2(f) Status of UGC Act,1956 and ISO 21001:2018 Certified Institution. DMI is known for its time-honourable tradition of imparting quality education to the society and rendering social service without discrimination.

Rev.Fr.Dr.J.E.Arul Raj is the Founder and Chairman of the college. He is ably supported by Rev.Sr.S.Lalitha, Superior General of DMI and Rev.Sr.S.Gnanaselvam, Managing Trustee of the society. The vision of the college is to provide a discipline life with a spiritual base to remain 'Fully Alive and Fully Human'. Further, it strives to achieve excellence and provides opportunities to the students to achieve technical excellence.

VISION

To emerge as an institute of excellence by imparting quality higher education to the youth, not only focused on imparting subject knowledge and skills, but also to mould the students with better conduct and character, committed to the societal needs and national development.

MISSION

To be innovative, inclusive and committed to excellence in teaching, research and knowledge transfer and to serve the social, cultural and economic needs of the Society To innovate and offer educational programmes in various disciplines with synergistic interaction with the industry and society To impart knowledge and skills to students equipping them to be ready to face the emerging challenges to the knowledge area To provide equal opportunity to women students and prepare them to be equal partners in meeting the scientific and technological demands of the nation To provide opportunity for the rural and underprivileged students to get collegiate education and make the first generation learners graduate and employable.

CONFERENCE THEME

Smart Innovation Technologies and Artificial Intelligence for Sustainable Development ICSAS-2026 focuses on the transformative role of smart innovation technologies and artificial intelligence in achieving sustainable development across economic, environmental, and social dimensions. The conference provides a global platform for researchers, industry experts, policymakers, and practitioners to exchange ideas on AI-driven solutions, intelligent systems, data analytics, automation, and emerging digital technologies that support sustainable industries, smart cities, renewable energy, healthcare, education, and governance. Emphasis is placed on ethical and responsible AI, digital inclusion, resilience, and innovation strategies aligned with global sustainability goals, fostering interdisciplinary collaboration to address pressing global challenges and shape a sustainable future.



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