

ISSN 2229-4406



**Smt. S.K. Gandhi Art's, Amolak Science & P.H. Gandhi Commerce College,  
Kada, Tq. Ashti, Dist. Beed (M.S.) 431518**

Published, Printed, Owned by Sow. Mahananda B. Kamble & Edited by Dr. J. M. Bhandari & Printed at Indo Vision Offset, Binding & Published by Jyotichandra Publication 'Gyandev - Parvati', R-9 / 139/6, Near Vishal School, L.I.C. Colony, Pragati Nagar, Latur. Dist. Latur-413531(M.S.) India. Contact :- 8484818000, 7276301000.



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CONTEMPORARY CHALLENGES : ADDRESSING INDIA'S BURNING ISSUES FOR A SUSTAINABLE FUTURE

Impact Factor :- 7.338 (SJIF)

ISSN 2229-4406

International Registered and Recognized  
Research Journal Related to Higher Education for all Subjects

# UNIVERSAL RESEARCH ANALYSIS

(UGC Approved, Peer Reviewed & Refereed Indexed Research Journal)

(Year -XVI, Issue - XXXII, Vol. - IV : Sept. 2025 To Feb. 2026) Special Issue



Shri Amolak Jain Vidya Prasarak Mandal's

## **Smt. S.K. Gandhi Art's, Amolak Science & P.H. Gandhi Commerce College, Kada**

Tq-Ashti, Dist. Beed (M.S.) 431518

(NAAC Accredited B+ Grade)

Affiliated to Dr. Babasaheb Ambedkar Marathwada University, Chh. Sambhajinagar (M.S.)

**One Day Multidisciplinary National Conference**

Date : 24/ 01/2026

On

### **Contemporary Challenges : Addressing India's Burning Issues for a Sustainable Future**



**Editor in Chief  
Dr. J. M. Bhandari**

**Co - Editor  
Dr. U. E. Chavan**



Shri Amolak Jain Vidya Prasarak Mandal's  
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**Internal Quality Assurance Cell (IQAC)**



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<p>Issue - XXXII, Vol. IV Year - XVI (Half Yearly) Sept. 2025 To Feb. 2026 ( Special Issue )</p>	<b>EDITOR IN CHIEF</b>	
<p><b>Editorial Office :</b> 'Gyandev-Parvati', R-9/139/6-A-1, Near Vishal School, LIC Colony, Pragati Nagar, Latur Dist. Latur - 413531. (Maharashtra), India.</p>	<p><b>Dr. J. M. Bhandari</b> Principal Smt. S.K. Gandhi Arts, Amolak Science &amp; P.H. Gandhi Commerce College, Kada Tq. Ashti, Dist. Beed (M.S.) 414202</p>	
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ISSN -2229-4406

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## Message



Dear Esteemed Participants,

It gives me immense pleasure and a deep sense of pride to address this academic gathering organized around the theme “**Contemporary Challenges: Addressing India’s Burning Issues for a Sustainable Future.**” At a time when our nation stands at a crucial crossroads facing challenges related to climate change, social inequality, economic sustainability, education, health, and technological transformation such scholarly deliberations are not only relevant but essential.

I heartily congratulate all the respected professors, researchers and contributors who have presented their research papers in this conference. The quality, depth, and originality reflected in these papers clearly demonstrate a strong commitment to academic excellence and social responsibility. Your research efforts do not remain confined to theory alone; rather, they provide meaningful insights and practical pathways toward building a resilient and sustainable India.

I also extend my sincere appreciation to the organizing committee, coordinators, reviewers and every member of our college who has worked tirelessly to make this conference a success. Organizing an academic event of this stature requires vision, teamwork, discipline, and dedication, and I am proud of the collective effort displayed by our institution.

As an educational institution, our responsibility goes beyond imparting knowledge; we must nurture critical thinking, ethical values, and a solution-oriented mindset among scholars and students alike. Conferences such as this serve as vibrant platforms for dialogue, innovation, and collaboration, helping bridge the gap between academic research and societal needs.

I am confident that the ideas and discussions generated here will inspire further research, policy thinking, and constructive action. Once again, I congratulate all contributors and members of the college and wish this academic endeavor continued success in shaping a sustainable and enlightened future for our nation.

Warm regards,

**Shri. Yogesh Sumatilal Bhandari**

President

Shri. Amolak Jain Vidya Prasarak Mandal,

Kada, Tal. Ashti Dist. Beed

## Message



**Dear Esteemed Delegates,**

It is a matter of great honor and privilege for me, as the Acting President of the institution, to convey my warm congratulations on the successful conduct of this academic conference on the theme “**Contemporary Challenges: Addressing India’s Burning Issues for a Sustainable Future.**” This conference reflects the institution’s commitment to academic excellence, social relevance, and national responsibility.

In the present era, India is facing multifaceted challenges that demand thoughtful analysis, innovative solutions, and collective intellectual effort. Academic platforms such as this conference play a vital role in encouraging meaningful dialogue and generating research-driven perspectives that can contribute to sustainable development and inclusive progress. The scholarly papers presented here demonstrate clarity of thought, depth of research, and a strong concern for contemporary societal issues.

I sincerely congratulate all the faculty members, researchers, and contributors for their valuable academic contributions. I also extend my appreciation to the organizing committee, coordinators, reviewers, and supporting staff for their dedication, teamwork and effective execution of this important academic event.

As Acting President, I firmly believe that such initiatives strengthen institutional values, inspire young scholars, and enhance the research culture of the college. I am confident that the outcomes of this conference will leave a lasting academic impact and guide future endeavors.

I once again congratulate everyone involved and wish the institution continued success in its academic mission.

Warm regards,

**Shri. Kantilal Fakirchand Chanodiya**  
Acting President  
Shri. Amolak Jain Vidya Prasarak Mandal  
Kada, Tal. Ashti District Beed

## Message



**Dear Esteemed Participants,**

As the President of the Trust, I feel a profound sense of satisfaction and honor in being associated with this national-level academic conference on the theme **“Contemporary Challenges: Addressing India’s Burning Issues for a Sustainable Future.”** The Trust firmly believes that higher education and research play a pivotal role in shaping a responsible, progressive and sustainable society and this conference stands as a testimony to that belief.

India today is confronted with complex and interlinked challenges environmental degradation, social disparities, economic transitions, digital transformation, and the need for inclusive growth. Addressing these concerns requires not only policy interventions but also strong intellectual engagement, critical analysis, and innovative thinking. The scholarly papers presented in this conference reflect such engagement and provide valuable perspectives for understanding and resolving these pressing national issues.

I sincerely congratulate all the faculty members, researchers, and contributors for their commendable academic work. Their dedication to research and commitment to national development are truly praiseworthy. I also extend my heartfelt appreciation to the college administration, organizing committee and all supporting staff members for their meticulous planning and collective efforts in organizing this meaningful academic event.

The Trust takes pride in supporting initiatives that encourage research culture, interdisciplinary dialogue, and socially relevant scholarship. Academic forums like this conference not only enhance institutional prestige but also inspire young minds to pursue knowledge with purpose and responsibility.

I am confident that the deliberations, discussions and outcomes of this conference will contribute constructively to academic discourse and societal progress. On behalf of the Trust, I extend my best wishes for the grand success of this conference and hope that such scholarly initiatives will continue to guide India toward a sustainable, inclusive and enlightened future.

Thank you.

Warm regards,

**Shri. Gokuldas Anandram Meher**

Trust President

Shri. Amolak Jain Vidya Prasarak Mandal

Kada, Tal. Ashti Dist. Beed

## Message



**Dear Attendees,**

We are delighted to extend a warm welcome to all participants of our One Day Multidisciplinary National Conference on “**Contemporary Challenges: Addressing India’s Burning Issues for a Sustainable Future.**” The conference has provided a meaningful platform for intellectual exchange and scholarly reflection on issues of critical national importance.

I sincerely congratulate all the faculty members, researchers, and contributors whose research papers have enriched this conference with quality, originality and relevance. Their academic efforts reflect a strong research culture and a deep sense of responsibility toward society and the nation. Such contributions play a vital role in translating academic knowledge into constructive solutions for contemporary challenges.

My special appreciation goes to the organizing committee, coordinators, reviewers, and supporting staff for their dedicated efforts, effective coordination and meticulous execution of this event. Their teamwork and commitment have been instrumental in making the conference a smooth and successful academic endeavor.

Academic conferences like this strengthen institutional values, promote collaborative learning and inspire both teachers and students to engage in meaningful research. I am confident that the ideas and insights generated through this conference will leave a lasting impact on future academic pursuits.

Once again, I congratulate everyone involved and wish continued success to all contributors and the institution in its academic journey.

Best regards,

**Shri. Hemant Babulal Pokharna**

Secretary

Shri. Amolak Jain Vidya Prasarak Mandal,

Kada, Tal. Ashti Dist. Beed

## Message



**Dear Esteemed Participants,**

It gives me immense satisfaction, as the Treasurer of the institution, to convey my hearty congratulations on the successful organization of this academic conference on the theme “**Contemporary Challenges: Addressing India’s Burning Issues for a Sustainable Future.**” This conference stands as a fine example of how academic vision, intellectual rigor and institutional commitment come together to address the pressing needs of the nation.

Sound academic initiatives require not only scholarly excellence but also careful planning, transparency, and responsible utilization of resources. I am pleased to note that this conference has been organized with a strong sense of discipline, efficiency and accountability, ensuring that academic objectives were achieved in a meaningful and sustainable manner.

I sincerely congratulate all the faculty members, researchers and contributors whose high-quality research papers have added immense value to this conference. Their work reflects dedication, foresight, and a deep understanding of contemporary national and global challenges. I also appreciate the organizing committee and staff members for their coordinated efforts and prudent management, which have ensured the smooth execution of this event.

As an institution, we remain committed to supporting academic excellence and research-oriented activities that contribute to national development and social progress. I am confident that the outcomes of this conference will inspire future research and responsible action.

Once again, I extend my best wishes and congratulations to everyone associated with this successful academic endeavor.

Warm regards,

**Dr. Umesh Ashok Gandhi**

Treasurer

Shri. Amolak Jain Vidya Prasarak Mandal

Kada, Tal. Ashti Dist. Beed

## Editorial

It gives me immense pleasure to present this One Day Multidisciplinary National Conference on “**Contemporary Challenges: Addressing India’s Burning Issues for a Sustainable Future.**” This theme is not merely academic in nature; it reflects the urgent realities of our time and the collective responsibility we bear as educators, researchers, and students in shaping a better tomorrow.

The enthusiastic participation of professors, researchers, and students in contributing high-quality research articles to this conference is truly commendable. Each paper reflects deep thinking, rigorous research, and a sincere concern for the social, economic, environmental, and cultural challenges facing India today. The diversity of perspectives and the depth of analysis showcased in this issue demonstrate the strong academic culture nurtured within our institution.

This conference is the result of collective effort. From conceptualizing the theme to organizing sessions, reviewing papers, and compiling the proceedings, everyone at the college has worked with dedication and a shared sense of purpose. Such teamwork reflects not only academic excellence but also institutional unity and commitment.

Most importantly, this endeavor highlights our core mission: to create responsible, socially aware, and future-ready students who contribute meaningfully to nation-building. By encouraging research, critical inquiry, and dialogue on contemporary issues, we are strengthening the foundation of our college and empowering students to become thoughtful leaders and change-makers.

I extend my heartfelt congratulations to all contributors, organizers, reviewers, and participants. This conference issue stands as a proud academic milestone for our college and a testament to our belief that knowledge, when aligned with social responsibility, becomes a powerful tool for sustainable development.

Let this be an inspiration to continue our academic journey with integrity, innovation and a deep commitment to society.

Congratulations to everyone involved.

**Editor in Chief**

**Dr. J. M. Bhandari** (Principal)

**Co-Editor**

**Dr. U. E. Chavan**

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## 1

## Indian Chemical Heritage : A Jewel in the Crown of IKS

Mr. Vishal B. Deokar, Miss. Sakshi T. Jagtap, Mrs. Dipali M. Jadhav,  
Mr. Suraj Bhukan, Dr. Ashishkumar P. Kataria

Dept. of Chemistry,  
SAJVPM's Smt. S. K. Gadhi Arts, Amolak Science & P. H. Gandhi  
Commerce, College, Kada, Dist. Beed

### ABSTRACT

*Indian Knowledge Systems (IKS) are the result of centuries of learning, observation, and practical experience that developed in India over thousands of years. These systems cover a wide range of subjects, including health, agriculture, astronomy, mathematics, philosophy, and the sciences. One of the most important and fascinating areas within IKS is the traditional knowledge of chemistry. This knowledge is reflected in various ancient Indian practices such as Rasashastra: the science of processing metals and minerals for health, metallurgy, medicine, especially in Ayurveda and materials science. Indian chemistry was not just limited to theoretical understanding but was also based on hands-on techniques and experimentation. This review article aims to explore the richness and complexity of chemical knowledge in ancient India. It highlights how this traditional wisdom was far ahead of its time and how it can still offer valuable insights today. By connecting this ancient knowledge with current scientific studies, the paper also discusses how Indian chemistry can be integrated into today's academic education and scientific research for a more holistic and culturally rooted learning experience.*

### Introduction

India has a long and rich tradition of knowledge that has evolved over thousands of years. This vast body of knowledge, known today as the Indian Knowledge Systems (IKS), includes a wide range of disciplines such as philosophy, science, art, health, and technology. It was not developed overnight but grew naturally through careful observation, continuous learning, and deep reflection by scholars, teachers, and practitioners across generations.

One of the most important branches within IKS is the traditional Indian understanding of chemistry, which is often called "Rasashastra" or "Rasavidya" in ancient texts. This form of chemistry was not limited to just theory; it was a hands-on science based on real-life applications and careful experimentation.

Unlike the popular belief that ancient knowledge was mostly spiritual or philosophical, Indian chemistry had practical uses in everyday life. It was applied in preparing medicines, work-

ing with metals, making dyes, perfumes, and even in agricultural and environmental practices. These scientific methods were well-organised and thoughtfully documented by scholars, showing that our ancestors had a deep and systematic understanding of how materials behave and change.

This research paper focuses on the development and use of chemistry in ancient India, how it was practised, and how it contributed to various fields such as health, metallurgy, and natural science. It also highlights the importance of recognising this rich heritage today, especially in academic and scientific circles, where traditional knowledge can still offer valuable insights and sustainable solutions for modern problems.

### **Ancient Foundations of Indian Chemistry**

The roots of chemistry in India go back thousands of years and are deeply embedded in the country's cultural, spiritual, and scientific traditions. In ancient Indian philosophy, all matter in the universe was believed to be made up of five fundamental elements known as the "Pancha Mahabhutas": Agni (fire), Jala (water), Prithvi (earth), Vayu (air), and Akasha (space). These elements were not just symbolic or spiritual; they represented real physical and chemical properties of the substances found in nature. This idea laid the foundation for a deeper understanding of how materials interact, transform, and behave under different conditions.

Over time, these early concepts evolved into practical applications in areas such as health, metallurgy, and daily life. One of the most important developments in ancient Indian chemical knowledge was the emergence of

Rasashastra, a branch of Ayurveda that focused on the use of minerals, metals, and other natural substances to prepare medicines. Rasashastra is believed to have developed around the 8th century CE, but the chemical ideas it applied had already been known and practised for many centuries before that.

Even during the Vedic period, long before formal chemistry was known to the world, Indian scholars were experimenting with fire-based rituals, known as Yajnas, which involved the use of different herbs, minerals, and substances under heat. These rituals required a basic understanding of combustion, transformation of materials, and chemical reactions, though the language used to describe them was spiritual and symbolic.

Further evidence of early chemical practices can be found in two ancient Ayurvedic texts, "Charaka Samhita" and "Sushruta Samhita", dated around 600 BCE or earlier. These texts offer detailed descriptions of the preparation of herbal medicines, mineral formulations, and metallic compounds. They discuss methods such as Shodhana (purification) to remove toxic properties, Marana (calcination) to make metals digestible, Bhavana (wet grinding and mixing with herbal juices), and Murchana (fermentation) to enhance the therapeutic qualities of natural substances. These techniques show a clear understanding of how substances change when heated, mixed, or treated with other compounds, basic ideas at the heart of modern chemistry.

What makes Indian chemistry remarkable is that it was not based on presumptions or superstition. It was an empirical science, built

through centuries of observation, experimentation, and documentation. Scholars and practitioners worked carefully with different materials, recorded their results, and refined their methods over time. The knowledge was passed down in the form of Sanskrit texts, often written in verses to aid memory, and taught within educational institutions, families, and guilds.

Indian chemists were not only preparing medicines but also dealing with materials in ways that showed deep insight into their nature. They knew how to transform metals, extract plant essences, distil liquids, and preserve substances, all without the help of modern instruments. Their understanding of material transformations, reactions under heat, and long-term storage indicates that chemistry in ancient India was not just practical but also highly advanced for its time.

Long before the scientific revolutions in Europe, Indian thinkers were exploring and applying principles that align closely with what we now recognise as chemical science. Their work laid a strong foundation for various applied fields like medicine, metallurgy, perfumery, dyeing, and agriculture. In this way, the early Indian approach to chemistry formed one of the strongest pillars of the Indian Knowledge Systems, contributing to both spiritual well-being and scientific advancement.

## **Applications**

### **Medicine and Pharmaceuticals**

One of the most important and long-lasting uses of traditional Indian chemical knowledge can be seen in the area of medicine. In ancient India, a special branch of Ayurveda called Rasashastra focused on preparing medicines using various metals and minerals such

as mercury, sulfur, gold, silver, copper, lead, and even arsenic. These materials were not used directly but were carefully purified and processed through multiple steps to make them safe and effective. The final products, called bhasmas, were fine powders made by burning or heating the metals in a controlled way. These bhasmas were believed to boost health, improve immunity, and increase strength and life span.

Interestingly, modern scientific research has found that many of these bhasmas contain very tiny particles, even at the nano level, which suggests that ancient Indian healers had a surprisingly deep understanding of material properties, even without modern tools. Several traditional techniques were used during the preparation of these medicines, such as bhavana (grinding with herbal liquids), putapaka (heating or burning in closed containers), and shodhana (purifying harmful substances). These processes show that people had strong knowledge of how to change substances through heat, grinding, or mixing, basic ideas in chemistry.

In addition to metallic medicines, many herbal remedies were also prepared using methods like soaking, extracting plant juices, and fermentation. These methods are quite similar to those used in modern drug production. Natural preservatives and stabilisers were used to make the medicines last longer without spoiling, which shows that they also understood how to maintain the quality of medicines over time. Ancient Ayurvedic texts even included detailed information about medicine dosage, their side effects, and shelf-life. All of this proves that medical chemistry in ancient India was well-organised, carefully studied, and far ahead

of its time.

### **Material Transformation**

In ancient India, alchemy (Rasavidya) aimed at both material change and spiritual growth. Unlike Western alchemy, which focused on turning metals into gold, Indian alchemy emphasised health, innovation, and inner transformation. Indian alchemists used advanced methods like distillation, crystallization, and sublimation, along with specially designed tools such as the dola yantra and khalva yantra. These practices show a deep understanding of chemistry and spiritual philosophy, blending scientific technique with holistic thinking.

### **Metallurgy and Materials Science**

India made remarkable progress in metallurgy in ancient times. Skilled methods were used to extract and work with metals like iron, copper, zinc, and gold. A great example is the Iron Pillar in Delhi, built around 400 CE, which has stood for over 1,600 years without rusting. This was possible because of its special composition, which includes high phosphorus and lacks sulfur and manganese. Another major achievement was the creation of Wootz steel, a strong and sharp high-carbon steel. It was highly valued and traded with the Middle East, where it was used to make the well-known Damascus swords. India also developed a way to extract zinc through distillation at the Zawar mines in Rajasthan in the 12th century. This method was used on a large scale, centuries before Europe discovered it. These practices show a deep understanding of chemical ideas like heating control, alloying, and chemical reactions, which are still important in modern material science.

### **Cosmetics, Perfumery, and Dyes**

Ancient Indian chemistry also found

expression in the fields of personal care, perfumery, and textile dyeing. The preparation of attars (natural perfumes) from flowers, herbs, and spices involved steam distillation, solvent extraction, and fermentation. Classical texts such as Brihat Samhita detail the preparation of deodorants, skin ointments, hair dyes, and face masks using chemical processes. Likewise, the dyeing of fabrics using indigo, turmeric, madder, and lac reflected a sophisticated understanding of natural dyes, fixatives, and pH-sensitive colour changes. These traditions were not merely cosmetic, they were rooted in health, ritual purity, and ecological harmony. The knowledge of organic substances and their interactions laid the foundation for early organic chemistry in India.

### **Environmental and Agricultural Chemistry**

Indian agricultural traditions employed a deep understanding of chemistry in soil management, pest control, and crop nutrition. Natural fertilizers like jeevamrut, panchagavya, and compost were used based on their chemical decomposition and microbial action. Ancient texts like Vrikshayurveda discuss soil testing, plant nutrition, and water management in detail. Ash, lime, cow urine, and herbal decoctions were used as pesticides and growth promoters. Water purification techniques using charcoal, sand, and herbs like Tulsi reflect early environmental chemistry practices. These sustainable methods align with the principles of green chemistry and are gaining renewed attention in the context of climate change and organic farming.

### **Legacy and Academic Excellence**

The legacy of Indian chemistry is not just technical; it is academic and institutional. Ancient universities like Takshashila and Nalanda offered instruction in medicine, metallurgy, and chemistry.

Texts were written systematically, and knowledge was transmitted through oral and written traditions, often in poetic form to aid memorization. The influence of Indian chemical thought extended beyond borders, impacting Islamic and later European alchemical traditions. Scholars like "Nagarjuna", "Sushruta", and "Charaka" exemplified the fusion of scientific inquiry with philosophical depth. Today, this legacy is being rediscovered and validated through interdisciplinary research. The National Education Policy (NEP) 2020 encourages the integration of IKS into mainstream education, creating opportunities to revisit, revise, and revive India's scientific heritage.

### Conclusion

Indian chemistry knowledge is a vital jewel in the crown of the Indian Knowledge Systems. It represents a holistic, empirical, and innovative tradition that spanned medicine, alchemy, metallurgy, and environmental science. Far from being outdated, these practices offer sustainable, nature-friendly, and scientifically sound models that can complement modern scientific pursuits. Recognizing, researching, and integrating this legacy is essential for nurturing academic excellence and fostering pride in our intellectual heritage. As India strides forward in science and technology, the wisdom of its past can serve as a guiding light for a more integrated and sustainable future.

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## 2

## Cyber Security in the Digital Era : Emerging Threats, Challenges and Strategic Responses

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### ABSTRACT

*Cybersecurity has become a critical concern in the digital era due to the rapid expansion of information technologies, increased internet penetration, and growing dependence on digital platforms. The widespread adoption of advanced technologies such as cloud computing, artificial intelligence, the Internet of Things, and mobile networks has significantly transformed how data is generated, processed, and stored. While these technologies offer efficiency and innovation, they also expose individuals, organizations, and governments to complex and evolving cyber threats. This paper examines the concept of cybersecurity, identifies major emerging cyber threats, and analyzes the challenges faced in securing digital systems. It further discusses strategic responses, including technological, human, and policy-driven measures, to address these challenges effectively. The study is conceptual in nature and relies on secondary sources. It aims to provide a comprehensive understanding of contemporary cybersecurity issues and highlights the need for continuous improvement in security practices to ensure resilience in the digital environment.*

**Keywords :** Cyber Security, Digital Era, Cyber Threats, Malware, Phishing, Cloud Security, IoT, Artificial Intelligence

### Introduction

As digitalization becomes ubiquitous across industries, society, and critical infrastructure, cybersecurity has transitioned from a purely technical concern to a strategic priority for individuals, enterprises, and governments. Secure digital systems are essential for preserving privacy, trust, and operational integrity in domains including healthcare, finance, national defense, and commerce. However, cyber threats are growing

in scale, sophistication, and frequency, propelled by emerging technologies and the global interconnectedness of systems. The rapid growth of digital technology has changed how data is shared, stored, and used, while also increasing cyber threats. With the proliferation of emerging technologies such as artificial intelligence, cloud computing, the Internet of Things (IoT), and quantum computing, the threat landscape is rapidly evolving.

## Conceptual Framework of Cybersecurity in the Digital Era

**Digital Technologies** (AI, Cloud Computing, IoT, Big Data)

**Emerging Cyber Threats** (Malware, Phishing, Ransomware, Data Breaches)

**Cybersecurity Challenges** (Technical gaps, Human errors, Legal and ethical issues)

**Strategic Responses** (Security technologies, Training & awareness, Policies & regulations)

**Outcomes** (Data protection, Trust, Business continuity, National security)

The framework illustrates how the adoption of digital technologies leads to new cyber threats, which create security challenges. These challenges require strategic responses to achieve secure and resilient digital systems.

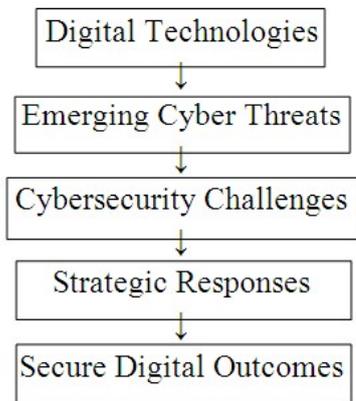


Figure 1: Conceptual Framework of Cybersecurity in the Digital Era

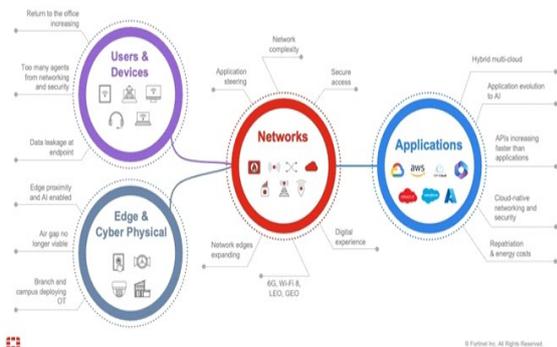


Figure 2: Challenges in Cybersecurity

## Core Challenges in Cybersecurity

- A. **Rapid Technological Advancement** New technologies, such as IoT, cloud computing, and AI, introduce unknown weaknesses.
- B. **Lack of Awareness and Training.** Many users become victims of attacks due to their poor understanding of security management best practices.
- C. **Insider Threats:** Employees with access to critical systems can intentionally or mistakenly undermine security.
- D. **Evolving Threat Landscape** Attackers constantly adapt their tactics and reduce the effectiveness of traditional security solutions.

## Major Cyber Security Threats

### 1 Malware

Malware includes viruses, worms, trojans, spyware, and ransomware, all of which are designed to damage systems or steal sensitive information. Ransomware attacks have increased significantly, resulting in substantial financial and operational losses for organizations.

### 2 Phishing and Social Engineering

Phishing attacks manipulate users into revealing confidential information such as passwords and banking details. These attacks exploit human vulnerabilities rather than technical flaws, making user awareness a critical defence mechanism.

### 3 Advanced Persistent Threats (APTs)

APTs are long-term, targeted cyberattacks often carried out by skilled attackers. They aim to gain unauthorized access to systems and remain undetected while extracting sensitive data.

### 4 Cloud and IoT Security Threats

The adoption of cloud services and IoT devices introduces new security challenges,

including misconfigured cloud environments, insecure devices, and a lack of standard security protocols.

### **Emerging Challenges in Cyber Security**

Despite technological advancements, several challenges hinder effective cybersecurity implementation. These include limited cybersecurity awareness among users, a shortage of skilled professionals, rapid evolution of attack techniques, and complex regulatory and compliance requirements. Additionally, securing large-scale, distributed digital infrastructures remains a significant challenge.

#### **1 AI-Enhanced Attacks and Defense**

AI is a double-edged sword: it empowers defenders with better threat detection, pattern recognition, and automation, but adversaries also harness AI to craft adaptive malware and realistic phishing simulations.

#### **2 IoT & Edge Computing Vulnerabilities**

The proliferation of IoT and edge devices increases the number of entry points for attackers, many of which lack robust security controls.

#### **3 Quantum Computing Threats**

Although still emerging, quantum computing has the potential to break traditional encryption, necessitating quantum-resistant cryptography.

#### **4 Zero Trust & Decentralized Security Models**

Security frameworks like Zero Trust, which assume no implicit trust for devices or users, are gaining prominence as traditional perimeter defences become inadequate.

#### **5 Privacy & Ethical Considerations**

Data privacy regulations and ethical use of data, especially in AI systems, present ongoing legal and social challenges requiring integration into cybersecurity strategy.

### **Solutions and Future Directions**

#### **1 Strengthening Human Factors**

Training users and practitioners in cybersecurity best practices remains vital to reducing exploits through human error.

#### **2 Advanced Defense Technologies**

- 1 AI-based anomaly detection
- 2 Blockchain for data integrity
- 3 Quantum-safe cryptography frameworks

#### **3 Regulatory and Policy Reforms**

Updating national and international cybersecurity policies to handle AI, data privacy, and cross-border cybercrime cooperation is essential.

#### **4 Public-Private Collaboration**

Cooperation between governments, industry, and academia enhances threat intelligence sharing and incident response capabilities.

### **CONCLUSION**

Cybersecurity continues to evolve alongside technological advancements and increasing digital dependence. The growing sophistication of cyber threats highlights the need for proactive, multi-layered security approaches that combine advanced technologies, effective policies, and collaborative efforts. Future developments such as artificial intelligence, blockchain-based security, and improved user awareness will play a vital role in strengthening cyber resilience. As a result, cybersecurity remains a critical pillar of the digital age, essential for protecting data and ensuring the reliability of digital infrastructure across all sectors.

#### **Limitations and Future Scope**

The present study is conceptual and based on secondary data sources. It does not include empirical analysis or sector-specific case studies. Future research may focus on quantitative assessment of cyber risks, industry-wise cybersecurity practices, or comparative studies across countries.

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## El Niño and Its Impact on the Environment

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### ABSTRACT

*El Niño is a natural climate phenomenon characterized by anomalous warming of sea surface temperatures in the central and eastern equatorial Pacific Ocean. It is a major component of the El Niño–Southern Oscillation (ENSO) and influences global weather, ecosystems, and human societies. This paper reviews the environmental mechanisms and impacts of El Niño, including changes in precipitation, temperature, marine and terrestrial ecosystems, and socioeconomic consequences.*

### 1. Introduction

El Niño, meaning “the little boy” in Spanish, refers to the warm phase of the El Niño–Southern Oscillation, occurring irregularly every 2–7 years and lasting several months to over a year. It is identified when sea surface temperatures in the eastern Pacific exceed average conditions by at least 0.5 °C for consecutive overlapping seasons. El Niño significantly alters atmospheric circulation and global climate patterns.

Encyclopedia Britannica

### 2. Mechanisms of El Niño

El Niño arises from weakening or reversal of Pacific trade winds, which otherwise push warm surface water westward. During El Niño, these winds diminish, allowing warm water to accumulate in the central and eastern Pacific. This disrupts normal upwelling of nutrient-rich deep water, leading to significant climatic and ecological shifts.

### 3. Environmental Impacts

#### 3.1 Changes in Weather Patterns

El Niño alters global rainfall and temperature patterns. Some regions experience heavier rainfall and flooding (e.g., parts of South America), while others undergo droughts (e.g.,

Southeast Asia, Australia). In India, El Niño often weakens monsoon rains and increases heatwave frequency, impacting water availability and agriculture.

#### 3.2 Extreme Temperatures

The elevated sea surface temperatures during El Niño contribute to higher global average surface temperatures and more frequent heatwaves. This can intensify heat-related stress on human and animal populations.

#### 3.3 Marine Ecosystem Disruptions

Warmer ocean waters reduce the upwelling of nutrients vital for phytoplankton, the base of marine food webs. As a result: 1. Fish populations decline or shift location. 2. Coral bleaching events increase. 3. Marine predators and seabirds suffer from reduced food availability.

#### 3.4 Terrestrial Ecosystem Effects

Altered precipitation can cause drought-induced wildfires, habitat loss, and plant stress. Excessive rainfall and flooding elsewhere can erode soils and disrupt ecosystem stability. Extended drought has been linked with increased mortality of tree seedlings in tropical forests.

## 4. Socioeconomic and Environmental Consequences

### 4.1 Agriculture and Food Security

Crop production is highly sensitive to changes in rainfall and temperature. Droughts can lead to crop failures, reduced yields, and food insecurity, especially in tropical and subtropical countries.

### 4.2 Public Health

Environmental changes due to El Niño can increase the prevalence of vector-borne and waterborne diseases. Extreme heat and altered rainfall patterns also exacerbate respiratory diseases and heat-related illnesses.

### 4.3 Economic Impacts

El Niño's disruption of agriculture, fisheries, and infrastructure often incurs significant economic losses. Historic events like the 1997–98 El Niño caused widespread flooding, drought, and damage worth billions of dollars globally.

## 5. Case Study: 1997–98 El Niño

The 1997–98 El Niño was one of the strongest in recorded history. It altered atmospheric and oceanic patterns worldwide, resulting in: 1. Significant flooding in South America. 2. Severe droughts and wildfires in Southeast Asia. 3. Collapse of fishery stocks due to changes in sea temperatures. 4. Global temperature anomalies that made 1998 one of the warmest years at the time.

## 6. Long-Term Environmental Considerations

### 6.1 Interaction with Climate Change

While El Niño is a natural phenomenon, anthropogenic climate change could influence its frequency and intensity. Warmer oceans and altered atmospheric dynamics may amplify El Niño's environmental effects, making extreme weather events more common.

### 6.2 Ecosystem Resilience and Adaptation

Understanding how ecosystems respond to periodic El Niño disturbances is important for conservation and climate adaptation strategies, particularly for coral reefs, coastal fisheries, and drought-prone forests.

## 7. Conclusion

El Niño has far-reaching environmental impacts that extend beyond temporary weather

changes. Its effects include altered precipitation, temperature extremes, marine and terrestrial ecosystem disruptions, and significant socioeconomic consequences. Enhancing monitoring, early warning systems, and climate adaptation strategies remains crucial to mitigating its impacts on both human and natural systems.

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# Environmental Degradation and Climate Change in Maharashtra (2024–25): Assessment, Spatial Patterns, and Policy Pathways

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## ABSTRACT

*Environmental degradation and climate change pose growing threats to ecological systems, public health, and socio-economic stability in Maharashtra. India's second most populous and highly urbanized state. This paper integrates the latest statistics (2024–25), spatial analysis (GIS), and policy reviews to map key environmental stressors: air and water pollution, forest fire incidence, land degradation, river contamination, and climate vulnerability. Using secondary data from government reports, news assessments, and hazard maps, we identify spatial patterns and offer targeted mitigation and resilience strategies.*

**Keywords:** Maharashtra, environmental degradation, air quality, water pollution, GIS, climate change, resilience.

### 1. Introduction

Maharashtra's diverse geography from the Konkan coast to the Deccan plateau makes it especially vulnerable to environmental degradation and climate change. Rapid urbanization, industrial growth, and agricultural expansion have intensified adverse impacts, while climate change amplifies extreme events including heatwaves, erratic monsoons, droughts, and forest fires. Understanding the spatial distribution and intensity of environmental stressors is essential for sustainable regional planning.

According to the Maharashtra State Disaster Management Authority (SDMA), the state faces multi-hazard risks including floods, droughts, landslides, cyclones, and heatwaves, with different

regions exhibiting varying susceptibility based on topography and climatic conditions. (MSDMA)

### 2. Study Area:

The present study focuses on the state of Maharashtra, located in the western part of India between 15°40' N to 22°00' N latitudes and 72°36' E to 80°54' E longitudes. It is the second-largest state in India by area, covering about 307,713 km<sup>2</sup>, and supports a population of over 125 million (Census of India). Maharashtra shares boundaries with Gujarat and Madhya Pradesh to the north, Chhattisgarh to the east, Telangana and Karnataka to the south, and the Arabian Sea along its western margin.

Physiographically, the state is highly diverse and can be broadly divided into three major regions:

- (i) The Konkan Coastal Plain,
- (ii) The Western Ghats (Sahyadri Range), and
- (iii) The Deccan Plateau comprising Marathwada

and Vidarbha. The Konkan is narrow, humid, and prone to flooding and cyclones, while the Western Ghats are ecologically sensitive and act as a major watershed. The Deccan Plateau is semi-arid with recurrent droughts and agrarian stress.

Maharashtra experiences a tropical monsoon climate, with most rainfall occurring during the southwest monsoon (June–September). Rainfall varies sharply from over 3,000 mm in the Western Ghats to less than 600 mm in parts of Marathwada and Vidarbha, leading to pronounced spatial contrasts in water availability and land use. Summers are hot, with frequent heatwaves affecting urban and rural areas alike.

The state is one of India's most urbanised and industrialised regions, hosting major metropolitan centres such as Mumbai, Pune, Nagpur, Nashik, and Aurangabad (Chhatrapati Sambhajinagar). Rapid urban growth, industrial clusters (MIDCs), transport corridors, and agricultural intensification have placed enormous pressure on air, water, land, and forest resources. Rivers such as the Godavari, Krishna, Tapi, Wardha, Wainganga, Ulhas, and Mithi form important drainage systems but are increasingly affected by pollution and over-extraction.

Because of its geographical diversity, climatic variability, and developmental pressures, Maharashtra provides an ideal spatial framework for examining environmental degradation and climate change impacts using GIS-based analysis. The study area allows the identification of regional contrasts, pollution hotspots, and climate-vulnerable zones necessary for sustainable planning and policy formulation.

### 3. Objectives of the Study:

1. To assess the extent and nature of environmental degradation and climate change impacts in Maharashtra (2024–25) with special reference to air, water,

land, forest, and urban ecosystems.

2. To suggest sustainable policy implications pathways, planning strategies for mitigating environmental degradation and enhancing climate resilience in Maharashtra.

### 4. Methodology

This research adopts a **mixed secondary data approach**, integrating:

1. Official air quality and river pollution data from the CPCB and MPCB through recent reports.
2. Hazard and vulnerability maps from the Maharashtra SDMA.
3. Spatial analysis using GIS layers for pollution hotspots, industrial clusters, river basins, and forest fire regions.
4. Peer-reviewed and verified news data for latest (2024–25) statistics.

### 5. Results and Discussion

#### 5.1 Air Pollution Patterns (2024–25)

##### Annual AQI & PM Levels:

· Mumbai's annual average PM<sub>10</sub> concentration is ~35 µg/m<sup>3</sup> and PM<sub>2.5</sub> ~91 µg/m<sup>3</sup>, improving ~12% over five years but still above national safe norms. (The Times of India)

· Several cities (Malegaon: PM<sub>10</sub> ~51 µg/m<sup>3</sup>; Jalna: ~50 µg/m<sup>3</sup>; Jalgaon: ~48 µg/m<sup>3</sup>) exceed safe limits and illustrate spatial variability across the state. (The Times of India)

· Thane recorded hazardous AQI peaks (~217-221) tied to infrastructure development, traffic emissions, and waste burning. (The Times of India)

**Analysis:** Industrial zones (MIDCs), high traffic corridors, and construction hotspots correlate with elevated PM concentrations in PCA/GIS overlays. These spatial patterns suggest targeted air quality interventions in urban and peri-urban areas.

## 5.2 Water Resources and Pollution

### Polluted River Stretches (2025):

- Maharashtra leads India with **54 polluted river stretches**, highest nationwide. (Drishti IAS)
- Rivers like Mithi, Dahisar, Poisar, Oshiwara, Ulhas in the Mumbai Metropolitan Region show high BOD levels (>20 mg/L), well above the safe 3 mg/L threshold. (Drishti IAS)

### Case Studies:

- Nagpur's Nag River ranks among heavily polluted water bodies due to untreated sewage and industrial effluent, severely affecting aquatic biodiversity. (The Districts Project)
- Kolhapur's Panchganga River suffers from sewage and solid waste build-up, impacting local fisheries and water usability. (The Districts Project)

### GIS Mapping Insight:

Overlay of polluted rivers with urban/industrial nodes shows strong correlation between urban effluent discharge points and low-water-quality zones.

## 5.3 Forest Fires and Land Degradation

### Fire Incidence (2025):

- The state recorded **8,091 forest fire cases (Jan-Sept 2025), a 56% increase over 2024**. Gadchiroli, Nagpur, Nashik, and Thane show the highest incidence densities. (The Times of India)

### Spatial Pattern:

GIS hotspot analyses reveal clustering of fires in the Eastern Ghats and dense forest belts, pointing to dry spells, biomass build-up, and human activities as major drivers.

### Land Degradation:

- Nagpur city lost ~431 ha of tree cover between 2001–23, releasing ~12.1 kt of CO<sub>2</sub>. (The Districts Project)
- Kolhapur saw forest cover loss and significant soil erosion due to deforestation and fires. (The Districts Project)

## 6. Climate Change Vulnerability and Extreme Events

Maharashtra's hazard risk matrix shows susceptibility to multiple climate-induced extremes: droughts, heatwaves, landslides (Western Ghats), coastal storms and flooding (Konkan), and urban flooding due to poor drainage. (MSDMA)

### Heat Stress:

Urban heat islands in Mumbai and Pune intensify thermal stress, exacerbated by reduced green cover and increased built-up surfaces.

### Climate Models & Projections:

Recent projections suggest monsoon variability and heatwave frequency will increase by mid-century, aggravating public health burdens and water scarcity.

**Table 1: Key Environmental Indicators in Maharashtra (2024–25)**

Indicator	Value (2024–25)	Source
Annual average PM <sub>2.5</sub> – Mumbai	35 µg/m <sup>3</sup>	CPCB/MPCB report (The Times of India)
Polluted river stretches (statewide)	54 stretches	CPCB/National report (Drishti IAS)
Forest fire cases (2025 Jan–Sept)	8,091	News data (The Times of India)
Loss of tree cover – Nagpur (2001–23)	431 ha	District environmental data (The Districts Project)
Peak AQI – Thane (2025)	217	MPCB reports (The Times of India)

Table 1 presents a snapshot of major environmental stress indicators in Maharashtra during 2024–25, highlighting the growing interaction between urbanization, resource degradation, and climate variability.

The annual average PM<sub>10</sub> concentration in Mumbai (35  $\mu\text{g}/\text{m}^3$ ) indicates persistent air quality stress. Although there has been some improvement in recent years, the value remains well above the WHO guideline (5  $\mu\text{g}/\text{m}^3$ ) and also exceeds India's safe annual standard. This reflects the continued influence of vehicular emissions, construction activity, industrial pollution, and reduced urban green cover. As Mumbai is the economic hub of the state, such pollution levels pose serious public health risks and reduce urban livability.

The presence of 54 polluted river stretches across Maharashtra demonstrates the severity of water quality degradation. Being the highest among Indian states, this figure points to widespread contamination from untreated sewage, industrial effluents, and agricultural runoff. Rivers in metropolitan and industrial belts, such as the Mithi, Ulhas, Godavari tributaries, and Panchganga, show elevated biochemical oxygen demand (BOD) levels, threatening aquatic ecosystems, drinking water safety, and irrigation sustainability.

The record of 8,091 forest fire cases between January and September 2025 highlights increasing climate-linked ecological vulnerability. The sharp rise in fire incidents reflects prolonged dry spells, higher temperatures, human interference, and accumulation of combustible biomass. Fire-prone districts in Vidarbha and the Western Ghats indicate that forest ecosystems are becoming increasingly unstable, affecting biodiversity, carbon sequestration, and rural livelihoods.

The loss of 431 hectares of tree cover in

Nagpur (2001–23) signals long-term land-use change and urban expansion impacts. Tree cover decline contributes to rising urban heat island effects, loss of carbon sinks, reduced air filtration capacity, and greater climate sensitivity of cities. This also reinforces the connection between urban growth and environmental degradation.

The peak AQI value of 217 in Thane (2025) falls within the 'Poor to Very Poor' category, indicating severe episodic air pollution events. Such peaks are usually associated with construction dust, traffic congestion, waste burning, and industrial emissions. High AQI episodes increase respiratory and cardiovascular risks, especially among children and elderly populations, and illustrate the uneven spatial distribution of air pollution across the Mumbai Metropolitan Region.

#### **Overall Inference:**

Collectively, the indicators reveal that Maharashtra's environmental degradation is multi-dimensional and spatially uneven, affecting air, water, forests, and land simultaneously. Urban and industrial regions emerge as major hotspots, while climate change intensifies risks such as forest fires and heat stress. The table underscores the urgency of integrating pollution control, climate adaptation, and GIS-based planning into Maharashtra's development strategy to achieve sustainable and resilient growth.

#### **7. Policy Implications and Pathways:**

##### **7.1 Strengthening Pollution Control:**

- Expand the National Clean Air Programme (NCAP) and ensure stricter enforcement of emissions norms.
- Enhance sewage treatment infrastructure to reduce untreated discharge into rivers.

##### **7.2 Climate Resilience and Adaptation**

- Integrate climate risk data into urban-regional plans, focusing on early warning systems

for heatwaves and floods.

- Promote afforestation and green belts in urban fringes to reduce heat island effects.

### 7.3 Community & Technology Initiatives

- Leverage GIS and remote sensing for real-time monitoring of fire risks, air quality, and water quality.
- Engage local communities in participatory monitoring and river rejuvenation efforts.

### 7. Conclusion:

Maharashtra's environmental degradation and climate challenges are spatially uneven but intensifying. The combination of urban pressures, industrialisation, and climate variability demands integrated responses that marry technology (GIS, remote sensing) with robust governance. Addressing these issues is essential for the state's sustainable development and long-term ecological resilience.

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## 5

## Network Security and Types of Attacks in Network

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### ABSTRACT

*The computer network technology is developing rapidly, and the development of internet technology is more quickly, people more aware of the importance of the network security. Network security is main issue of computing because many types of attacks are increasing day by day. Network security is the practice of protecting computer networks from unauthorized access, misuse, modification, or destruction. It ensures that sensitive data, systems, and applications remain safe while still allowing legitimate users and devices to access resources efficiently. When people ask, "What is network security?", the simplest answer is: it is the safeguard that keeps your digital communications, data, and resources protected from cybercriminals. Since networks are the backbone of modern IT environments, network security in cyber security plays a foundational role. Without it, organizations would be vulnerable to data breaches, malware infections, ransomware attacks, and insider threats.*

### 1. Introduction

Many people rely on the Internet for many of their professional, social and personal activities. But there are also people who attempt to damage our Internet-connected computers, violate our privacy and render inoperable the Internet services.

Given the frequency and variety of existing attacks as well as the threat of new and more destructive future attacks, network security has become a central topic in the field of computer networking. To fully understand network security meaning, think of your network as a virtual highway where information flows. Just like physical highways need traffic rules and checkpoints to prevent accidents or crime, networks need rules,

policies, and technologies to prevent security attacks in network security. Thus, network security meaning refers to the measures and techniques used to keep this digital highway safe from disruptions and intrusions. It combines hardware, software, processes, and human awareness to build layers of protection.

In short: Network security is the practice of defending the usability, reliability, integrity, and safety of your network and data.

### 2. Network security

Network security protects networks and the data they carry from unauthorized access, misuse, and cyberattacks. It ensures systems remain confidential, available, and trustworthy across all digital environments.

- Prevents unauthorized access and cyber threats
- Protects data integrity, confidentiality, and availability
- Uses layered security controls across devices, users, and systems
- Ensures safe communication and reliable network operations

### 1. Physical Network Security

Physical security prevents unauthorized individuals from physically accessing network hardware, servers, or devices.

- Uses access cards, biometrics, CCTV, and locked server rooms
- Protects routers, switches, cables, and data centers
- Prevents tampering, device theft, and hardware-level attacks

### 2. Technical Network Security

Technical security protects data as it is stored, processed, and transmitted across the network using software-based controls.

- Secures data in motion and at rest
- Blocks unauthorized access and malicious activities
- Includes firewalls, encryption, antivirus, and intrusion detection

### 3. Administrative Network Security

Administrative security defines policies, user permissions, and procedures that control how the network is accessed and managed.

- Manages authentication, authorization, and user roles
- Enforces security policies and access controls
- Ensures proper configuration, monitoring, and compliance[6]

### 3. Types of Attacks

**Malware:** - short for malicious software which is specifically designed to disrupt, damage,

or gain authorized access to a computer system. Much of the malware out there today is self-replicating: once it infects one host, from that host it seeks entry into other hosts over the Internet, and from the newly infected hosts, it seeks entry into yet more hosts. In this manner, self-replicating malware can spread exponentially fast.[5]

**Virus :-** A malware which requires some form of user's interaction to infect the user's device. The classic example is an e-mail attachment containing malicious executable code. If a user receives and opens such an attachment, the user inadvertently runs the malware on the device. [5]

**Worm :-** A malware which can enter a device without any explicit user interaction. For example, a user may be running a vulnerable network application to which an attacker can send malware. In some cases, without any user intervention, the application may accept the malware from the Internet and run it, creating a worm. [5]

**Botnet:** - A network of private computers infected with malicious software and controlled as a group without the owners' knowledge, e.g. to send spam. [5]

**DoS (Denial of Service)** - A DoS attack renders a network, host, or other pieces of infrastructure unusable by legitimate users. Most Internet DoS attacks fall into one of three categories :

- **Vulnerability attack:-** This involves sending a few well-crafted messages to a vulnerable application or operating system running on a targeted host. If the right sequence of packets is sent to a vulnerable application or operating system, the service can stop or, worse, the host can crash.

- **Bandwidth flooding:-** The attacker sends a deluge of packets to the targeted host—so many packets that the target's access link becomes clogged, preventing legitimate packets from reaching the server.

• **Connection flooding:-** The attacker establishes a large number of half-open or fully open TCP connections at the target host. The host can become so bogged down with these bogus connections that it stops accepting legitimate connections. [5]

**DDoS (Distributed DoS) :-** DDoS is a type of DOS attack where multiple compromised systems, are used to target a single system causing a Denial of Service (DoS) attack. DDoS attacks leveraging botnets with thousands of comprised hosts are a common occurrence today. DDoS attacks are much harder to detect and defend against than a DoS attack from a single host. [5]

**Packet sniffer:-** A passive receiver that records a copy of every packet that flies by is called a packet sniffer. By placing a passive receiver in the vicinity of the wireless transmitter, that receiver can obtain a copy of every packet that is transmitted! These packets can contain all kinds of sensitive information, including passwords, social security numbers, trade secrets, and private personal messages. some of the best defenses against packet sniffing involve cryptography. [5]

**IP Spoofing:-** The ability to inject packets into the Internet with a false source address is known as IP spoofing, and is but one of many ways in which one user can masquerade as another user. To solve this problem, we will need end-point authentication, that is, a mechanism that will allow us to determine with certainty if a message originates from where we think it does. [5]

**Man-in-the-Middle Attack -** As the name indicates, a man-in-the-middle attack occurs when someone between you and the person with whom you are communicating is actively monitoring, capturing, and controlling your communication transparently. For example, the attacker can re-route a data exchange.

**Compromised-Key Attack :-** A key is a secret

code or number necessary to interpret secured information. Although obtaining a key is a difficult and resource-intensive process for an attacker, it is possible. After an attacker obtains a key, that key is referred to as a compromised key. An attacker uses the compromised key to gain access to a secured communication without the sender or receiver being aware of the attack. [5]

**Phishing:-** The fraudulent practice of sending emails purporting to be from reputable companies in order to induce individuals to reveal personal information, such as passwords and credit card numbers. [5]

**DNS spoofing:-** Also referred to as DNS cache poisoning, is a form of computer security hacking in which corrupt Domain Name System data is introduced into the DNS resolver's cache, causing the name server to return an incorrect IP address.

**[5] Rootkit -** Rootkits are stealthy packages designed to benefit administrative rights and get the right of entry to a community tool. Once installed, hackers have complete and unrestricted get right of entry to the tool and can, therefore, execute any movement including spying on customers or stealing exclusive data with no hindrance. [5]

#### 4. Proposed System

1. SMS ALERT SYSTEM: Making the software module to give sms alert from unwanted link
2. FRAUD CALL PREVENTATION: To make the software module to prevent from fraud call
3. EMAIL PROTECTION :To make software module To alert from malicious emails.

#### 5. Conclusion

The security is the main problem in the mobile ad-hoc network. Use two-factor authentication. Do not click on attractive and

tempting links sent over a WhatsApp message or routine SMS. Don't store your passwords in your device. Don't disclose your password to anyone and keep changing it at regular intervals (2-4 months). Always have a lock screen on your smartphone, tablet, laptop, etc protected by a PIN or password. Do not keep your device open and unattended even for a minute, esp. in public places and your workplace.

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## The Trade Relation between India and Ukraine from : 2016-17 to 2020-21

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### ABSTRACT

*The five year import and export trade between India and Ukraine from 2016-17 to 2020-21. During this period, India received 11,379.12 from Ukraine. India exported 5 1945.84 million to Ukraine over a five-year period. India major exports to Ukraine are electrical and electronic equipment, plastics and related articles, oil seeds, elegiac fruits, grain, fruits, seeds and chemical products. India's major Import from Ukraine is Animal or vegetable fats and oils and there cleavage products, fertilizers, inorganic chemicals, plastic, wood and articles of wood charcoal, iron steel, nuclear reactors boiler machinery.*

**Keywords:** Trade, India, Ukraine, Export, Import  
**Introduction:**

India and Ukraine established diplomatic relations in January 1992. Ukraine is India's second largest trade partner after Russia in the former Soviet Union. In March, 1992 the 'Treaty on Friendship and Co-operation' was signed between India and Ukraine, providing a major boost to India-

Ukraine trade relations. On 24 February 2022 Russia Ukraine war is started. This war is affected global economy as well as Indian economy. So it is important to study the trade relationship between India and Ukraine.

**Discussion:**

Table no.1 shows the five year import and export trade between India and Ukraine from 2016-

**Table No. – 1**  
**India's Total Import and Export to Ukraine: (2016-17 to 2020-21)**

(Values in US\$)

Year	Indies Total Import From Ukraine	Indies Total Import	%Share	Growth in %	Indies Total Export For Ukraine	India's Total Export	%Share	%Growth	Balance of Payments
1	2	3	4= 2÷3*100	5	6	7	8= 6÷7*100	9	10 = 2 - 6
2016-17	2,481.47	384,357.03	0.6456	41.71	310.16	275,852.43	0.1124	19.7	-2,171.31
2017-18	2,355.97	465,580.99	0.506	-5.06	330.1	303,526.16	0.1088	6.43	-2,025.87
2018-19	2,341.03	514,078.42	0.4554	-0.63	390.8	330,078.09	0.1184	18.39	-1,950.23
2019-20	2,060.79	474,709.28	0.4341	- 11.97	463.81	313,361.04	0.148	18.68	-1,596.98
2020-21	2,139.86	394,435.88	0.5425	3.84	450.97	291,808.48	0.1545	-2.77	-1,688.89
<b>Total</b>	<b>11,379.12</b>	<b>2,233,161.60</b>	<b>0.5095</b>	<b>27.89</b>	<b>1945.84</b>	<b>1,514,626.20</b>	<b>0.1284</b>	<b>60.43</b>	<b>- 9,433.28</b>

17 to 2020-21. During this period, India received 11,379.12 from Ukraine. Millions of dollars have been imported. Ukraine accounted for 0.5095 percent of India's total imports in the last five years. During the period, import from Ukraine increased by 27.89 percent. But in the post-2016-17 period, the export from Ukraine is declining. In 2016-17, India imported 8 2481.47 million from Ukraine. That is down from 3 2139.86 million in 2020-21.

**Source:** Export Import Data Bank, Department of Commerce, Ministry of Commerce and Industry Dated: 19/3/2022.

India exported 5 1945.84 million to Ukraine over a five-year period from 2016-17 to 2020-21. Ukraine accounted for 0.1284 per cent of India's total exports during the five-year period. During this period, exports to Ukraine increased by 60.43 percent. Exports to Ukraine have been increasing

**Table No. - 2**  
**Top Ten Commodity of India's Export and Import to Ukraine: 2020-21**

Sr. No.	Name Of Commodity	Export Value	Growth %	Name Of Commodity	Import Value	%Growth
1	Pharmaceutical Products	173.68	43.88	Animal Or Vegetable Fats And Oils And Their Cleavage Products; Pre. Edible Fats; Animal Or Vegetable Waxex.	1,607.12	7.13
2	Electrical Machinery And Equipment And Parts Thereof; Sound Recorders And Reproducers, Television Image And Sound Recorders And Reproducers, And Parts.	20.85	-70.08	Fertilisers.	279.53	97.78
3	Plastic And Articles Thereof.	20.64	-8.27	Inorganic Chemicals; Organic Or Inorganic Compounds Of Precious Metals, Of Rare-Earth Metals, Or Radi. Elem. Or Of Isotopes.	66.83	-6.27
4	Oil Seeds And Olea. Fruits; Misc. Grains, Seeds And Fruit; Industrial Or Medicinal Plants; Straw And Fodder.	18.85	-19.71	Plastic And Articles Thereof.	29.49	-63.35
5	Vehicles Other Than Railway Or Tramway Rolling Stock, And Parts And Accessories Thereof.	16.61	22.84	Wood And Articles Of Wood; Wood Charcoal.	24.96	15.97
6	Organic Chemicals	15.96	31.95	Iron And Steel	24.01	-57.71
7	Miscellaneous Chemical Products.	14.88	-57.6	Nuclear Reactors, Boilers, Machinery And Mechanical Appliances; Parts Thereof.	23.81	0.52
8	Nuclear Reactors, Boilers, Machinery And Mechanical Appliances; Parts Thereof.	14.38	-15.32	Ores, Slag And Ash.	14.95	349.43
9	Cereals.	14.04	51.62	Optical, Photographic Cinematographic Measuring, Checking Precision, Medical Or Surgical Inst. And Apparatus Parts And Accessories Thereof;	10.37	427.2
10	Ceramic Products.	12.73	62.6	Residues And Waste From The Food Industries; Prepared Animal Foder.	9.62	-49.49
	Total Of Top Ten Commodity Export	322.62	69.55	Total Of Top Ten Commodity Import	<b>2090.69</b>	<b>97.74</b>
	India's Total Export To Ukraine	<b>450.97</b>	<b>-2.77</b>	India's Total Import To Ukraine	<b>2,139.86</b>	<b>3.84</b>
	India's Total Export	<b>2,91,808.48</b>	<b>0.1545</b>	India's Total Import	<b>3,94,435.88</b>	<b>0.5425</b>

since 2016-17. In 2016-17, India exported 31 310.16 million to Ukraine. That's up from 50 450.97 million in 2020-21.

From 2016-17 to 2020-21, India imported 311379.12 million from Ukraine and exported 1941945.84 million to Ukraine. This means that India's balance of payments with Ukraine over the next five years is 151596.98 million.

Table no.1 above shows imports and exports between India and Ukraine. The table shows that India's screen exports are increasing while its imports from Ukraine are declining.

India major exports to Ukraine are electrical and electronic equipment, plastics and related articles, oil seeds, elegiac fruits, grain, fruits, seeds and chemical products. India's total exports to Ukraine in 2020-21 were 4 450.97 million, of which Pharmaceutical Products the highest was 3 173.68 million. Then electrical machinery and equipment and parts trade of sound recorder and reproductions television image and sound recorder and parts exported 20.85 million. The top ten exports from India are valued at 2 322.62 million. In other words, 71.53 percent of export from India to Ukraine go to the above ten items.

India's major Import from Ukraine is Animal or vegetable fats and oils and there cleavage products, fertilizers, inorganic chemicals, plastic, wood and articles of wood charcoal, iron steel, nuclear reactors boiler machinery. 2020 - 21 India imported total 2139.86 billionDollar's from Ukraine, of which the Ten most imported goods were valued at 20 2090.69 million dollars. In 2020-21, India imported the most Animal or vegetable fats and oils and there cleavage products from Ukraine. It is valued at 60 1.607 million.

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## Digital Payment Systems: Advantages and Disadvantages

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### ABSTRACT

*Digital payment technology has become an important part of human life in modern period. The globalization and digitalization have entered the daily activities of the people, where almost all of the citizens today are using technology and digital. The development of information technology has been moving so fast that almost all of the communities' have been taken part in the advantage of these developments of digital era. That is the digital payment applications which is mostly used by the customers because of the benefits provided by the application and also the application can also be trusted, that is why the most popular digital payment application is used by smartphone users currently. However, this technology presents certain risks to users, requiring caution during its use. Therefore, this technology also has some disadvantages. This research paper reviews the advantages and disadvantages of digital payments.*

**Keywords.** History of Digital Payments advantages and disadvantages of Digital Payment Systems.

### History of Digital Payments.-

In ancient times, cash was the primary medium of exchange because it was easy to use and universally accepted. However, it involved the need for physical handling and carried the risk of theft. Therefore, humans later invented checks as a means of transaction. This allowed individuals to complete transactions by transferring money through checks via banks, without the need for the physical exchange of cash. This provided security in transactions, but the process was slow. As a solution, credit cards were invented in the 1950s. Credit cards not only increased the purchasing power of consumers but also captured a large market by providing businesses with a secure way to accept payments. After credit cards, debit cards arrived in the 1970s. Debit cards increased the speed of transactions due to the easy availability

of funds and eliminated the need to handle cash. Subsequently, the convenience of prepaid cards became available, giving customers the freedom to conduct transactions without a credit check or a bank account.

In the 2000s, with the rise of the internet and mobile technology, payments shifted from plastic cards to smartphones. Companies like PayPal emerged, providing customers with digital wallets directly linked to their bank accounts or cards, making online shopping easier and more secure. Mobile wallets like Apple Pay, Google Pay, and Samsung Pay followed, allowing customers to make contactless payments through their phones.

### Introduction:

The digital payment revolution represents a transformative journey within the broader context of economic landscape. In the distant past,

traditional banking methods held sway, often entailing cumbersome processes and lengthy transaction times. However, with the advent of digital payments witnessed a paradigm shift that aligned with the country's aspirations for a more efficient and technologically advanced financial sector.

This introduction of digital payments was not merely a technological upgrade; it was a catalyst for financial inclusion, empowerment, and economic growth. As the nation embraced digital platforms, a ripple effect permeated various sectors, reaching corporate organizations, entrepreneurs, fitness, and business executive's alike. This sets the stage for a deeper exploration of the digital payment landscape where innovative platforms and forward-thinking enterprises have played a crucial role in shaping the narrative of financial evolution. The journey from traditional methods to the digital frontier is not just a local phenomenon but a testament embrace of the future of finance.

#### **Definition.-**

Digital payment is the electronic payment of money in place of cash. It uses technology through digital devices such as a phone, computer, or card to make payments safe and easy

#### **Advantages of Digital Payment Systems.-**

The digital payment system has emerged as a transformative force, bringing numerous benefits to businesses worldwide. These benefits positively impact businesses across various sectors and geographical boundaries. The multifaceted advantages associated with digital payments can be reviewed as follows.

##### **1) Efficiency and Speed.-**

One of the primary advantages of the digital payment system is the unparalleled efficiency it introduces to financial transactions. Unlike traditional methods that involve manual processing and delays, digital payments enable swift and real-time transactions. This speed is a game-changer for businesses, ensuring that transactions, whether local or international, occur promptly, fostering a dynamic and responsive financial environment.

##### **2) Easy to Design.-**

As we know, digital systems are two state

switching circuits that have only two voltage levels namely, HIGH and LOW. Hence, it is easier to design a digital system. In the case of digital systems, the knowledge of intermediate values of voltages are not important, but the lower and upper limits in which they fall are important. Therefore, digital circuits are less complex to design and implement.

##### **3) Easy Information Storage.-**

In digital systems, data and information are represented in the form of binary digits, i.e., 0s and 1s. There are several types of magnetic, optical, and semiconductor memories available to store digital data. It is very easy to store digital information in a digital storage device like pen drive that provides a compact and efficient method to store data for long periods as compared to analog storage devices.

##### **4) Enhanced security.-**

Electronic payments are safer than carrying cash. Features like encryption and fraud detection keep your money and personal info secure.

##### **5) Cost efficiency.-**

Managing and processing paper payments can be expensive. Electronic systems cut down these costs significantly, saving businesses money

##### **6) Multiple Payment Methods.-**

There are plenty of digital payment methods to choose from. You can pay via net banking, online payment apps, digital wallets, or even through your debit and credit cards. You can choose a payment method according to your convenience.

##### **7) International Payments.-**

Digital payments have made international payments simple and hassle-free. Many online payment apps such as Shriram One allow you to make payments outside of India with ease. Because of these new-age payment methods, businesses can serve international customers and individuals can make payments to their friends and family abroad.

##### **8) Facilitate Sales Growth for Businesses.-**

If you run a business, accepting customer payments through digital modes can improve your sales. Imagine that a customer does not have enough cash to pay for the groceries they got from

your shop. If you don't accept digital payments, they will surely walk to another shop that does. That's why the use of QR codes is on the rise in India. There was a 79.5% growth in the acceptance of the UPI QR code in 2022 than in 2021 because of these advantages.

#### 9) Customer satisfaction.-

Offering multiple electronic payment options like credit/debit cards, UPI payments, payment by links or points, etc. can improve customer experience, making them more likely to return.

#### Disadvantages of Digital Payment Systems.-

The digital payment system has brought about significant changes in the financial sector. While digital systems offer many advantages, it is crucial to study their potential disadvantages and their impact on businesses, as these factors play a significant role in their design and usage. Therefore, this section discusses the challenges associated with digital payments and the disadvantages that negatively affect all types of businesses. These disadvantages are as follows.

#### 1) Risk of Fraud.-

This is the first concern that comes to mind when we think of risks related to digital payments. And the news about cyber fraud does not make it easier. Most online payment methods use state-of-the-art payment security features, but scammers have come up with ways to surpass some of them. There are many types of digital fraud such as phishing scams, ransom ware attacks, and information stealing that you should be aware of.

#### 2) Security Concerns.-

One of the primary disadvantages of digital payments revolves around security issues. Businesses and consumers alike face the constant threat of cyberattacks, including phishing, hacking, and data breaches. This vulnerability can lead to unauthorized access to sensitive financial information, posing a significant risk to businesses and eroding customer trust.

#### 3) Digital Divide.-

The digital payment divide, where some segments of the population have limited access to digital technologies, can negatively impact

businesses targeting diverse customer demographics. Those without smartphones, internet access, or digital literacy may be excluded from the benefits of digital payments, affecting the reach and potential customer base for businesses.

#### 4) Transaction Limits.-

Digital payments are convenient, but banks often set up limitations on them. Some banks prohibit transactions above a certain limit in a single day. One has to keep these limits and restrictions in mind before initiating payments.

#### 5) Transaction Costs.-

While digital payments can be cost-effective in some aspects, businesses may still encounter transaction fees, particularly with certain payment gateways or international transactions. Cumulative transaction costs over time can impact the overall profitability of businesses, especially for small and medium enterprises (SMEs) operating on thin profit margins.

#### 6) Dependence on Technology.-

The reliance on technology for digital payments exposes businesses to the risk of disruptions. Technical glitches, server downtimes, or system failures can temporarily halt transactions, leading to potential financial losses for businesses and inconvenience for customers.

#### 7) Dependency on Internet.-

You cannot use digital payment methods without having a good internet connection. For instance, if you are travelling to a remote area with no mobile network or internet connection, these payment methods are of no use to you.

#### 8) Identity Theft.-

Fraudsters may steal your financial information and use digital payment methods to impersonate you. They could purchase items using your credit card or transfer funds from your bank account to theirs using UPI apps. These identity theft scams are quite difficult to detect, so maintaining payment security becomes difficult.

#### 9) Loss of Cards.-

Some digital payments are completely paperless, but you should keep your debit and credit cards safe. If you lose your cards, they could easily be misused. Losing your card information is another

similar threat. To prevent these, banks have started implementing OTP verifications for online transactions.

#### **Conclusion.-**

Payments are the backbone of every economy, but how we pay for goods and services has evolved dramatically over the centuries. What started as a barter system has transformed into a sophisticated web of digital transactions, changing the way businesses and consumers interact. The digital revolution has dawned digital payments transcend being a mere technological convenience; they signify a profound paradigm shift in our approach to financial transactions and those who swiftly adapt are poised to forge a trail to financial success. Embracing this wave of digitization is not merely a choice; it is a strategic imperative for sustainable growth and resilience in an ever-evolving economic landscape.

As we stand at the crossroads of tradition and innovation, the call to action echoes louder than ever. Let businesses be pioneers in this transformative era, riding the digital wave to unprecedented heights of efficiency, connectivity, and financial prosperity. The opportunities abound, and the time to embrace the future is now. Due to high reliability, ease of integration, high security, etc. digital systems are being widely used in various fields like telecommunication, medical, science, research, etc. Digital systems however have some limitations like finite resolution, limited voltage levels and sampling rates, relatively slow speed, etc. These limitations have to be addressed while designing and implementation for better advancement in digital technologies.

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## Vocational Language Learning for Employability: A Policy Review of NEP 2020

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### ABSTRACT

*The present research paper examines the vocational dimension of language learning within the framework of India's National Education Policy (NEP) 2020, focusing on employability enhancement in higher education. In the present century language proficiency and communication competence have emerged as core employability indicators in global knowledge economy. Although India is a multilingual country and expanding higher education system, the employability of graduates remains low due to lack of proper skills, limited vocational base and inadequate professional communication training. NEP 2020 has focused on vocational courses for undergraduate studies that is shifting towards holistic, skill-based education, flexible curriculum design and also the integration of communication, language, and soft skills training. The research article offers a policy-focused examination of NEP 2020's aspects related to language education, assesses the employability disparity in India, studies the possible effects of vocational language training, and points out ongoing obstacles in execution. The research contends that although NEP 2020 provides a groundbreaking strategy for aligning language education with job market needs, its effectiveness hinges on institutional preparedness, educator training, collaborations with industries, multilingual teaching methods, and reforms in assessment. The study concludes that successful vocational language education can close the employability divide and enhance socio-economic mobility, if it is backed by strong policy implementation.*

**Keywords:** NEP 2020; vocational language training; employability; communication skills; higher education reform; multilingual education; skill development; English language proficiency.

### Introduction:

The relevance of language and communication skills as crucial employability tools has increased due to the ongoing change of global labor markets, which is being driven by technology breakthroughs, automation, service economies, and cross-border communication. Particularly

communication competency, that includes English proficiency, workplace communication, presenting ability, and writing skills, is one of the most sought-after qualities in employable graduates, according to studies and industry associations. Leveraging language skills for economic growth presents both benefits and challenges in India, a multilingual country with hundreds of linguistic identities and more than 22 scheduled languages.

As compared to other countries India still

has low employability indicators even though it has the second-largest network of higher education in the world. Most of the students in undergraduate classes to lack the fundamental communication and soft skills needed for professional positions, particularly in industries like IT/ITES, tourism, healthcare, business processing, and related services, according to a number of surveys carried out by the National Skills Development Corporation (NSDC) and private employability platforms. However, the employability gap is a result of deficiencies in language competency, job preparedness, and exposure to occupational communication situations rather than only a technical skills issue.

India still has poor employability indicators even though it has the second-largest higher education network in the world. According to a number of surveys by the National Skills Development Corporation (NSDC) and private employability platforms, a sizable portion of graduates do not possess the fundamental communication and soft skills needed for professional positions, particularly in industries like IT/ITES, tourism, healthcare, business processing, and related services. The employability gap is a result of deficiencies in language skills, workplace preparedness, and exposure to vocational communication contexts rather than just technical skills.

Through significant changes to higher education, skill development, and vocationalization, the National Education Policy (NEP) 2020 aims to address this systemic problem. The policy places particular emphasis on competency-based learning, flexible curricula, credit-based vocational courses, bilingual instruction, and the integration of soft skills and communication training at different educational levels. Vocational language learning, which is defined as language instruction that is directly related to business and professional needs, has gained strategic significance in this changing environment.

## **Language, Employability, and the Indian Higher Education Context**

The New Education Policy has been prioritizing for skill-based education related to job opportunities in the curriculum. Those areas are gate ways of employment availability.

### **1. Employability in the Indian Labor Market**

Indian Labor market is one of the important sectors refers to a graduate's ability to secure and retain suitable employment, supported by cognitive, communication, technical, and social as well as communication skills. In India Employers are prioritized communication and interpersonal skills reports from NASSCOM, FICCI, and CII much as domain knowledge. In present situations the booming service sectors including IT services, BPO, tourism, hospitality, healthcare, and financial services demands graduates capable of navigating professional communication contexts, often in English.

### **2. Language as Human Capital for Employment**

Now a days communication skills is increasingly recognized as "employability capital." English has gained prominence as a global linguistic focus in business, science, and technology, while regional languages play crucial roles in domestic markets, governance, culture, and local entrepreneurship. Therefore, employability in India requires both English proficiency and local language proficiency for community and sectoral interaction.

### **3. Filling the gap of Conventional Language Education**

Traditional language teaching in our country has been theoretical not focused on practical education, which was literature-centric, and disconnected from workplace application those included less focus on oral communication, lack of workplace training. Another problem is absence of vocational English or sector-specific communication modules. Limited exposure to real life language tasks is another problem in previous education policy. NEP 2020 put forth some

reforms to the needs of market and students with perfect curriculum suggested by teachers.

### **Policy Provisions Relevant to Employable Language Skills**

The New Education Policy reimagines Indian higher education by focusing on multidisciplinary study, vocational skills, multilingualism, and professional readiness etc. There are Several key provisions which support vocational language learning.

#### **1. Multilingual Proficiency and Functional Communication**

India is a multilingual country and the present Education policy strongly emphasizes multilingualism and recognizes the cognitive, cultural, and socio-economic benefits of mastering multiple languages. Use of Indian languages has been promoted as mediums of instruction while supporting English proficiency for global communication by this policy. This dual approach strengthens employability by enabling in terms of cross-cultural communication, linguistic flexibility, national and international workforce mobility.

#### **2. Vocational Integration in Higher Education Systems:**

NEP 2020 prescribed vocational education in at least 50% of learners by 2025 and allows universities to integrate vocational modules into undergraduate degrees. This vocational education can integrate sector-specific language training, including use of business English, tourism and hospitality communication, healthcare communication, technical and scientific writing, legal communication, media and journalism language skills, entrepreneurship communication etc. These models will align language learning with employability ways.

#### **3. Skill Enhancement Frameworks**

The New Education Policy aligns with Skill India, NSQF, and National Skills Qualification Frameworks, which emphasize communication and soft skills as essential components. In this language policy the inclusion of credit-based skill courses is enabled to students to accumulate workplace-relevant competencies

alongside academic degrees.

#### **4. Industry-Academia Collaboration**

Encouraging partnership between higher education institutions and industries is to enable the creation of vocational language laboratories, internships, apprenticeships and professional training program in NEP 2020. Industry-academia connect is focused in the education policy. Such collaborations support experiential learning and occupational language competence.

#### **5. Flexible Curriculum Design and Evaluation**

Multiple reforms are prescribed such as multiple entry-exit options, academic bank of credits (ABC), and outcome-based assessments facilitate opportunities for communication training and professional language certification. This policy shifted from theoretical learning to competence-based evaluations directly benefits vocational language learning.

#### **Enhancing Employability through Vocational Language Education**

The integration of vocational language skills in NEP 2020 in higher education can address several employability dimensions in these areas.

##### **1. Improved Workplace Communication**

NEP 2020 will help in terms of trained graduates in vocational language well equipped with the areas to write business emails that students learn practical email writing in corporate world. Students will present projects focus on oral skills, presentation structure through visual aids explaining ideas clearly and maintain audience management skills necessary for academic, technical, or business presentations. Students develop language for persuasion, bargaining, conflict resolution, and agreement making which is essential for management, sales, client relations, and team coordination. Learners gain interpersonal communication skills, customer handling language, active listening, in instructions, and to speak politely to customers. Documentation writing knowledge will develop through manuals, reports, project documentation etc. Overall, NEP 2020 supports a shift from theoretical language learning to **practical, functional, and practical**

**communication**, thereby improving employability and industry readiness.

## 2. Workplace-Specific Language Skills

NEP 2020 provides language students an opportunity industry ready customized communication skills including BPO through accent training, voice modulation. Multilingual customer interaction is required in tourism sector that is prescribed in the curriculum. Healthcare sector is also needed skilled employee bearing patient communication, documentation. In media sector, employees to have mastery in editing, reporting, public speaking. In Courts also employees must be train in drafting, advocacy language skills. All those skills have prescribed in to the curriculum. These needs have been fulfilled by vocational language training.

## 3. Enhanced Soft Skills:

Need for soft skills required in modern workplaces is to be strengthened by Language communication skills. In industry Clear and effective communication improves teamwork and leadership by enabling better coordination and guidance. It supports time management and problem-solving through efficient information exchange and quick power of decision-making. Good communication also promotes workplace etiquette and professional ethics by encouraging respectful interactions, accountability, and integrity in professional settings. The framework of NEP 2020's develops soft skills and increase employability.

## 4. Benefits of Multilingual Proficiency

This education policy offers multilingual ability in translation of any language, localization industries. This also helps in content creation, diplomacy and cultural exchange through communication. Linguistic entrepreneurship is also beneficial in language policy of NEP 2020. However, vocational multilingualism can be a major economic asset.

## Barriers to Effective Implementation

Vocational Language Skills in NEP 2020 offers a progressive blueprint, but there are many challenges to implement.

## 1. Institutional Readiness

First major constraints are lack of infrastructure including language labs, digital resources, and qualified trainers. Proper implementation requires investments, partnerships, and resource development. The major constrains is vacant seats of teachers in undergraduate colleges.

## 2. Teacher Training Gaps

Most of teachers are not trained and they may require orientation in occupational linguistics, applied communication. They may also require soft skill's knowledge. Teachers may well acquaint with digital language tools. These training programs should be conducted from time to time. Without faculty development, curricular reforms may remain on paper.

## 3. Coherence Between Teaching and Assessment

The new syllabus must integrate communicative tasks, workplace simulations, and project-based assessments. Rote examinations cannot measure employable communication skills.

## 4. Industry Participation

Industry Participation is one of constrains in implementation of vocational language skills in the present policy. More ever, sustained collaborations with industries are essential for meaningful vocational language exposure. Many institutions struggle to establish such partnerships.

## 5. Socio-Linguistic Inequalities

NEP's multilingual emphasis must avoid reinforcing to reduce class inequalities in terms of English-speaking students gain disproportionate advantages. It will beneficial when there is equality in gaining the knowledge and skills.

## Strategic Policy Measures

Some strategies are recommended to maximize the potential of NEP 2020 for employable language skills; the following strategies are recommended including to establish Vocational Language Centers in universities. New Education Policy Develop Sector-Based Language Modules through training of teachers in applied linguistics and communication pedagogy. To train teachers

in applied linguistics and communication pedagogy. It also integrates soft skills with language curriculum systematically. It also emphasizes to encourage industry partnerships for internships and communication workshops. Encouraging industry partnerships for internships and communication workshops is also key factor in NEP 2020. Use of digital tools in language labs, simulation software speech analytics is another area needs to be developed. Adopting competency-based assessment with workplace tasks is also beneficial in learning of students. Multilingual certification programs also need to promoted for the implementation.

#### **Conclusion:**

The New Education Policy 2020 represents a landmark reform in Indian education, particularly through its emphasis on vocational education, skill development, and multilingual competence. Language learning, when aligned with vocational goals and workplace communication demands, has the potential to significantly reduce India's employability gap and improve labor market outcomes. The policy provides a strong foundation for integrating vocational language education into higher education, but successful implementation will require coordinated efforts in curriculum design, teacher training, resource allocation, and industry collaboration.

Vocational language learning can empower students with professional communication skills, enhance socio-economic mobility, support India's service-driven economy, and contribute to sustainable national development. In essence, NEP 2020 positions language not merely as an academic subject but as employability capital, capable of transforming India's demographic dividend into a skilled and confident workforce.

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## The Role of Nutrition in Preventing Non-Communicable Diseases in Low- and Middle-Income Countries

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### ABSTRACT

*Non-communicable diseases (NCDs) such as cardiovascular diseases, diabetes, cancer, and chronic respiratory conditions are rapidly increasing in low- and middle-income countries (LMICs), posing a significant public health and economic burden. This paper examines the role of nutrition in the prevention of NCDs within LMIC contexts, where dietary transitions, urbanization, and globalization have led to increased consumption of energy-dense, nutrient-poor foods. Using a review of existing literature and global health data, the study analyzes how poor dietary patterns, micronutrient deficiencies, and the rising intake of ultra-processed foods contribute to the development of NCDs. It further explores the protective effects of balanced diets rich in fruits, vegetables, whole grains, and essential micronutrients in reducing NCD risk. The paper also discusses structural and socioeconomic barriers to healthy nutrition, including poverty, food insecurity, limited nutrition education, and weak food systems. Policy interventions such as nutrition-sensitive agriculture, food fortification, fiscal policies, and public health nutrition programs are highlighted as critical strategies for NCD prevention. The findings underscore that improving nutritional quality and access to healthy foods is a cost-effective and sustainable approach to reducing the NCD burden and advancing health equity in low- and middle-income countries.*

### Introduction:

Non-communicable diseases (NCDs), including cardiovascular diseases, diabetes, cancer, and chronic respiratory conditions, have emerged as leading causes of morbidity and mortality worldwide. While traditionally considered diseases of high-income countries, NCDs are increasingly prevalent in low- and middle-income countries (LMICs), accounting for a growing share of deaths and placing substantial strain on fragile healthcare systems. The World

Health Organization (WHO) estimates that nearly three-quarters of global NCD deaths occur in LMICs, highlighting the urgent need for preventive strategies tailored to these settings.

Nutrition plays a pivotal role in both the development and prevention of NCDs. Diets high in saturated fats, refined sugars, and salt, coupled with low intake of fruits, vegetables, and whole grains, contribute to obesity, hypertension, insulin resistance, and other metabolic disorders. Conversely, balanced and nutrient-rich diets have

been shown to reduce the risk of NCDs, improve quality of life, and lower healthcare costs. In LMICs, however, challenges such as food insecurity, poverty, limited nutrition education, and the increasing availability of ultra-processed foods hinder optimal dietary practices.

Addressing the nutritional determinants of NCDs in LMICs requires a multi-faceted approach that integrates public health policies, community-based interventions, and education initiatives. This paper explores the critical role of nutrition in preventing NCDs, examining the dietary risk factors, socio-economic barriers, and policy interventions that can support healthier populations in low- and middle-income countries. By emphasizing nutrition as a preventive tool, this study contributes to the broader discourse on sustainable health promotion and the reduction of the growing NCD burden.

### **General Objective:**

To examine the role of nutrition in the prevention of non-communicable diseases (NCDs) in low- and middle-income countries and to identify effective strategies for promoting healthy dietary practices.

### **Specific Objectives:**

To assess the relationship between dietary patterns and the prevalence of NCDs in LMIC populations.

To identify key nutritional risk factors that contribute to the development of NCDs, such as obesity, micronutrient deficiencies, and excessive consumption of processed foods.

To evaluate socioeconomic, cultural, and environmental barriers that limit access to healthy diets in LMICs.

To analyze the effectiveness of nutrition-based interventions and policies in reducing NCD risk in low- and middle-income settings.

To provide evidence-based recommendations for integrating nutrition into public health strategies for NCD prevention in

LMICs.

### **Significance of the Study**

The study on the role of nutrition in preventing non-communicable diseases (NCDs) in low- and middle-income countries (LMICs) is significant for several reasons:

**Public Health Impact:** By highlighting the link between nutrition and NCD prevention, the study provides critical insights for reducing the rising burden of chronic diseases, which are a leading cause of mortality and morbidity in LMICs.

**Policy Development:** The findings can guide policymakers in designing and implementing nutrition-sensitive health policies, including food fortification programs, dietary guidelines, and public health campaigns that promote healthy eating habits.

**Healthcare Cost Reduction:** Preventing NCDs through improved nutrition can reduce the financial strain on already overstretched healthcare systems in LMICs by lowering treatment costs and hospitalizations.

**Community and Individual Benefits:** The study emphasizes the importance of accessible, affordable, and culturally appropriate diets, thereby empowering communities and individuals to adopt healthier lifestyles.

**Academic and Research Contribution:** This research fills gaps in the understanding of dietary risk factors specific to LMICs and provides a foundation for future studies, interventions, and health promotion strategies.

**Sustainable Development Goals (SDGs):** By promoting nutrition as a preventive measure, the study contributes to achieving SDG 2 (Zero Hunger), SDG 3 (Good Health and Well-being), and SDG 10 (Reduced Inequalities).

### **Research Methodology**

#### **Research Design**

This study will adopt a descriptive and analytical research design using a mixed-methods approach. The descriptive component will examine

dietary patterns, nutritional status, and prevalence of non-communicable diseases (NCDs) in low- and middle-income countries (LMICs). The analytical component will explore the relationship between nutrition and NCD prevention, considering socioeconomic and environmental factors.

### **Study Population:**

The study population will include individuals of all age groups from selected LMICs, with a focus on populations most vulnerable to NCDs, such as adults over 30, women of reproductive age, and children. Secondary data from national health surveys, WHO reports, and peer-reviewed studies will also be utilized.

### **Sampling Technique**

A purposive sampling method will be employed to select relevant studies, reports, and datasets focusing on LMICs. For any primary data collection (if applicable), a stratified random sampling technique will be used to ensure representation across age, gender, and socioeconomic groups.

### **Data Collection Methods**

#### **Secondary Data Collection:**

Review of published literature, including journal articles, government reports, and WHO databases, to assess dietary patterns, prevalence of NCDs, and existing nutrition interventions.

Analysis of statistical data from national health surveys, Demographic and Health Surveys (DHS), and the Global Burden of Disease (GBD) database.

#### **Primary Data Collection (optional):**

Structured questionnaires to assess dietary habits, lifestyle behaviors, and knowledge of NCD prevention.

Key informant interviews with nutritionists, healthcare providers, and policymakers to understand barriers and facilitators of healthy nutrition.

### **Conclusion:**

Nutrition plays a fundamental role in the prevention of non-communicable diseases (NCDs) in low- and middle-income countries (LMICs). The growing prevalence of NCDs in these regions is closely linked to dietary transitions, including increased consumption of ultra-processed foods, high sugar intake, and inadequate consumption of fruits, vegetables, and whole grains. Addressing these nutritional risk factors offers a cost-effective and sustainable strategy to reduce the burden of chronic diseases, improve population health, and alleviate pressures on fragile healthcare systems.

This study underscores that promoting healthy dietary practices requires a multi-faceted approach that integrates public health policies, community education, food system interventions, and socio-economic support. Policymakers, healthcare providers, and stakeholders must prioritize nutrition-sensitive strategies, such as food fortification, dietary guidelines, fiscal policies targeting unhealthy foods, and nutrition education programs, to effectively prevent NCDs.

Ultimately, enhancing nutrition in LMICs not only contributes to the prevention of chronic diseases but also supports broader public health goals, including achieving health equity and the Sustainable Development Goals. By placing nutrition at the center of NCD prevention efforts, LMICs can make significant strides toward healthier, more productive populations and sustainable healthcare systems.

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## NEP 2020 : A Transformational Framework for Education in India

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### ABSTRACT

*The National Education Policy (NEP) 2020, introduced by the Government of India in July 2020, marks a watershed moment in the country's education strategy. It replaces the three-decade-old 1986 policy and aims to transform the Indian education system for the twenty-first century. The policy places strong emphasis on holistic development, skill acquisition, and reforms in higher education to make graduates more employable, adaptable, and globally competitive. This paper critically examines the implementation status of NEP 2020, analyses its provisions for skill development, explores higher education reforms, identifies challenges in implementation, and outlines possible pathways forward.*

**Key words:** National Education Policy, Skill Development, ABC, Technology, Tools.

### Introduction

The National Education Policy 2020 represents a radical overhaul of India's education system designed to align it with global standards while preserving the nation's cultural heritage and linguistic diversity. The NEP's vision encompasses the entire educational spectrum - from foundational literacy and numeracy to higher education and lifelong learning - with an underlying goal to equip learners with competencies relevant in the rapidly evolving global economy. The policy emerges against the backdrop of a rapidly changing world economy, where traditional rote-based learning has proven insufficient for developing critical thinking, creativity, and practical skills. NEP 2020 envisions a learner-centric model where

skills, competencies, flexibility, and inclusivity are prioritized. Its framework integrates vocational education early in schooling and reforms higher education structures to make India a global knowledge hub.

The National Education Policy (NEP) 2020 marks a paradigm shift in India's approach to education, aiming to align the system with the needs of the 21st century while preserving India's cultural and linguistic diversity. With the learner at its core, the policy focuses on developing critical thinking, creativity, ethical reasoning, and practical skills rather than rote learning. In higher education, NEP 2020 envisions a transformation from rigid, discipline-based structures to flexible, multidisciplinary learning ecosystems. It seeks to increase the Gross Enrolment Ratio (GER) to 50% by 2035, promote research and innovation, en-

hance employability, and position India as a global knowledge hub. However, translating these ambitious reforms into practice remains a complex task due to India's vast and diverse higher education landscape.

### Objectives of the Study

- 1 To analyse the major reforms introduced under NEP 2020 in higher education.
- 2 To examine the opportunities created by NEP 2020 for students, institutions, and society.
- 3 To identify key challenges in the implementation of NEP 2020 reforms.
- 4 To suggest measures for effective implementation of NEP 2020 in higher education.

### Key Features of NEP 2020

#### Holistic and Multidisciplinary Education

NEP 2020 advocates for holistic education that transcends disciplinary boundaries. Higher education institutions (HEIs) are encouraged to design multidisciplinary programs combining science, arts, humanities, and vocational training. This enables students to pursue combinations of courses reflecting their interests and career goals.

#### Flexible Learning Pathways

The policy introduces multiple entry and exit points in undergraduate programs, allowing students to leave after one year with a certificate, after two years with a diploma, after three years with a bachelor's degree, and pursue a fourth year for research or specialization. Academic credits are stored in the Academic Bank of Credits (ABC), enabling learners to accumulate and transfer credits across institutions.

#### Focus on Skill Development and Vocational Education

One of NEP's defining priorities is integrating vocational education beginning at the

middle school level (Class 6 onward). Vocational subjects are offered as part of mainstream education, providing students early exposure to job-related skills and practical competencies. This structural shift aims to produce work-ready graduates equipped for industry demands.

#### Technology Integration and Digital Learning

NEP establishes the National Educational Technology Forum (NETF) to guide the use of technology in education. It emphasizes blended learning, online education platforms, virtual labs, and digital resources - key tools for expanding access and enhancing learning quality, especially in remote regions.

#### Teacher Education Reforms

NEP mandates a four-year integrated B.Ed program as the minimum qualification for teachers by 2030 and calls for continuous professional development through initiatives like NISHTHA to prepare educators for the competencies required by the new pedagogy.

**Institutional Autonomy and Governance Reforms** The policy proposes the creation of a single overarching regulator - the Higher Education Commission of India (HECI) - to replace bodies like the UGC and AICTE, promoting unified standards for quality and autonomy for institutions.

#### Inclusive and Equitable Education

NEP 2020 emphasizes equitable access to quality education for marginalized communities, gender inclusion, and linguistic diversity, aligning with Sustainable Development Goal 4 (SDG 4).

#### Rationale Behind Skill Integration

India faces a significant skill gap between the theoretical knowledge imparted through formal education and the practical competencies demanded by employers. Graduates often lack communication skills, critical thinking, digital

literacy, and hands-on experience with technology and industry practices. NEP seeks to bridge this divide through structured skill integration throughout the education lifecycle.

### **Vocational Education from Early Stages**

NEP mandates that vocational courses be incorporated from Class 6 onward. Schools and colleges are expected to partner with industries and training providers to offer hands-on experience, internships, and apprenticeships. This early introduction demystifies vocational skills and helps students make informed career choices.

### **Embedded Skill Components in HEIs**

Higher education programs are required to integrate vocational elements and skill courses into the curriculum. This ensures that students graduate with both academic knowledge and practical competencies relevant to the labor market. Additionally, soft skills such as communication, collaboration, problem-solving, and entrepreneurial skills are mainstreamed into pedagogy.

### **Academic Bank of Credits and Flexible Skill Pathways**

By allowing students to accumulate credits from different sources - including online courses, internships, and vocational programs - the Academic Bank of Credits enables diverse pathways tailored to individual career trajectories. This flexibility particularly benefits those seeking to upskill, reskill, or reenter education after a break.

### **Industry Partnerships and Apprenticeships**

NEP emphasizes strong industry-academia linkages, promoting internship and apprenticeship models that embed real-world skill training into higher education. Collaborative curriculum design with industry stakeholders ensures alignment with evolving job market needs.

### **Role of Digital Platforms in Skills**

Digital platforms such as SWAYAM, virtual labs, and adaptive learning systems allow for scalable delivery of skill development modules. The NETF provides a framework for using educational technology to support personalized learning pathways and industry-relevant training. Reforms in Higher Education

### **Gross Enrolment Ratio (GER) Goals**

NEP 2020 sets an ambitious target to increase the Gross Enrolment Ratio in higher education - including vocational education - from about 26.3% (2018) to 50% by 2035. This entails expanding institutional capacity and financial support for students from disadvantaged backgrounds.

Multidisciplinary Education and Flexible Curricula Higher education institutions are encouraged to move away from rigid disciplinary structures, offering interdisciplinary programs that reflect the complexity of contemporary problems. Cross-disciplinary study enhances creativity and prepares students for diverse career paths.

### **Autonomy and Quality Assurance**

The restructuring of regulatory architecture under HECI aims to provide academic, administrative, and financial autonomy to universities and colleges. Simplifying accreditation and compliance through uniform standards is expected to improve transparency and institutional accountability.

### **Strengthening Research Culture**

NEP 2020 calls for the creation of a National Research Foundation (NRF) to fund and catalyse research across institutions, fostering innovation and knowledge creation. This is critical for India's ambition to become a global research hub.

### **Internationalization and Global Partnerships**

The policy encourages top Indian

universities to establish campuses abroad and invites reputed global institutions to set up operations in India. This global engagement is intended to enhance academic quality and cultural exchange.

### **Inclusive Access and Support Schemes**

To ensure access for economically disadvantaged students, initiatives like the PM VidyaLakshmi Scheme facilitate collateral-free loans for students attending premier institutions. Such schemes aim to reduce financial barriers to quality education.

### **Implementation Status and Case Examples**

#### **Ongoing Implementation Efforts**

Across India, states and institutions have begun implementing various NEP components. For example:

Panjab University has begun preparations to implement NEP frameworks at the postgraduate level by 2026-27.

#### **The Times of India**

In Haryana, 22 government schools are being transformed into Centres of Excellence in Skills to offer vocational training alongside academic subjects.

IGNOU has launched MBA programs in Hindi and Odia, integrating multilingual accessibility into professional education.

#### **Accreditation Reforms**

The government is poised to revamp higher education accreditation, adopting a binary system (accredited/not accredited) to simplify quality assessment in alignment with NEP goals.

#### **The Economic Times**

#### **Challenges in Implementation**

While NEP 2020's vision is compelling, its realization faces significant barriers:

#### **Financial and Resource Constraints**

The policy envisions increasing education spending to 6% of GDP, but actual allocations

remain below this target, limiting infrastructure expansion, teacher recruitment, and training programs.

#### **Infrastructure and Human Resource Gaps**

Many schools and colleges, particularly in rural areas, lack digital infrastructure, trained faculty, and facilities to support experiential learning and blended education.

#### **Education for All in India**

#### **Uneven Implementation Across States**

Political and administrative differences have led to fragmented adoption of NEP reforms. Certain states resist specific provisions such as language policy and restructuring efforts.

#### **Regulatory and Administrative Delays**

Establishing bodies like HECI and finalizing regulatory frameworks has been slow, creating uncertainty among institutions about compliance and governance changes.

Teacher Preparedness and Resistance to Change Inadequate teacher training and resistance to pedagogical shifts remain major impediments to adoption of competency-based and skill-oriented instruction.

#### **Education for All in India**

#### **Equity Concerns**

Lack of transport, sanitation, gender-sensitive infrastructure, and persistent socioeconomic inequities risk widening gaps rather than narrowing them, if implementation is not equitable and targeted.

#### **Opportunities and the Way Forward**

Despite challenges, NEP 2020 presents significant opportunities:

#### **Preparing Future-Ready Graduates**

Integration of skills, multidisciplinary education, and flexible learning pathways will produce graduates with competencies aligned to future jobs, innovation, and entrepreneurship.

### **Industry-Academia Collaboration**

Enhanced partnerships with industry create avenues for internships, research collaborations, and curriculum co-design, ensuring relevance of education to real-world demands.

### **Digital Expansion and Inclusion**

Scaling digital platforms and blended learning can expand access to quality education, particularly for underserved communities.

### **Enhanced Research and Innovation Ecosystem**

With the NRF and multidisciplinary institutes, India can cultivate a robust research culture essential for technological advancement and nation-building.

### **Skill Ecosystem Expansion**

Embedding vocational training from early schooling and through higher education creates a pipeline of skilled workers ready for industry 4.0 and beyond.

### **Strengthening industry-academia partnerships**

Investing in digital infrastructure and teacher training

Ensuring equitable funding for public institutions

Phased and region-specific implementation strategies

### **Robust monitoring and feedback mechanisms**

The National Education Policy 2020 stands as a visionary blueprint for transforming education in India. Its emphasis on skill development, flexible learning pathways, multidisciplinary education, and higher education reforms reflects a strategic shift toward producing globally competent and employable graduates. However, achieving its ambitious goals demands sustained political commitment, adequate funding, extensive teacher training, and

seamless coordination between central and state governments.

In an era defined by technological advancements, the mindset of the teaching community holds significant sway over the success of educational reforms. The outlook on educational skills among teachers is an asset, and the most important need is to navigate landscapes in education development. Continuous expertise development programs that cover digital tools and promote rational technical thinking in the educational community are essential for the stable success of NEP-2020.

### **Conclusion**

The policy's true impact will likely become evident over the next decade - as institutions restructure curricula, learners adapt to flexible frameworks, and skill-oriented education becomes the norm. NEP 2020's success will ultimately be measured not just by policy enactment, but by meaningful improvements in learning outcomes, graduate employability, and the capacity of India's youth to contribute innovatively to the nation's socioeconomic development.

The National Education Policy 2020 provides a visionary roadmap for transforming India's higher education system into a flexible, inclusive, and globally competitive framework. Its emphasis on multidisciplinary learning, skill development, research, and institutional autonomy creates immense opportunities for learners and institutions alike. However, the challenges of funding, infrastructure, teacher preparedness, and governance must be addressed through coordinated efforts by the central and state governments, institutions, and stakeholders. With effective implementation and sustained commitment, NEP 2020 has the potential to position India as a global hub of education, research, and innovation.

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## Cooperative Governance in Public Administration : Enhancing Intergovernmental Collaboration

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### ABSTRACT

*Cooperative governance has emerged as a critical framework in public administration for enhancing collaboration and coordination among different tiers of government. In federal and decentralized systems, effective intergovernmental cooperation is essential to ensure policy coherence, efficient resource allocation, and the delivery of public services. This paper examines the principles, mechanisms, and challenges of cooperative governance in public administration, with a focus on promoting intergovernmental collaboration. Drawing on case studies, policy analyses, and comparative literature, the study explores how institutional arrangements, legal frameworks, and communication channels facilitate or hinder cooperative practices. It also identifies barriers such as bureaucratic fragmentation, political competition, and limited capacity at subnational levels. The findings highlight that cooperative governance, when effectively implemented, strengthens trust, accountability, and policy harmonization across government tiers, ultimately improving service delivery and fostering sustainable development. The study concludes by offering recommendations for institutional reforms, capacity building, and policy innovations that can enhance collaborative governance in diverse administrative contexts.*

### Introduction

In contemporary public administration, the complexity of governance in federal and decentralized systems necessitates effective collaboration between multiple levels of government. Cooperative governance, also known as collaborative or intergovernmental governance, emphasizes coordination, communication, and joint decision-making among national, regional, and local governments to achieve common policy goals. It is particularly important in contexts where responsibilities and resources are distributed across different government tiers, as poor coordination can lead to inefficiencies, policy conflicts, and gaps in service delivery.

The concept of cooperative governance

extends beyond mere coordination; it involves institutionalized mechanisms that foster trust, accountability, and shared responsibility among public institutions. By promoting intergovernmental collaboration, cooperative governance enhances policy coherence, optimizes resource allocation, and ensures that public services are delivered effectively and equitably. In many countries, both developed and developing, challenges such as bureaucratic silos, political competition, and limited administrative capacity can impede cooperative efforts.

This paper explores the role of cooperative governance in public administration, highlighting its significance in enhancing intergovernmental collaboration. It examines key

mechanisms, best practices, and barriers to implementation, with the aim of providing insights for policymakers, administrators, and scholars seeking to strengthen the effectiveness and efficiency of multilevel governance systems.

### General Objective

To examine the role of cooperative governance in public administration and its effectiveness in enhancing intergovernmental collaboration.

### Specific Objectives

- To analyze the key principles and mechanisms of cooperative governance in public administration.
- To assess the effectiveness of intergovernmental collaboration in policy formulation and service delivery.
- To identify the challenges and barriers that hinder cooperative governance among different tiers of government.
- To evaluate case studies or examples of successful cooperative governance initiatives in both federal and decentralized systems.
- To provide policy recommendations for strengthening intergovernmental collaboration and promoting efficient governance.

### Significance of the Study

The study on Cooperative Governance in Public Administration: Enhancing Intergovernmental Collaboration is significant for several reasons:

**Improving Policy Coordination:** By examining cooperative governance, the study provides insights into how national, regional, and local governments can better coordinate policies, reducing duplication of efforts and ensuring more coherent decision-making.

**Enhancing Service Delivery:** Effective intergovernmental collaboration ensures that public services reach citizens efficiently and equitably, particularly in federal and decentralized systems where responsibilities are shared across multiple levels of government.

**Strengthening Institutional Capacity:** The findings highlight best practices and mechanisms for fostering cooperation among government

agencies, contributing to the development of institutional frameworks that support accountability, transparency, and responsiveness.

**Conflict Prevention and Resolution:** Cooperative governance can mitigate tensions between government tiers by promoting dialogue, negotiation, and shared problem-solving, reducing political and administrative conflicts.

**Supporting Policy and Administrative Reforms:** The study offers evidence-based recommendations for policymakers and public administrators seeking to reform governance structures, implement intergovernmental collaboration, and enhance the effectiveness of public administration.

### Research Methodology

#### Research Design

This study will adopt a descriptive and analytical research design to examine cooperative governance in public administration and its role in enhancing intergovernmental collaboration. The descriptive component will focus on understanding the principles, mechanisms, and practices of cooperative governance, while the analytical component will evaluate the effectiveness, challenges, and outcomes of intergovernmental collaboration.

#### Study Population

The study population will include public administrators, policymakers, and officials from national, state/regional, and local government institutions in countries with federal or decentralized governance systems. Secondary sources, including policy documents, official reports, and academic literature, will also be analyzed.

#### Sampling Technique

**Purposive Sampling:** Key government institutions, policymakers, and administrators involved in intergovernmental coordination will be selected purposively for interviews and case studies.

**Stratified Sampling (optional):** If conducting surveys, respondents may be stratified by government tier (national, regional/state, local) to ensure representative insights.

#### Data Collection Methods

##### Secondary Data:

Review of scholarly articles, government publications, reports from intergovernmental

agencies, and legal frameworks to understand cooperative governance structures and best practices.

Analysis of case studies and policy documents that highlight intergovernmental collaboration initiatives.

#### **Primary Data (optional):**

**Structured Interviews:** Conducted with public administrators, policymakers, and experts to gather in-depth insights into cooperative governance mechanisms and challenges.

**Questionnaires/Surveys:** Designed to assess perceptions of collaboration effectiveness, barriers, and recommendations for improvement.

#### **Data Analysis**

**Qualitative Data:** Thematic analysis will be applied to interviews, case studies, and open-ended survey responses to identify patterns, challenges, and successful strategies for cooperative governance.

**Quantitative Data (if surveys are used):** Descriptive statistics (percentages, frequencies) and inferential analysis (correlation or regression) may be used to examine relationships between intergovernmental collaboration factors and perceived effectiveness.

**Academic Contribution:** This research enriches scholarly understanding of cooperative governance, providing a framework for analyzing intergovernmental collaboration, especially in countries navigating federal, quasi-federal, or decentralized governance systems.

#### **Conclusion**

Cooperative governance is a cornerstone of effective public administration, particularly in federal and decentralized systems where responsibilities are shared across multiple levels of government. This study highlights that intergovernmental collaboration is essential for achieving policy coherence, efficient resource allocation, and equitable service delivery. By fostering trust, accountability, and communication between national, regional, and local government institutions, cooperative governance strengthens the overall capacity of the public sector to respond to complex societal challenges.

The study also emphasizes that while cooperative governance offers significant benefits,

it faces challenges such as bureaucratic fragmentation, political competition, and limited administrative capacity. Addressing these challenges requires institutional reforms, clear legal frameworks, capacity building, and mechanisms for continuous dialogue and coordination among government tiers.

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## Impact of NEP 2020 on Modern Generation

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### ABSTRACT

*"Where there is knowledge, there is respect" it means that the liability and strength of a person is measured by the knowledge one has. Knowledge is the key to success. So, one must take education for good life. Life without education is useless. Education plays an important role in the life of human being. This stream of education has been started from the ancient time. Education is fundamental for achieving full human potential, developing an equitable and just society, and promoting national development. Providing universal access to quality education is the key to India's continued ascent, and leadership on the global stage in terms of economic growth, social justice and equality, scientific advancement, national integration, and cultural preservation. Universal high-quality education is the best way forward for developing and maximizing our country's rich talents and resources for the good of the individual, the society, the country, and the world. India will have the highest population of young people in the world over the next decade, and our ability to provide high-quality educational opportunities to them will determine the future of our country. The global education development agenda reflected in the Goal 4 (SDG4) of the 2030 Agenda for Sustainable Development, adopted by India in 2015 - seeks to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" by 2030. Such a lofty goal will require the entire education system to be reconfigured to support and foster learning, so that all of the critical targets and goals (SDGs) of the 2030 Agenda for Sustainable Development can be achieved. The world is undergoing rapid changes in the knowledge landscape. With various dramatic scientific and technological advances, such as the rise of big data, machine learning, and artificial intelligence, many unskilled jobs worldwide may be taken over by machines, while the need for a skilled workforce, particularly involving mathematics, computer science, and data science, in conjunction with multidisciplinary abilities across the sciences, social sciences, and humanities, will be increasingly in greater demand. With climate change, increasing pollution, and depleting natural resources, there will be a sizeable shift in how we meet the world's energy, water, food, and sanitation needs, again*

*resulting in the need for new skilled labour, particularly in biology, chemistry, physics, agriculture, climate science, and social science. There will be a growing demand for humanities and art, as India moves towards becoming a developed country as well as among the three largest economies in the world. Indeed, with the quickly changing employment landscape and global ecosystem, it is becoming increasingly critical that children not only learn, but more importantly learn how to learn. Education thus, must move towards less content, and more towards learning about how to think critically and solve problems, how to be creative and multidisciplinary, and how to innovate, adapt, and absorb new material in novel and changing fields. Pedagogy must evolve to make education more experiential, holistic, integrated, inquiry-driven, discovery-oriented, learner-centred, discussion-based, flexible, and, of course, enjoyable. The curriculum must include basic arts, crafts, humanities, games, sports and fitness, languages, literature, culture, and values, in addition to science and mathematics, to develop all aspects and capabilities of learners; and make education more well-rounded, useful, and fulfilling to the learner. Education must build character, enable learners to be ethical, rational, compassionate, and caring, while at the same time prepare them for gainful, fulfilling employment. The gap between the current state of learning outcomes and what is required must be bridged through undertaking major reforms that bring the highest quality, equity, and integrity into the system, from early childhood care and education through higher education. The aim must be for India to have an education system by 2040 that is second to none, with equitable access to the highest-quality education for all learners regardless of social or economic background.*

**Keywords:** NEP, well-rounded, pedagogy, Multidisciplinary, innovate, ethical, revamping, rational, aspirational

### **Introduction**

This National Education Policy 2020 is the first education policy of the 21st century and aims to address the many growing developmental imperatives of our country. This Policy proposes the revision and revamping of all aspects of the education structure, including its regulation and governance, to create a new system that is aligned with the aspirational goals of 21st century education, including SDG4, while building upon India's traditions and value systems. Education Policy lays particular emphasis on the development of the creative potential of each individual. It is based on the principle that education must develop not only cognitive capacities - both the 'foundational capacities' of

literacy and numeracy and 'higher-order' cognitive capacities, such as critical thinking and problem solving - but also social, ethical, and emotional capacities and dispositions.

The National The National Education Policy (NEP) 2020 marks a transformative shift in the Indian educational landscape, moving away from rigid silos toward a multidisciplinary, skill-centric model. National Education Policy (NEP) 2020 highlights its role as a "transformative blueprint" designed to shift the modern generation from a rote-learning culture to a competency-based, 21st-century skill set.

### **Structural Paradigm Shift:**

The 5+3+3+4 Model Recent studies indicate that the move from the traditional 10+2 structure to the 5+3+3+4 model aligns education with cognitive development stages.

### 1 Foundational Stage (Ages 3-8):

Focuses on "play-based" and "activity-based" learning. 2 Research by Mudasir Amin (2025) suggests this reduces early-age academic anxiety and builds stronger literacy and numeracy.

### 2 Flexibility:

The removal of rigid silos between Arts, Science, and Commerce allows the modern generation to build "multidisciplinary identities." 3

### Impact on Employability & Skill Development

#### 1 Vocational Integration:

Introducing vocational training from Grade 6 (e.g., coding, carpentry, pottery) is projected to increase "work-readiness."

#### 2 The 50% Goal:

NEP aims for 50% of learners to have exposure to vocational education by 2025.

#### 3 21st Century Soft Skills:

- o Critical thinking and problem-solving.
- o Digital literacy and AI awareness.
- o Collaboration and social-emotional learning.

### Digital Empowerment & Modern Pedagogy

The "modern generation" is native to the digital world. Research papers (e.g., Gupta, 2024) emphasize:

#### 1 DIKSHA & SWAYAM:

These platforms have democratized access to quality content for rural youth.

#### 2 Virtual Labs:

Especially post-pandemic, the policy's push for virtual labs has allowed for "experiential learning" even in resource-constrained environments.

### Higher Education: Multi-Entry and Multi-Exit

Research by B. Venkateshwarlu (2024) highlights the Academic Bank of Credits (ABC)

as a major benefit for the modern mobile workforce.

- 1 Flexibility: Students can "pause" their education to gain work experience and "re-enter" later without losing academic progress.
- 2 Holistic Undergraduate Degrees: The shift to 4-year degrees with research focus prepares students for global PhD standards.

### Challenges

While the outlook is optimistic, researchers (e.g., Taylor & Francis, 2024) point out hurdles that could affect the generation:

#### 1 The Digital Divide:

Students in remote areas may struggle without stable internet/hardware.

#### 2 Teacher Training:

The success of the policy depends on \$2\$ million+ teachers unlearning old methods.

#### 3 Infrastructure:

Many schools lack the facilities to implement the "activity-based" curriculum.

### Conclusion:

To conclude we can say that NEP 2020 has the potential to turn India's "demographic dividend" into a global workforce, provided that the implementation at the grassroots level matches the visionary goals of the policy document.

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## Internet of Things (IoT) and Smart Classrooms : A New Era of Learning

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### ABSTRACT

*The rapid development of digital technology has greatly changed the way education works, and the Internet of Things (IoT) has become an important part of smart classrooms. IoT allows different devices such as smart boards, sensors, attendance systems, and online learning platforms to connect and share information instantly. This research paper focuses on how IoT helps in building smart classrooms and improves teaching quality, student involvement, and the overall learning experience. The study follows a descriptive and analytical method and is based on secondary data collected from research papers, reports, and case studies related to IoT in education. It explains the use of IoT in activities like automatic attendance, classroom monitoring, personalized learning, tracking student performance, and managing campus resources efficiently. The paper also explains how IoT makes learning more interactive, supports teamwork among students, and improves access to education in both offline and online classrooms. At the same time, the study points out challenges such as data privacy concerns, high installation costs, technical issues, and the need to train teachers in digital skills. The paper concludes that IoT-based smart classrooms mark a new phase in education by making learning more effective, innovative, and student-centered, and it highlights the need for proper planning, strong infrastructure, and supportive policies for successful adoption.*

**Keywords:-** Internet of Things (IoT), Smart Classrooms, Digital Learning, Educational Technology, Innovation in Education,

### **Introduction:-**

I am sure you would have heard of several smart devices such as smart watches, smart bulbs, smart thermostat, smart tv, smart refrigerators, and perhaps anything that comes with a prefix of "smart". These devices are increasingly being used and serve various purposes such

as health monitoring, regulating temperature, capturing video or audio intelligently, etc. These devices are also commonly called as Internet of Things or IoT in short.

### **Definition:**

The Internet of Things (IoT) is a collection of diverse technologies that interact with the physical world.

In a nutshell, IoT refers to not only smart devices but also the underlying technologies that

enable and connect these devices to the Internet. There are billions of such devices in homes, schools, organisations, factories, oil wells, hospitals, cars, and several other places. With the explosion of these connected devices, you increasingly need solutions to connect them, and collect, store, and analyse device data to gain powerful and actionable insights.

Education has always changed with the development of new technologies, and today digital tools play an important role in modern learning. With the growing use of smart devices and internet-based systems, the Internet of Things (IoT) has become a key innovation in the field of education. IoT means connecting different devices so that they can collect, share, and use data in real time. In schools and colleges, these devices include smart boards, sensors, digital attendance systems, learning management platforms, and other tools that support teaching and learning. These technologies help create a more organized and responsive learning environment.

#### **Objectives:-**

1. To understand what internet of Things (IoT) is and how it is used in education.
2. To study how IoT helps in creating smart classrooms.
3. To know how IoT affects teaching and learning methods.
4. To understand how IoT improves student interest and learning experience.
5. To find out the problems faced while using IoT in education.
6. To suggest simple ways to use IoT effectively in classrooms.

#### **Research Methodology :-**

Research is essentially a systematic inquiry, seeking facts through objective verifiable methods in order to discover the relationship among them and to deduce from them broad

principles or laws. It is really a method of critical thinking. It comprises defining and re-defining problems, formulating hypotheses or suggested solutions, collecting, organizing and evaluating data, making deductions and making conclusions, and at last, carefully testing the conclusions to determine whether they fit the formulated hypothesis.

#### **Definition of Research**

In Webster's Twentieth Century Dictionary, research is defined as "a careful patient, systematic, diligent inquiry or examination in some field of knowledge undertaken to establish facts or principles".

This research paper is based on secondary data from books, journals, newspapers, websites, and information available on the internet.

#### **What is Internet of Things (IoT)?**

The internet of things, or IoT, is a network of interrelated devices that connect and exchange data with other IoT devices and the cloud. IoT devices are typically embedded with technology, such as sensors and software, and can include mechanical and digital machines and consumer objects. These devices encompass everything from everyday household items to complex industrial tools. Increasingly, organizations in various industries are using IoT to operate more efficiently, deliver enhanced customer service, improve decision-making and increase the value of the business. With IoT, data is transferable over a network without requiring human-to-human or human-to-computer interactions.

#### **How does IoT work?**

IoT systems function by gathering data from sensors embedded in IoT devices, which is then transmitted through an IoT gateway for analysis by an application or back-end system.

An IoT ecosystem works by combining four main elements: devices or sensors, connectivity, data analysis, and a graphical user interface.

1. Sensors or devices :- Sensors or smart devices are the core part of IoT. These devices are connected to the internet and have built-in processors, sensors, and communication tools that help them collect information from their surroundings and send it for further use.
2. Connectivity :- Connectivity allows IoT devices to communicate with each other through the internet. The data collected by sensors is sent to a central system called an IoT gateway, which acts as a link between devices and networks. Sometimes, the data is first processed on nearby devices, known as edge devices, before being sent further.
3. Data analytics :- Data analytics plays an important role in IoT by selecting useful data and analyzing it to find patterns, give suggestions, and detect problems early. Processing data locally helps reduce internet usage and improves system efficiency. In many cases, IoT devices can work automatically and make decisions without human involvement. However, users can still control the devices, give instructions, or view the data when needed. The type of network and communication method used depends on the specific IoT application.
4. Graphical user interface :- IoT systems also use technologies like artificial intelligence (AI) and machine learning (ML) to make data collection and decision-making smarter and more flexible. A graphical user interface is used

to interact with the IoT system.

### **Why is IoT important?**

IoT helps people live and work in a smarter and more convenient way. In daily life, people use IoT-based devices such as smartwatches, smart cars, and smart thermostats to make their routines easier. For example, when a person reaches home, their car can automatically open the garage door, the room temperature can adjust on its own, and the lights can turn on with a soft brightness.

IoT is also very useful for businesses. It allows companies to monitor their systems in real time and understand how machines, supply chains, and daily operations are working. This helps organizations improve efficiency, reduce errors, and make better decisions.

### **The following are some common examples of IoT applications:**

- 1 Agriculture. IoT can benefit farmers by making their jobs easier. For example, sensors can collect data on rainfall, humidity, temperature and soil content, and IoT can help automate farming techniques.
- 2 Construction. IoT can help monitor operations surrounding infrastructure. Sensors can monitor events or changes within structural buildings, bridges and other infrastructure that could potentially compromise safety.
- 3 Home automation. A home automation business can use IoT to monitor and manipulate mechanical and electrical systems in a building. Homeowners can also remotely control and automate their home environment using IoT devices, including smart thermostats, lighting systems, security cameras and voice assistants such as Alexa and Siri for

- 4 increased comfort and energy efficiency. Smart buildings and cities. Smart cities can help citizens reduce waste and energy consumption. In this application, IoT sensors can reduce energy costs by detecting how many occupants are in a room and turning the air conditioner on if they detect a conference room is full, or lowering the heat if everyone in the office has gone home.
- 5 Urban consumption systems. IoT technologies can also monitor and manage urban consumption, such as traffic lights, parking meters, waste management systems and public transportation networks.
- 6 Healthcare monitoring. IoT devices, such as remote patient monitoring systems, smart medical devices and medication trackers, enable healthcare providers to monitor patients' health status, manage chronic conditions and provide timely interventions. IoT gives providers the ability to monitor patients more closely by analyzing the generated data.
- 7 Retail. IoT sensors and beacons in retail stores can track customer movement, analyze shopping patterns, manage inventory levels and personalize marketing messages.
- 8 Transportation. IoT devices help the transportation industry by monitoring vehicle performance, optimizing routes and tracking shipments. For example, the fuel efficiency of connected cars can be monitored to reduce fuel costs and improve sustainability. IoT devices can also monitor cargo condition so that it reaches its destination in optimal condition.

**Some of the advantages of IoT devices include the following:**

1. Provides easy accessibility. IoT offers easy access to information from anywhere at any time on any device. For example, IoT enhances the accessibility of information by providing real-time data and insights, intuitive interfaces and proactive alerts.
2. Improves communication. IoT improves communication between connected electronic devices by enabling efficient data exchange, extending network reach, conserving energy and prioritizing critical communications.
3. Saves time and money. IoT enables the transfer of data packets over a connected network, which can save time and money. Predictive maintenance in industrial settings is a good example of this. IoT sensors installed on machinery continuously monitor parameters, such as temperature, vibration and operating conditions, in real time.
4. Optimizes supply chain. IoT data can be used to optimize supply chain and inventory management processes, enabling manufacturers to reduce costs and enhance customer satisfaction.
5. Improves efficiency. IoT analyzes data at the edge, reducing the amount of data that needs to be sent to the cloud. Edge computing enables physical devices to communicate more efficiently by processing data locally and exchanging only relevant information with other devices or cloud services.
6. Provides automation. IoT automates tasks to improve the quality of a company's services and reduces the need

for human intervention. For example, in agriculture, IoT-enabled irrigation systems can automatically adjust watering schedules based on soil moisture levels, weather forecasts and crop requirements.

7. Improves customer experience. IoT enables the development of personalized products and services tailored to individual preferences and needs. Smart home devices, wearable technology and personalized recommendations in retail are examples of how IoT enhances the customer experience.
8. Provides flexibility. IoT options can be scaled according to an organization's changing needs. Whether adding new devices, expanding operations or integrating with existing systems, IoT provides the flexibility to scale and evolve with business requirements.
9. Enables better business decisions. IoT generates vast amounts of data that can be analyzed to gain valuable insights into operations, consumer behavior and market trends.
10. Offers environmental sustainability. IoT enables efficient resource use and reduces negative environmental effects through initiatives such as smart energy management, waste reduction and sustainable agriculture practices.

### How IoT Helps in Creating Smart Classrooms

#### 1. Connected Classroom Setup :-

IoT helps create smart classrooms by connecting tools like smart boards, projectors, computers, and sensors through the internet. All these devices work together and make teaching and learning smoother and more digital.

#### 2. Automatic Attendance System :-

With IoT, attendance can be taken automatically using smart cards, biometric systems, or face recognition. This saves time during class and reduces mistakes that can happen with manual attendance.

#### 3. Live Classroom Monitoring :-

IoT sensors help check classroom conditions such as temperature, lighting, noise levels, and student presence. This helps maintain a comfortable learning environment and supports better classroom control.

#### 4. Personalized Learning Support :-

IoT systems collect information about student participation and performance. Teachers can use this data to understand students' strengths and weaknesses and provide learning support according to individual needs.

#### 5. Interactive Teaching and Learning :-

IoT-enabled tools like smart boards and digital platforms allow teachers to use videos, quizzes, and animations during lessons. This makes classes more interesting and helps students understand topics better.

#### 6. Better Use of Resources and Energy :-

IoT helps control classroom equipment such as lights, fans, air conditioners, and projectors automatically. This reduces energy waste and helps institutions save costs.

#### 7. Student Performance Tracking :-

IoT-based systems help teachers track attendance, assignments, test results, and class participation easily. This allows quick evaluation of student progress and timely feedback.

### How IoT Affects Teaching and Learning Methods

#### 1. Concept of IoT in Education

The Internet of Things (IoT) in education refers to the use of smart and connected devices such as digital boards, sensors, smart attendance

systems, learning apps, and cloud platforms that communicate with each other through the internet.

## 2. Impact of IoT on Teaching Methods

IoT has significantly changed the way teachers plan and deliver lessons.

Firstly, teaching becomes more personalized. IoT tools track students' learning speed, performance, and participation. Based on this information, teachers can modify lessons to meet individual student needs

## 3. Impact of IoT on Learning Methods

IoT also transforms how students learn and interact with knowledge.

Students become active learners rather than passive listeners. IoT-enabled activities promote exploration, collaboration, and hands-on learning experiences. IoT also supports collaborative and self-directed learning, allowing students to work together using digital platforms and access learning resources anytime and anywhere.

## 4. Role of Smart Classrooms

Smart classrooms use IoT technology to create a comfortable and responsive learning environment. Automatic lighting, temperature control, digital attendance, and resource management systems reduce manual work for teachers and institutions.

## 5. Benefits of IoT in Teaching and Learning

- a. Improves student engagement and motivation
- b. Supports personalized and flexible learning
- c. Enhances teaching efficiency and classroom management
- d. Enables continuous assessment and monitoring
- e. Encourages critical thinking and problem-solving skills

## 6. Challenges in Using IoT in Education

Despite its advantages, IoT adoption faces some challenges. These include the need for strong internet infrastructure, proper training for teachers, high initial costs, and concerns related to data privacy and security.

## 7. Future Scope of IoT in Education

The future of IoT in education looks promising. With proper planning and policy support, IoT can help build inclusive, smart, and learner-centered education systems. Future classrooms may use advanced analytics and artificial intelligence along with IoT to further improve teaching quality and learning outcomes

## How IoT Improves Student Interest and Learning Experience

### 1. Interactive Learning Environment

IoT creates interactive classrooms using smart boards, digital devices, and connected tools. Students can see visuals, take part in activities, and interact with content instead of only listening to lectures.

### 2. Personalized Learning Experience

IoT systems can track student learning patterns such as speed, performance, and participation. Teachers can then adjust lessons according to individual needs.

### 3. Instant Feedback and Better Understanding

With IoT-based quizzes and assessments, students receive immediate feedback. This helps them identify mistakes quickly and improve their understanding. Quick feedback reduces confusion and keeps students motivated to learn more.

### 4. Comfortable and Smart Classroom Environment

IoT helps maintain proper lighting, temperature, and classroom conditions automatically. A comfortable learning environment

improves student concentration and reduces distractions, leading to a better overall learning experience.

## 5. Real-Life and Practical Learning

IoT allows students to use sensors, smart tools, and real-time data for practical activities. This connects classroom learning with real-life situations, making lessons meaningful, enjoyable, and easier to remember.

## Problems Faced While Using IoT in Education

### 1. High Cost of Implementation and Maintenance Implementing

IoT in education requires smart boards, sensors, connected devices, software systems, and reliable internet services. Many schools and colleges, especially government and rural institutions, have limited budgets and cannot afford such advanced technology.

### 2. Lack of Technical Skills and Training

Teachers and administrative staff need proper training to use IoT tools effectively in classrooms. Many educators are not familiar with advanced technologies and may feel uncomfortable or hesitant while using them.

### 3. Poor Internet Connectivity and Network Issues

IoT-based learning systems depend on continuous and stable internet connectivity. In areas with slow or unreliable internet services, smart classrooms may face frequent disruptions.

### 4. Data Privacy and Security Risks

IoT devices collect and store sensitive student information such as attendance, academic performance, and personal details. If proper security measures are not taken, this data can be misused, leaked, or hacked. Protecting student privacy and ensuring data security remain major concerns in IoT-based education systems.

### 5. Technical Failures and System Errors

IoT devices may face hardware breakdowns, software bugs, or power failures. When systems stop working suddenly, classroom activities are disturbed, and valuable teaching time is lost. Frequent technical issues can create frustration among teachers and students.

### 6. Distraction Due to Excessive Technology Use

Although IoT makes learning interactive, too much use of digital devices can distract students. Students may focus more on gadgets rather than the lesson content.

### 7. Inadequate Infrastructure in Educational Institutions

Many institutions lack basic infrastructure such as smart classrooms, sufficient devices, technical support teams, and proper electricity supply. Without these essential facilities, implementing IoT becomes difficult and ineffective.

## Simple Ways to Use IoT Effectively in Classrooms

### 1. Begin with Simple and Useful IoT Tools

Schools should start using basic IoT tools such as smart boards, digital projectors, and online attendance systems. These tools are easy to operate and help teachers manage classes smoothly.

### 2. Train Teachers to Use IoT Confidently

Proper training is essential for effective IoT use. Teachers should receive hands-on training sessions that explain how to use smart devices during lessons.

### 3. Use IoT to Monitor Student Learning Progress

IoT systems can track student attendance, participation, and performance. This helps teachers identify students who need extra support. Early identification of learning gaps improves teaching strategies and overall student performance.

#### 4. Promote Interactive and Engaging Learning

IoT can be used for live quizzes, group discussions, and classroom polls. These activities encourage students to participate actively instead of being passive listeners.

#### 5. Create a Comfortable Classroom Environment

IoT devices can automatically control classroom lighting, temperature, and ventilation. A comfortable learning environment helps students concentrate better and reduces distractions, improving the learning experience.

#### 6. Maintain Data Privacy and Security

Schools must protect student data collected through IoT devices. Using secure systems and clear data policies prevents misuse of information. Ensuring privacy builds trust among students, parents, and teachers.

#### 7. Balance Technology with Traditional Teaching

IoT should support teaching, not replace teachers. Combining smart tools with traditional teaching methods ensures effective learning. A balanced approach prevents overuse of technology and maintains classroom discipline.

#### Conclusion :-

The Internet of Things (IoT) has become an important part of modern education by helping traditional classrooms grow into smart and interactive learning spaces. This study shows that IoT improves teaching quality, increases student interest, and makes learning more engaging and student-focused. By using connected tools such as smart boards, sensors, digital attendance systems, and online platforms, classrooms become more organized, flexible, and responsive to student needs. IoT supports personalized learning, quick feedback, better classroom management, and easy tracking of student

performance, which helps both teachers and learners. At the same time, the study highlights challenges such as high costs, lack of technical skills, internet issues, and concerns about data safety, which can affect the successful use of IoT. Therefore, technology alone is not enough; proper planning, teacher training, strong infrastructure, and clear policies are also required. Overall, IoT-based smart classrooms mark a new era of learning by making education more effective, innovative, and accessible, and they have the potential to create a more modern and inclusive education system when used thoughtfully.

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## Adaptation of Climate Change in 21st Century Indian English Literature

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### ABSTRACT

*Indian English literature in the 21st century has begun to reflect the urgency of global climate change not only as a scientific and political concern but as a deep cultural and imaginative challenge. Writers have shifted from traditional narratives of nationalism, diaspora, and postcolonial identity to incorporate environmental consciousness and climatic adaptation, challenging anthropocentric worldviews and reimagining human relationships with nature. This paper explores the evolving literary modes used by Indian authors - especially Amitav Ghosh and others - to depict climate change, articulate human vulnerability, and offer paradigms of adaptation in narrative form.*

**Keywords:** climate change, ecological realism, nationalism, diaspora, postcolonial identity

### Introduction :

Climate change, once a subject primarily discussed in scientific and policy circles, has entered the realm of literary imagination. This transformation marks a pivotal moment in Indian English literature, where writers respond to ecological degradation, rising sea levels, and climate-induced migration through fiction, allegory, and ecological realism. Literature humanizes climate crises, translating data into lived experiences and emotional truths. As critics assert, Indian literature today engages "postcolonial ecologies" and develops ecological awareness within narrative structures, foregrounding climate change as a continually evolving theme in the Anthropocene era.

The study of literature and environment in the 21st century has shifted from traditional ecocriticism - which foregrounded nature as backdrop - to cli-fi (climate fiction), which

examines climate change as a central narrative driver. Cli-fi, unlike abstract scientific discourse, "makes distant threats feel immediate and personal," compelling readers to "feel" climate change as a lived experience rather than a distant abstraction.

Indian English literature absorbs these global literary turns while infusing unique postcolonial critiques - interrogating industrialization, globalization, and their roles in environmental degradation. Climate change becomes more than a weather shift; it evolves into ethical, historical, and cultural consciousness.

Amitav Ghosh may be rightly looked upon as the pioneer in producing climate fiction. His climate narratives include:?

### The Great Derangement:

Amitav Ghosh's nonfiction work *The Great Derangement* criticizes modern literature's historical neglect of climate change, arguing that

the literary imagination has been reluctant to engage with planetary crises. Ghosh insists that literature must expand its narrative capacity to include climate change not as metaphor but as reality shaping human lives.

Ghosh writes that fiction often fails to "deal with climate change" because the crisis exceeds traditional narrative frameworks that prioritize individual human experience disconnected from planetary scales. His call to literary action underscores the urgency of environmental storytelling and representation.

### **Gun Island and Planetary Climate Realism**

In *Gun Island* (2019) - Ghosh's climate novel - environmental degradation becomes intertwined with myth, history, migration, and planetary connectivity. The narrative revolves around Deen Datta, a rare books dealer whose quest spans the Sundarbans and Europe, linking a mythic curse to contemporary climate catastrophes. Ghosh foregrounds issues like sea-level rise, chemical pollution, and climate-induced displacement, illustrating the global reach of ecological change.

Critics note that Ghosh blends ecological concerns with human drama, portraying climate change not only as environmental disruption but as a shared cultural and ethical crisis. Literary scholar Rakibul Hasan Khan argues that *Gun Island* encourages cross-cultural cooperation and multispecies justice as essential to climatic adaptation and survival.

### **Jungle Nama: Myth and Ecological Allegory**

Ghosh's verse adaptation *Jungle Nama* uses a traditional Sundarbans legend to explore ecological imbalance and greed - transforming mythology into an allegory for human-caused climate change. The story cautions against unlimited extraction and highlights the Sundarbans' vulnerability in the Anthropocene. Through poetry and legend, Ghosh reveals climate change's moral dimensions and challenges readers to rethink human stewardship of the environment.

**Environmental consciousness is also witnessed in the following contemporary works:**

### **Latitudes of Longing by Shubhangi Swarup**

Shubhangi Swarup's *Latitudes of Longing* (2018) interweaves four vignettes across the Indian subcontinent, celebrating nature's beauty and lamenting its fragmentation. The novel treats the earth as a living entity and explores human connectivity to the environment - underscoring the emotional and existential impact of ecological disruption. This work highlights a literary turn toward seeing nature not as static backdrop, but as active, sentient presence.

Poetic voices in India contribute to climate adaptation discourse through ecopoetry, expressing climate anxiety, environmental loss, and calls for action. Ecopoetry integrates emotional resonance with ecological observation, urging readers to recognize environmental fragility and responsibility.

**Indian writers use several narrative strategies to depict adaptation, They can be enlisted as under:**

Mythic Resonance - integrating folklore and myth to connect eco-consciousness with cultural memory.

Planetary Realism- situating local ecological crises within global environmental processes.

Character-Centric Ecology - portraying individuals and communities transforming belief systems in response to ecological stress.

Multispecies Perspectives - weaving nonhuman narratives into human stories to challenge anthropocentrism.

These strategies expand literature into a space where adaptation is not merely survival but ethical transformation - readers are invited to engage with climate realities on emotional and intellectual levels.

Writers do not merely depict climate change as catastrophe; many of them frame adaptation as a moral mission. Through compelling storytelling, authors like Ghosh,

Swarup, and publishers of ecopoetry stress that adaptation involves empathy - across cultures, ecologies, and time. Literature becomes a vehicle for understanding climate change not only as data but as human experience.

To conclude, Indian English literature in the 21st century reflects a marked shift toward ecological consciousness and climate adaptation themes. From Ghosh's planetary narratives to ecopoetic engagement, these texts articulate the emotional, cultural, and ethical dimensions of climate change. Literature thus emerges as a critical arena for imagining adaptive futures, reconfiguring human-nature relationships, and inspiring empathy and action.

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## The Study of Nano-Systems for Environmental Sustainability and Pollution Control in Agriculture Sector

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### ABSTRACT

*The application of nanosystems in agriculture has emerged as a promising approach for enhancing environmental sustainability and effective pollution control. Conventional agricultural practices often involve excessive use of fertilizers, pesticides, and water, leading to soil degradation, water contamination, and adverse impacts on ecosystems and human health. Nanosystems, including nanofertilizers, nanopesticides, and nanosensors, offer innovative solutions by improving the efficiency, targeted delivery, and controlled release of agrochemicals. This study focuses on the role of nanosystems in minimizing environmental pollution while promoting sustainable agricultural productivity. Nanotechnology-based inputs reduce nutrient losses, limit chemical runoff, and decrease the accumulation of toxic residues in soil and water. Additionally, nanosensors enable real-time monitoring of soil health, moisture, and pollutant levels, supporting precision farming practices. The adoption of nanosystems in agriculture contributes to reduced environmental burden, conservation of natural resources, and improved crop yield. Thus, nanosystems play a vital role in advancing environmentally sustainable and pollution-controlled agricultural practices for long-term ecological balance and human well-being.*

**Keywords:** Nanoparticles, nanofertilizers, nanosensors, agricultural, Biomedicine, nanopesticides, high-strength adhesives, soil degradation.

### Introduction:

The agriculture sector is critical to food production but contributes to environmental problems such as soil contamination, water pollution, greenhouse gas emissions, and loss of biodiversity. Traditional farming methods rely heavily on chemical fertilizers and pesticides,

which are often inefficient and harmful to ecosystems. Scientists are exploring nano systems including nanoparticles, nano-encapsulated agrochemicals, and nanostructured sensors as alternative tools to increase sustainability and improve pollution control. Nano systems are materials or devices engineered at the nanoscale extremely small scales (1-100 nanometers). At this size, materials can exhibit unique physical and chemical properties that improve their efficiency, reactivity, and stability. Examples of Nano Systems

in Agriculture: Nanoparticles (e.g., nano-silver, nano-zinc) Nano-encapsulated fertilizers and pesticides Nanofibers and nanocomposites Nanosensors and nanodevices. Nanopesticides are nanostructures with two to three dimensions between 1 to 200 nm, used to carry agrochemical ingredients (AcI). Because of their unique properties, the loading of AcI into nanoparticles offers benefits when compared to free pesticides. However, with the fast development of new engineered nanoparticles for pests' control, a new type of environmental waste is being produced. This paper describes the nanopesticides sources, the harmful environmental and health effects arising from pesticide exposure.

#### **Nano-Fertilizers in Agriculture**

Traditional fertilizers lose significant nutrients to leaching and volatilization, increasing pollution. Nano-fertilizers can be engineered to slowly release nutrients Increase nutrient uptake efficiency Reduce total fertilizer input this can improve plant growth while minimizing nutrient runoff into water bodies. Nanofertilizers, primarily Nano Urea and Nano DAP, are gaining traction in India for enhanced nutrient efficiency, reduced usage (up to 50% for urea), and environmental benefits like lower leaching. Led by IFFCO, the government promotes them through awareness campaigns and makes them available at PMKSKs, with multiple plants established to boost production, though challenges like farmer awareness and varying efficacy results persist. The nano urea is potential components of 4 R nutrient stewardship as it promote precision and sustainable agriculture, it promote clean and green technology as its industrial production is neither energy intensive nor resource consuming in addition to this nano urea helps in minimizing the environmental footprint by reducing loss of nutrients from agriculture field in the form of

leaching and gaseous emission which use to cause environmental pollution and climate change.

#### **Nano-Pesticides**

Nano pesticides are advanced agrochemicals using nanoscale particles for targeted, efficient pest control, offering benefits like reduced dosage, better water solubility, controlled release, and lower environmental impact compared to conventional ones, but they also raise environmental/health concerns requiring careful study. They work by encapsulating active ingredients in nanocarriers (polymers, silica, lipids) for enhanced leaf adhesion, penetration, and sustained delivery, improving efficacy against insects, fungi, and weeds while minimizing runoff. Nano-encapsulation improves the delivery of pesticides by protecting active ingredients from degradation, releasing pesticides only when needed by the plant, reducing total chemical use, lower pesticide use reduces toxic exposure for humans, wildlife, and soil organisms. Nanopesticides stand for pesticides formulated in nanomaterials to find applications in the agricultural field, whether specially fixed on a hybrid substrate, encapsulated in a matrix or functionalized nanocarriers for external stimuli or enzyme-mediated triggers. Nanosized particles, coupled with their shape and special properties, are thought to explore pesticide activities in nanocarrier innovative formulations based on several materials like silica, lipids, polymers, copolymers, ceramic, metal, carbon and others. The nanopesticide formulations can increase water solubility, bioavailability and protect agrochemicals against environmental degradation, revolutionizing the control of pathogens, weeds, and insects in the crops. However, the nanomaterial features are also borderline their cytotoxicity and genotoxicity. The indiscriminate and irrational use of pesticides

influence the balance of the ecosystem and expose everyone's health to risk. Adverse effects of short-term (acute) and long-term (chronic) resultant of occupational or accidental ingestion of pesticide residues from food, water-drinking is fatal or disability-adjusted life years. Children are more vulnerable to pesticide exposure and are subject to permanent tissue and organ damage. Between them, the central and peripheral neurotoxicity and the effect on the loss of blood ability for coagulation are meaningful reasons for concerns. Indeed, a detailed assessment of the pros and cons that influence the activity and toxicity of nanopesticides is crucial for the safe and sustainable development of the already approved use of nanoparticles in agriculture.

### **Nanosensors for Soil and Water Monitoring**

Nanosensors can detect environmental conditions like nutrient levels, moisture, pollutants quickly and accurately, real-time monitoring of soil health, early detection of contaminants, guidance for precision farming that is apply water/fertilizer only when necessary, this helps reduce waste and environmental harm. By utilize nanomaterials like carbon nanotubes, graphene, and metal oxides to provide high-sensitivity, real-time monitoring of soil and water quality. These devices enable precision agriculture and environmental protection by detecting nutrients, pH, moisture, contaminants, and pathogens at low concentrations. They are essential for optimizing resource use and enhancing agricultural sustainability. A sensor is broadly defined as a device that detects events or changes in its physical environment. Information is relayed as data to other devices, such as a computer. Water quality sensors are essential for ensuring availability and accessibility for quality water for human activities ranging from drinking to agricultural and industrial purposes. The

sensors can be located at the point of use, at the water treatment facilities, or within the water distribution system. Nanosensors are sensing devices that utilize nanomaterials as recognition elements to detect changes. In recent years, nanomaterials-based sensors have gained popularity.

### **Potential Toxicity**

Some nanoparticles may harm soil microbes, plants, animals, or humans if not properly regulated. Cost and Accessibility. Manufacturing nano materials can be expensive, making adoption difficult for small farmers. There are limited regulations on the use of nano systems in agriculture, raising concerns about environmental and human health safety. Nano-Fertilizers demonstrated higher nutrient uptake and lower leaching compared with conventional fertilizers, reducing nitrogen and phosphorus pollution. Agricultural pollution, often referred to as "diffuse pollution" due to its widespread nature, is the contamination of the environment caused by farming activities, including the use of synthetic fertilizers, pesticides, herbicides, and, in some cases, untreated animal waste. It is a critical environmental issue, impacting water, soil, and air quality. Pesticides & Herbicides are designed to kill insects and weeds but often have unintended consequences, including toxicity to non-target organisms like birds, bees, and fish. Many, including older chlorinated, are highly toxic and persist in the environment, with some, like DDT, being banned in developed countries. Excess nutrients, particularly nitrogen and phosphorus, can run off into water bodies, causing eutrophication—a process that depletes oxygen and creates "dead zones" where aquatic life cannot survive. Heavy Metals indiscriminate use of chemical fertilizers (specifically phosphate-based) can introduce harmful heavy metals like cadmium,

arsenic, and lead into the soil, which are then absorbed by crops, potentially entering the food chain and affecting human health. The extensive use of plastic sheeting for greenhouses and mulch can introduce micro plastics into the soil, with 10 million tons of plastic waste produced annually, much of which is never collected.

### **Environmental Sustainability Benefits**

Using nano systems in agriculture offers multiple environmental benefits like, reduced chemical use, lower soil & water pollution, improved nutrient efficiency, less nutrient runoff, better monitoring, precision application and reduced waste, enhanced water purification, cleaner water resources by improving efficiency and reducing excess chemicals, nano systems contribute to environmental protection and sustainability. Environmental sustainability in agriculture focuses on farming methods that protect the planet, conserve resources, and ensure long-term food production by integrating practices like soil health management (crop rotation, cover crops, no-till), efficient water use (drip irrigation, rainwater harvesting), biodiversity enhancement, reduced chemical inputs (Integrated Pest Management), and renewable energy to create resilient food systems that benefit people and the environment. Crop rotation, the practice of growing different crops in succession on the same land, is a cornerstone of sustainable agriculture that enhances soil health, boosts biodiversity, and breaks pest/disease cycles. It significantly reduces the need for synthetic fertilizers and chemical pesticides, lowering environmental footprints while improving farm profitability and resilience against climate variability. Agricultural water management optimizes water use for crops to maximize yields, enhance sustainability, and conserve resources, crucial for adapting to climate change.

### **Future Prospects**

The future of pollution control in the agricultural sector is shifting towards a precision-based, regenerative approach designed to mitigate environmental degradation while ensuring global food security. As modern agriculture faces increasing scrutiny for its role in soil degradation, water contamination, and greenhouse gas emissions (methane, nitrous oxide), the sector is moving toward integrating innovative technologies and sustainable practices to minimize environmental footprints. Nanotechnology in agriculture is rapidly advancing.

### **Future research goals include:**

Designing safer, biodegradable nanomaterials  
Development of low-cost nanosensors and nano-agrochemicals  
Clear regulatory policies for environmental safety.  
Instead of uniform application, future agriculture will use AI, drones, and IoT sensors to apply water, fertilizers, and pesticides only in the specific amounts and locations required. This targeted approach reduces chemical runoff and waste. A shift from conventional to regenerative practices is expected, focusing on improving soil biodiversity, reducing tillage, and using cover crops to restore soil carbon and reduce erosion. Conventional chemical pesticides are expected to be slowly replaced by biopesticides and smart-delivery nanotechnology (nano-fertilizers and nano-pesticides). These are designed to boost crop growth while significantly reducing pollution and enhancing absorption efficiency.

### **Conclusion**

The future of agricultural pollution control lies in bridging technological innovation with ecological management. By moving away from high-input, industrial models toward precision, circular, and regenerative systems, the

agricultural sector can reduce its environmental impact while enhancing resilience to climate change. Nano systems offer innovative tools for promoting sustainability and reducing pollution in agriculture. Although challenges remain, their ability to improve nutrient use, reduce chemical inputs, and enable precise agricultural management makes them valuable for future farming.

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## Role of Mythology in the Indian Knowledge System

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### ABSTRACT

*The Indian Knowledge System (IKS) represents a holistic framework of intellectual traditions encompassing philosophy, science, ethics, spirituality, and cultural practices. Among its foundational pillars, mythology plays a central role in preserving and transmitting knowledge across generations. Far from being mere fictional narratives, Indian myths encode philosophical insights, moral values, scientific thought, and social norms in symbolic and accessible forms. This paper examines the contribution of mythology to the Indian Knowledge System by exploring its philosophical depth, pedagogical function, ethical guidance, scientific symbolism, and cultural continuity. Through a qualitative and interpretative approach, the study highlights how mythology operates as a living and dynamic knowledge system that continues to shape Indian thought and identity.*

**Keywords:** Indian Knowledge System, Mythology, Philosophy, Culture, Ethics, Symbolism

### Introduction

The Indian Knowledge System (IKS) is a vast and interconnected intellectual tradition developed over millennia. It encompasses diverse domains such as philosophy, metaphysics, science, medicine, linguistics, art, and spirituality. Central to this system is mythology, which functions not merely as storytelling but as a sophisticated medium for preserving and transmitting knowledge.

Indian mythology, rooted in texts such as the Vedas, Upanishads, Puranas, Ramayana, and Mahabharata, reflects the collective con-

sciousness of civilization. These narratives offer moral guidance, philosophical insights, and cosmological understanding while maintaining relevance across historical periods. This paper explores how mythology contributes significantly to the structure, continuity, and vitality of the Indian Knowledge System.

This study adopts a qualitative and interpretative approach, relying on secondary sources such as classical scriptures, philosophical texts, and modern scholarly interpretations.

Mythology as a Medium of Philosophical Thought

Indian mythology is not merely a collection of sacred stories or legendary narratives; it is a profound medium through which

complex philosophical ideas are expressed, preserved, and transmitted across generations. Rooted in texts such as the Vedas, Upanishads, Ramayana, Mahabharata, Puranas, and various folk traditions, Indian mythology functions as a symbolic language that translates abstract metaphysical concepts into accessible narrative forms. Through myths, philosophy in India becomes experiential, ethical, and deeply integrated into everyday life.

### **1. Myth and Philosophy: An Indian Perspective**

In the Indian intellectual tradition, there is no rigid separation between myth (itihasa or purana) and philosophy (dar?ana). Mythology serves as a narrative extension of philosophical inquiry. While philosophy asks questions about Brahman (ultimate reality), Atman (self), karma, dharma, moksha, and maya, mythology embodies these ideas in characters, events, and cosmic dramas. For example, the Upanishadic idea "Tat Tvam Asi" (That Thou Art) is philosophically abstract, but myths about divine incarnation and cosmic unity render this idea emotionally and imaginatively comprehensible.

### **2. Dharma as a Central Philosophical Concept**

One of the most significant philosophical ideas conveyed through Indian mythology is dharma—a multifaceted concept encompassing duty, righteousness, cosmic order, and moral responsibility. In the Ramayana, Rama represents ideal dharma, sacrificing personal happiness to uphold social and moral obligations. In the Mahabharata, dharma is portrayed as complex and situational, particularly in the Bhagavad Gita, where Krishna teaches Arjuna that duty must be performed without attachment to results (nishkama karma).

### **3. Karma, Rebirth, and Moral Causality**

Indian myths consistently explore the

philosophical doctrine of karma and samsara (cycle of birth and rebirth). Mythological narratives demonstrate that actions—moral or immoral—have consequences that transcend a single lifetime. Stories of kings like Harishchandra, characters like Karna, or mythic curses and boons in the Puranas reinforce the philosophical belief in moral causality and cosmic justice. Mythology thus acts as a pedagogical tool, teaching philosophy through narrative consequence rather than abstract reasoning alone.

### **4. Metaphysics and the Nature of Reality**

Indian mythology is rich in metaphysical symbolism. Concepts such as maya (illusion), lila (divine play), and advaita (non-duality) are embedded in mythic narratives. The cosmic dance of Shiva (Nataraja) symbolizes creation, preservation, destruction, illusion, and liberation—core metaphysical processes. The myth of Vishnu's avatars reflects the philosophical idea that the absolute reality manifests in multiple forms to restore cosmic balance. Here, mythology visualizes philosophical abstractions, allowing metaphysics to be grasped intuitively.

### **5. Myth as Psychological and Existential Philosophy**

Indian mythology also functions as a form of existential and psychological philosophy. Characters confront dilemmas of identity, suffering, desire, detachment, and liberation. Arjuna's despair in the Bhagavad Gita mirrors existential crisis, while Krishna's discourse offers a synthesis of jnana (knowledge), bhakti (devotion), and karma (action). The renunciation myths of sages and gods reflect philosophical paths toward self-realization and moksha. These narratives explore the inner life of human beings, making mythology a guide to self-understanding.

### **6. Symbolism and Allegory as Philosophical Tools**

Indian myths operate on multiple

levels-literal, symbolic, and allegorical. Deities, demons, battles, and journeys often represent internal philosophical struggles. The battle of Kurukshetra can be read as an inner moral battlefield. Demons (asuras) often symbolize ego, ignorance, and uncontrolled desire.

### **7. Continuity in Modern Thought and Literature**

Even in modern Indian thought and English literature, mythology continues to serve as a philosophical medium. Writers reinterpret myths to address contemporary questions of identity, ethics, power, and spirituality. This demonstrates the timeless philosophical relevance of mythological frameworks.

### **Preservation and Transmission of Knowledge through Indian Mythology**

Indian mythology has played a crucial role in the preservation and transmission of knowledge across centuries. Long before the widespread use of written texts, mythology functioned as a living archive of philosophical, ethical, scientific, social, and cultural wisdom. Through oral traditions, symbolic narratives, rituals, and performative arts, Indian mythology ensured that knowledge remained accessible, memorable, and adaptable to changing times.

#### **1. Oral Tradition and Collective Memory**

One of the most distinctive features of Indian mythology is its oral mode of transmission. The Vedas, Upanishads, Itihasas (Ramayana and Mahabharata), and Puranas were preserved for centuries through precise oral recitation (śruti and smṛiti traditions). Techniques such as ghanapāṭha, krama pāṭha, and jāpāṭha ensured accuracy and minimized textual corruption.

#### **2. Mythology as a Repository of Philosophical Knowledge**

Indian mythology encodes complex philosophical ideas in narrative form, making them intelligible to diverse audiences. Concepts such

as dharma, karma, moksha, rebirth, and cosmic order (ṛta) are embedded within mythic stories. The Bhagavad Gita, placed within the mythological framework of the Mahabharata, transmits profound metaphysical and ethical teachings through dialogue rather than abstraction.

#### **3. Scientific and Cosmological Knowledge in Mythic Form**

Indian mythology also preserves early scientific and cosmological understanding. Myths describing cyclical time (yugas) reflect advanced philosophical conceptions of temporality. Astronomical knowledge appears in mythic references to constellations, planetary deities (Navagrahas), and celestial events. Ayurvedic, ecological, and medical knowledge is embedded in myths surrounding sages, healing herbs, sacred rivers, and divine physicians like Dhanvantari.

#### **4. Ethical and Social Knowledge Systems**

Mythology has been a powerful medium for transmitting social norms, moral values, and legal principles. Epics model ideal and flawed human behavior through characters such as Rama, Sita, Yudhishtira, Karna, and Draupadi. Stories illustrate consequences of ethical choices, reinforcing collective moral education. Kingship, governance, gender roles, and social responsibilities are explored through mythic exemplars.

#### **5. Rituals, Festivals, and Performative Traditions**

Knowledge preserved in mythology is continuously transmitted through ritual practice and cultural performance. Festivals like Diwali, Dussehra, Holi, and Janmashtami reenact mythological events, reinforcing historical memory and values. Classical dance forms (Bharatanatyam, Kathakali, Odissi) and folk traditions narrate myths through embodied knowledge. Temple

iconography serves as a visual text, teaching philosophy and mythology to non-literate audiences.

## 6. Mythology and the Guru-Shishya Tradition

Indian mythology emphasizes the guru-shishya parampara, a pedagogical model central to knowledge transmission. Myths of sages like Vyasa, Vishwamitra, Vasistha, and Narada highlight disciplined learning, ethical conduct, and spiritual inquiry. Knowledge is portrayed not merely as information but as transformative wisdom, requiring moral readiness. Mythology thus reinforces epistemological values alongside content.

## 7. Adaptability and Regional Variations

A key reason for the longevity of Indian mythological knowledge is its adaptive nature. Myths exist in multiple regional, linguistic, and cultural versions without losing their core philosophical essence. Folk retellings and local traditions ensure inclusivity and continuity. This flexibility prevents stagnation and allows mythology to remain a living knowledge system.

## Role of Indian Mythology in Creating an Ethical and Moral Framework

Indian mythology has been central to the formation and sustenance of ethical and moral frameworks in Indian society. Far from being mere sacred stories, mythological narratives function as carriers of values, ideals, and norms that guide human conduct. By embedding ethical principles within stories, symbols, and exemplary characters, Indian mythology transforms moral philosophy into a lived and culturally resonant experience.

## 1. Dharma as the Foundation of Moral Order

The concept of dharma lies at the heart of Indian mythology and serves as its primary ethical framework. Dharma encompasses duty,

righteousness, justice, and social responsibility.

The Ramayana presents Rama as the embodiment of ideal dharma, where moral duty is placed above personal desire. The Mahabharata portrays dharma as complex and situational, showing that ethical choices often involve conflict and ambiguity. Through such narratives, mythology teaches that morality requires discernment rather than rigid adherence to rules.

## 2. Karma and Moral Accountability

Indian mythology reinforces ethical behavior through the doctrine of karma, which establishes a moral universe governed by cause and effect. Every action has consequences, whether immediate or across lifetimes. Stories of curses, boons, rebirth, and divine justice reinforce accountability and self-restraint.

## 3. Moral Education through Ideal and Flawed Characters

Mythological figures function as ethical exemplars. Ideal figures like Rama, Sita, Yudhishtira, and Harishchandra represent truth, sacrifice, loyalty, and integrity. Complex characters such as Karna, Ravana, and Duryodhana illustrate the ethical consequences of pride, attachment, and moral blindness.

## 4. Ethical Dilemmas and Moral Choice

Indian mythology frequently focuses on moments of ethical crisis, emphasizing moral agency. Arjuna's hesitation in the Bhagavad Gita highlights moral confusion and ethical paralysis. Krishna's teachings advocate nishkama karma-performing one's duty without attachment to results. Such narratives validate ethical struggle as an essential part of moral growth.

## 5. Social and Collective Ethics

Mythology extends ethics beyond the individual to society at large. Family ethics, including duties of parents, spouses, and siblings,

are central to mythic narratives. Kingship myths emphasize justice, compassion, and responsibility toward subjects. Reverence for nature-rivers, mountains, animals-promotes an ecological moral framework rooted in sacredness.

## 6. Transmission of Ethical Values through Culture and Ritual

Ethical frameworks preserved in mythology are continuously reinforced through rituals, festivals, storytelling, and performing arts. Festivals like Ram Navami, Dussehra, and Janmashtami reenact moral victories and ethical ideals. Temple iconography and folk traditions visually and orally transmit moral lessons. This ensures ethical continuity across generations.

Indian mythology plays a crucial role in creating and sustaining ethical and moral frameworks by integrating philosophy, narrative, and cultural practice. It does not impose morality as abstract law but nurtures ethical consciousness through stories that reflect human complexity, moral conflict, and spiritual aspiration.

## Indian Mythology as a Living Knowledge System

Indian mythology is not a static collection of ancient tales but a living knowledge system-dynamic, adaptive, and continuously interpreted across time. It functions as an integrated framework that preserves, transmits, and renews philosophical, ethical, scientific, cultural, and social knowledge.

### 1. Mythology beyond Storytelling

In the Indian tradition, mythology (itih?sa and pur??a) is regarded as a valid mode of knowledge. Myths communicate dar?anic (philosophical) ideas through narrative. Knowledge is conveyed not only through texts but through oral traditions, symbols, rituals, and performances.

### 2. Preservation and Transmission of Knowledge

Indian mythology has ensured continuity

of knowledge through multiple modes: Oral transmission safeguarded texts like the Vedas, epics, and pur??as over centuries. Rituals, festivals, and storytelling act as recurring educational practices. Regional retellings and folk traditions allow adaptability while preserving core values. This multi-layered transmission keeps mythological knowledge alive across generations.

### 3. Philosophical and Metaphysical Knowledge

Mythology encodes complex philosophical ideas in accessible forms. Concepts such as dharma, karma, moksha, atman, brahman, maya, and lila are embodied in mythic narratives. The Bhagavad Gita exemplifies how philosophical discourse is integrated within mythic context. Deities symbolize metaphysical principles rather than fixed dogmas. This ensures that philosophy remains relevant and relatable.

### 4. Ethical and Social Knowledge

Indian mythology provides moral frameworks guiding individual and collective behavior. Ethical dilemmas in the Ramayana and Mahabharata reflect real-life moral complexity. Mythology models social roles, responsibilities, and ideals of governance. Values such as compassion, sacrifice, justice, and non-violence are repeatedly reinforced. As society evolves, these ethical narratives are reinterpreted rather than discarded.

### 5. Scientific and Ecological Knowledge

Mythology preserves scientific awareness through symbolism. Cyclical cosmology reflects advanced notions of time and universe. Deification of rivers, forests, animals, and earth promotes ecological consciousness. Medical and biological knowledge appears in myths of healing, herbs, and balance. Scientific insights survive through cultural reverence and symbolic encoding.

## 6. Cultural Integration and Social Cohesion

As a living system, mythology unites diverse communities. Shared narratives coexist with regional diversity. Festivals and public performances create collective participation. Mythology provides a common cultural vocabulary across languages and regions. This integrative function sustains social harmony in a pluralistic society.

## 7. Adaptation and Contemporary Relevance

Indian mythology continually renews itself. Modern literature, cinema, graphic novels, and digital media reinterpret myths. Contemporary retellings address issues of identity, gender, power, and ethics. Mythological symbols are recontextualized to respond to modern challenges. Such adaptability confirms its status as living knowledge rather than closed tradition.

Indian mythology functions as a living knowledge system by integrating philosophy, ethics, science, culture, and spirituality into a dynamic narrative framework. Its strength lies in its ability to preserve ancient wisdom while remaining open to reinterpretation. By engaging with changing social realities without losing its core values, Indian mythology continues to shape thought, behavior, and identity in both traditional and modern contexts.

## Conclusion

Mythology forms the intellectual and cultural backbone of the Indian Knowledge System. By integrating philosophy, ethics, science, and spirituality into symbolic narratives, it enables holistic understanding and lifelong learning. Its enduring relevance lies in its ability to evolve while preserving foundational wisdom. Recognizing mythology as a legitimate and profound knowledge system allows for a deeper appreciation of India's intellectual heritage and its relevance in the modern world.

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## Study on Dietary and Hygiene Habits in Tribal Communities

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### ABSTRACT

*Health problems are widely prevalent in tribal communities. Although tribals are inherently hardy and resilient, they are frequently found to fall ill due to unsanitary conditions and a lack of nutritious food. The problem of malnutrition is also observed due to a lack of food security. It has been repeatedly observed that tribal communities are not particularly aware of education or hygiene. Due to poverty and unemployment in tribal communities, a balanced diet is not included in their daily meals, and due to ignorance, they lack knowledge about hygienic practices. All of this results in a substandard quality of life. Therefore, the researcher has attempted to present a study of dietary and hygienic habits in this context.*

**Keywords :** Nutritional diet, habits of hygiene, standard of living, health status of tribals etc.

### Introduction :

The tribal community is the oldest in all of humanity. A tribal person is someone who lives according to an old lifestyle, stays away from modern ways, and avoids contact with the outside world. Even today, the tribal community is seen to consider itself separate from mainstream society and constantly tries to remain isolated. Our constitution, as well as anthropologists like Dr. Ghurye and Dr. Verrier Elwin, has stated that the isolation of the tribal community is one of its defining characteristics. It is because of this isolation that this community is found to be educationally backward. Due to this educational backwardness, there is a lack of knowledge and awareness regarding health. Because of this ignorance about health, even serious diseases like malnutrition, sickle cell anemia, and sexually trans-

mitted diseases are neglected; proper care, medication, and dietary precautions are ignored. Consequently, problems such as infant mortality, weakness, premature death, incomplete physical development, and weak immunity are observed. This research attempts to study the impact of dietary and hygiene habits on the health of the tribal community.

### Lack Of Education and Ignorance About Health:

The tribal community is not very serious about education because, in their community, survival and getting through the present day are given more importance than education. There is a prevailing attitude that if their daily livelihood is secured through their traditional way of life, why worry about the future? The tribal community emphasizes a joyful way of life, which includes entertainment, socializing with the group, dancing, hunting, etc. This habit of simply getting through the day results in a lack of education and

employment. In Maharashtra, the school dropout rate among tribal students is 14.5%, while the unemployment rate is 2.5%. Both these rates are higher compared to other communities. Due to the lack of education, individuals do not acquire good habits or knowledge about health. Ignorance prevents them from understanding the relationship between hygiene and disease; consequently, the highest incidence of infectious diseases is observed in the tribal community. Furthermore, instead of seeking medical treatment from doctors, they rely on home remedies and traditional healers. This often leads to them facing even more serious illnesses instead of recovering from their ailments.

Due to the government's persistent initiatives, schools have been established in even the most isolated villages, leading to efforts to integrate the tribal community into formal education. However, they still fall significantly behind in terms of literacy and awareness. Their longstanding beliefs about the importance of preserving traditional customs hinder them from embracing external knowledge and using education to tackle health issues. As a result, they often rely on traditional views, which can foster superstition, dishonesty, and hypocrisy.

### **Tribals' diet and health hygiene:**

Indigenous diets are often rich in biodiversity, but systemic issues like geographical isolation and poverty frequently lead to nutritional deficiencies and hygiene-related health risks.

#### **1. Dietary Patterns and Nutritional Status:**

Tribal diets are typically characterised by a close relationship with the local ecosystem, though modern shifts have introduced "empty calories" through processed foods. Traditional tribal diets are rooted in a rich heritage of resilient staples like millets, pulses, and diverse forest produce such as wild tubers and mushrooms. These communities also maintain unique cultural traditions involving fermented beverages like Handia and Mahua, which provide essential probiotics and B-vitamins, though their consumption must be balanced with health

concerns. However, a stark nutritional paradox exists, as studies show tribal populations particularly women and children-frequently consume less than 80% of the Recommended Dietary Allowance for calories and proteins. This deficit leads to a high prevalence of anaemia, reaching up to 90% in some adolescent groups, further exacerbated by hookworm infestations and poor sanitation. Consequently, "hidden hunger" or micronutrient deficiency manifests in high rates of stunting and wasting among children under five. Ultimately, addressing these health disparities requires a holistic approach that bridges traditional dietary wisdom with improved modern healthcare and sanitation infrastructure to break the cycle of malnutrition.

#### **2. Health and Hygiene Habits:-**

Hygiene practices in tribal areas are often a mix of deep-rooted cultural beliefs and a lack of modern infrastructure. Maintaining personal and domestic hygiene remains a significant challenge for many tribal communities, where reliance on unprotected water sources like streams and ponds leads to frequent outbreaks of waterborne diseases. The prevalence of open defecation, driven by a lack of infrastructure or traditional preferences, further compounds these sanitation issues and increases the risk of illness. While traditional oral hygiene methods like Neem twigs are common, the introduction of refined sugars has led to a decline in dental health that current practices struggle to address. These physical challenges are deeply intertwined with local belief systems, where illness is often attributed to supernatural causes, making shamanic healing the primary recourse. Such reliance on "Jhad-phook" frequently delays critical medical intervention, leading to worsened outcomes for preventable conditions. Maternal health is particularly vulnerable, as unhygienic childbirth practices and restrictive dietary taboos contribute to high mortality rates. These taboos often prevent pregnant women from consuming essential nutrients, further weakening both mother

and child. Furthermore, the distance from modern healthcare facilities often cements the role of traditional healers as the sole providers of care. Ultimately, bridging the gap between these cultural beliefs and modern sanitary practices is essential for improving long-term health outcomes. Achieving this requires a sensitive approach that respects traditional wisdom while introducing life-saving hygiene and medical protocols.

### 3. Major Health Challenges :-

Tribal communities face a dual burden of disease as traditional health threats intersect with modern lifestyle ailments. Communicable diseases like malaria, tuberculosis, and leprosy remain endemic in hilly and forested regions due to environmental factors and limited access to healthcare. Simultaneously, the rise of non-communicable diseases (NCDs) such as hypertension and diabetes reflects a shifting landscape where lifestyles are becoming more sedentary and traditional millets are being replaced by processed grains. Furthermore, specific ethnic groups within these populations show a high genetic prevalence of disorders like G6PD deficiency and Sickle Cell Anaemia, with the latter affecting approximately 1 in 86 births among Scheduled Tribes in India. This complex health profile requires targeted interventions that address both long-standing infectious diseases and the emerging crisis of genetic and lifestyle-related conditions.

#### Illiteracy and Superstitions:

Illiteracy acts as a significant barrier that prevents tribal communities from transitioning toward safer health and nutritional practices. Without the ability to access or understand scientific information, many communities remain reliant on "generational myths" that can be physically harmful.

#### 1. Dangerous Nutritional Myths:-

In many illiterate tribal households, nutritional choices are governed by taboos rather than biological needs. Harmful dietary myths often undermine health in tribal communities,

particularly regarding maternal and infant care. A prevalent belief suggests that eating full meals during pregnancy will make the fetus too large and cause a difficult delivery, which leads women to intentionally eat less, resulting in low birth weight and maternal exhaustion. Similarly, the nutrient-rich "first milk" or colostrum is frequently discarded because it is perceived as dirty or stale, depriving newborns of vital antibodies and exposing them to infections through substitutes like honey or sugar water. These challenges are further complicated by the "Hot and Cold" theory, where foods are avoided based on perceived properties regardless of their actual temperature. For instance, during a fever or cough, nutritious citrus fruits and greens are often restricted because they are labelled as "cold," which unintentionally delays recovery by depriving the body of essential Vitamin C and other micronutrients.

#### 2. Hygiene and the Superstition Trap:-

Illiteracy often leads to a preference for supernatural explanations over germ theory, creating a cycle of unhygienic living. Cultural beliefs regarding sanitation and hygiene often lead to significant health risks, as building toilets near the home is sometimes viewed as "spiritually impure," sustaining the cycle of open defecation and chronic hookworm infestations that cause severe anaemia. Traditional wound care practices also pose grave dangers, with healers occasionally applying ash, mud, or cow dung to open injuries and newborn umbilical cords, which frequently results in life-threatening neonatal tetanus and sepsis. This risk extends to water management, where communities often rely on a visual assessment of purity; clear stream water is perceived as "blessed by the forest" and inherently safe, despite harbouring invisible bacteria or parasites. Because the concept of microscopic germs is not widely understood, the practice of boiling water is rarely adopted, leaving families vulnerable to preventable waterborne illnesses.

**3. Delayed Health Seeking Behaviour :-**The "bad side" of health habits is most visible in how tribal communities respond to emergencies. Because of illiteracy, a shaman (traditional healer) is often the first person consulted. The illness is attributed to an "evil eye" or an "angry ancestor." Time is wasted on rituals and animal sacrifices. By the time the patient reaches a modern hospital, the condition (like malaria or pneumonia) has often become terminal.

#### **Addictions and Marketing:**

Illiteracy makes these populations vulnerable to the aggressive marketing of tobacco and cheap country liquor. Without the ability to read health warnings, these substances are often integrated into daily life from a very young age, leading to high rates of oral cancer and liver disease.

#### **Summary:**

Tribal communities have a profound heritage of nutritious coarse grains and forest products; however, they encounter a significant nutritional paradox, with many individuals consuming less than 80% of their daily nutritional needs. This shortfall is worsened by certain cultural misconceptions, such as the idea that consuming a complete meal during pregnancy complicates childbirth or that nutrient-dense gruel is considered 'impure.' These beliefs have dire implications for the survival of mothers and children. Additionally, hygiene practices are shaped by tradition; many individuals depend on unsafe water sources regarded as 'sacred' by the forest, while the avoidance of household toilets for spiritual reasons perpetuates a harmful cycle of parasitic infections and anaemia. Moreover, the reliance on traditional healing methods and unsanitary wound care, such as the application of ash to the umbilical cord, hinders or obstructs essential medical treatment for endemic diseases like malaria and tuberculosis. Ultimately, the health of these communities is influenced by the intricate interaction of genetic disorders such as sickle cell anaemia and the evolving landscape of modern

lifestyle diseases, highlighting the need for a nuanced approach that combines traditional knowledge with contemporary medical practices.

#### **In conclusion:**

1. To live a healthy life, a tribal society requires education.
2. Having a hygienic awareness will always keep you smiling.
3. Education and habits of hygiene will surely improve their standard of living.
4. A country's health is always reliant on the hygienic habits of its citizens.

#### **Resolution:**

1. The education that could pull them out from superstitions should be given.
2. It should be observed that without cleanliness, some facilities should be restricted.
2. Rather than showing sympathy for their poor condition, people should make them aware of their illiteracy and ignorance.
3. Modifications must be made in the education system according to the tribals' requirements to improve their literacy rate.

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## Reflection of Social Life in Jane Austen's novels

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### ABSTRACT

*Jane Austen is one of the well-known novelists. In her novels she tried to portray realistic picture of contemporary English life. In her novels she depicts events in the daily life of people who lived in a social world which she knew very well. Although her novels generally deal with family, love and relationships. She tries to highlight harsh social realities of the period. In her novels she criticizes social conditions which governs the life of various characters. Often her characters seems to struggle between personal desires and social demands. Social class and social constraints play an important role in shaping people's lives. Her novels also throw light on women's condition and their status in Contemporary society.*

**Key words :** society, women, marriage, portrayal, relationship, class.

Jane Austen is one of the greatest of all the novelists. She was born at Stevenson in 1775. Her father Rev. George Austen was a clergyman. She took education at home. Due to the spread of education, feeling to express oneself became strong in women in this period. As a result, women started writing novels. Generally, their novels filled with emotions and contemporary social and domestic life. Jane Austen while doing household duties started writing novels. She had spent her life in small country parish. In her novels, she tried to present real social conditions contrary to her contemporary authors. She usually describes household activities, country gatherings and marriages in her novels. She mostly focused on the detail portrayal of the manners and behaviours of various characters in a specific

social environment.

In other words, Jane Austen presents eighteenth century world with its habits, tastes and appearances. She wrote just before the Industrial Revolution changed England's social life. Her novels depict relation between social conventions and individual. She confines herself to the limited part of contemporary society. Following are some of the novels which shows social class and economic status plays an important role in shaping various characters' views and life.

### **Pride and Prejudice**

Pride and Prejudice Published in 1813. In this novel, she illustrates the tragic aspects of marriage through the character of Mr. and Mrs. Bennet. The novel also deals with manners, education, morality and marriage in contemporary society. It is the story of Mr. and Mrs. Bennet's

five unmarried daughters i.e. Jane, Elizabeth, Mary, Kitty and Lydia and two neighbours Mr. Bingley and Mr. Darcy. Mr. and Mrs. Bennet who are not very wealthy wants their five daughters to marry above their social status and rich persons to secure their future financially. Bennet family has an estate, Longbourn but Mr. Bennet's daughters could not inherit it. Because according to the law after the death of Mr. Bennet this property was going to be Mr. Collins. Mr. Bingley is courteous but his friend Fitzwilliam Darcy seems to be arrogant and proud. After meeting, Jane Mr. Bingley becomes interested in her. Mr. Darcy also feels attracted to Elizabeth though she is below his social class. At first Elizabeth reject his proposal. Later when Elizabeth and Mr. Darcy overcomes their prejudice she accepts it. In this novel wealth and social status play an important role in characters lives.

### **Sense and sensibility**

It is the first novel of Jane Austen published in 1811. It is the story of three sisters Elinor, Marianne and Margaret Dashwood and their mother Mrs. Dashwood. After the death of Mr. Dashwood his son John inherits his estate of Norland and large fortune. Although his father had commanded him to take care of his sisters and mother he refuses to do so. John can easily afford to give money to his mother and sister but his wife persuades him not to give any money to them. As a result they are forced to leave their family estate and move to a cottage in rural Devonshire. In other words, they are left nearly destitute because being women they could not inherit the property of their father. Consequently, they have to struggle to fulfil financial needs. In addition there were very less opportunities for women to secure their own life financially. So marriage was considered to be a means of achieving desired social and economic status.

### **Emma**

Emma published in 1815 is a famous novel of Jane Austen. It is set in Highbury. It is about a young woman named Emma. She is clever and rich. She considers herself an excellent matchmaker and interferes in the life of her friends and neighbours. When Robert Martin, a farmer proposes to Harriet Emma thinking Robert is from a lower social class manipulates her to reject him. She wants her to marry Mr. Elton, the vicar in Highbury. It sheds light on contemporary people's views about social and economic status.

### **Northanger Abbey**

It was published in 1817. Like most of the novels of Jane Austen, it portrays the lives of wealthy families who spent most of their time at balls and parties. In this novel social class is given more importance. It is the story of a seventeen-year-old, an ordinary girl, Catherine Morland who is obsessed with gothic novels. Catherine falls in love with Henry Tilney, a smart, rich and intelligent young man. The good heartedness of Catherine attracts him. His father thinking that she is from a rich family and it would be a good match for his son, invites her to their estate i.e. Northanger Abbey. But later He considering Catherine poor disapproves their marriage. Soon, it becomes clear that John Thorpe lied to him about Catherine's social status. In the end, General Tilney gives consent to their marriage. It highlights how wealth and social status influence relationships.

In this way, Austen has depicted how social class and economic status influence people's views. Though her characters are from wealthy and privileged upper social class they are very concerned about their social and economic position in society. It influences man woman relationships and their lives. It illustrates reality of women's condition in the eighteenth century. They have to depend on their husband or father for the fulfilment of their

financial needs. They tried to secure their life financially by marrying in high social class family. They also could not inherit the property of their parents or family. In short, contemporary society gave more importance to financial and social status of people.

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## Implementing NEP 2020: Opportunities and Challenges

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### ABSTRACT

*The National Education Policy (NEP) 2020 represents a landmark reform initiative aimed at transforming India's education system to meet the demands of the twenty-first century. The policy envisions a holistic, flexible, multidisciplinary, and learner-centric educational framework aligned with global standards while remaining rooted in Indian values. NEP 2020 introduces several progressive opportunities, including competency-based curricula, integration of vocational and skill-oriented education, promotion of digital learning, emphasis on foundational literacy and numeracy, and enhanced focus on equity and inclusion. These reforms seek to improve access, quality, and relevance of education across school and higher education sectors. However, the effective implementation of NEP 2020 presents significant challenges. Infrastructural inadequacies, uneven digital access, limited financial resources, teacher preparedness, administrative complexities, and regional and linguistic diversity pose substantial barriers to uniform execution. The policy's success depends largely on institutional capacity, stakeholder readiness, and governance mechanisms at both central and state levels. This paper critically examines the key opportunities and challenges associated with the implementation of NEP 2020 through an analytical review of policy documents and existing literature. It also proposes strategic measures such as capacity building, phased implementation, strengthened teacher education, and improved governance frameworks to ensure the successful realization of the policy's transformative goals.*

**Keywords :** NEP 2020, Education Reform, Opportunities, Challenges, Indian Education System

### Introduction

Education is a fundamental instrument for social transformation, economic development, and national progress. In an era characterized by rapid globalization, technological advancement, and

evolving knowledge economies, education systems worldwide are undergoing significant reforms to remain relevant and inclusive. In India, the National Education Policy (NEP) 2020 represents a comprehensive response to these changing demands and seeks to overhaul the existing education system that had been governed by the National Policy on Education of 1986. NEP 2020

aspires to create an education framework that is holistic, multidisciplinary, flexible, and aligned with the needs of the twenty-first century (**Government of India, 2020**).

The policy emphasizes a shift from rote-based learning to competency-based education, fostering critical thinking, creativity, and problem-solving abilities among learners. It introduces structural reforms across all levels of education, including early childhood care and education, school education, higher education, teacher education, and vocational training. Key features such as the 5+3+3+4 curricular structure, multiple entry and exit options in higher education, integration of vocational education, and the promotion of mother tongue or regional languages as the medium of instruction reflect the policy's learner-centric and inclusive vision (**Kumar, 2021**).

NEP 2020 also underscores the importance of equity and access by focusing on socio-economically disadvantaged groups, digital learning initiatives, and the use of technology to expand educational reach. The policy aligns with global education agendas such as Sustainable Development Goal 4, which advocates inclusive and equitable quality education for all (UNESCO, 2021). Through institutional autonomy, multidisciplinary universities, and enhanced research ecosystems, NEP 2020 aims to position India as a global knowledge hub.

Despite its progressive vision, the implementation of NEP 2020 presents considerable challenges. Issues related to infrastructure, funding constraints, digital divide, teacher preparedness, governance complexities, and inter-state disparities pose significant barriers to effective execution (Tilak, 2020). Education being a concurrent subject in India further complicates uniform implementation across

diverse socio-cultural and regional contexts. Therefore, understanding both the opportunities and challenges associated with NEP 2020 is crucial for assessing its feasibility and long-term impact.

In this context, the present study seeks to critically analyze the opportunities offered by NEP 2020 and examine the challenges encountered in its implementation. Such an analysis is essential to bridge the gap between policy intent and practice and to ensure the successful realization of the transformative goals envisioned by NEP 2020.

### **Scope of the Study**

The scope of the present study is confined to an analytical examination of the opportunities and challenges associated with the implementation of the National Education Policy (NEP) 2020 in the Indian context. The study focuses primarily on reforms related to school education and higher education as outlined in the policy document. It examines key dimensions such as curriculum restructuring, pedagogical transformation, teacher education, digital learning initiatives, inclusivity, and governance mechanisms. The analysis is based on secondary sources, including policy documents, government reports, and scholarly literature, and does not involve empirical fieldwork or primary data collection. Geographically, the study is limited to India, acknowledging the diversity of its educational landscape and inter-state variations in implementation. The study does not assess learning outcomes or long-term impacts of NEP 2020 but concentrates on policy intent, implementation strategies, and existing constraints. This focused scope allows for a critical understanding of the feasibility and implications of NEP 2020 reforms.

### **Objectives;**

1. To study the major opportunities provided by the National Education Policy (NEP)

2020 for improving the quality and accessibility of education in India.

2. To identify and analyzed the key challenges faced in the effective implementation of the National Education Policy (NEP) 2020.

### Research Methodology

This study uses a descriptive research design based only on secondary data. Information was collected from the NEP 2020 policy document, government reports, books, and research journals, etc.

### Opportunities of New Education Policy 2020

#### 1. Holistic and Multidisciplinary Education

NEP 2020 promotes a flexible curriculum that allows students to study multiple subjects across streams such as arts, science, and vocational education. This approach fosters critical thinking, creativity, and problem-solving skills, enabling students to explore their interests and develop a well-rounded intellectual foundation (Government of India, 2020; Kumar, 2021).

#### 2. Skill and Vocational Development

The policy emphasizes vocational and skill-based education from early schooling, integrating practical skills with academic knowledge. This approach enhances employability and entrepreneurship, preparing students for future careers in diverse fields such as technology, agriculture, and healthcare (Tilak, 2020).

#### 3. Digital Learning and Technology Integration

NEP 2020 encourages the use of digital tools, online platforms, and virtual labs, facilitating remote and personalized learning. This initiative expands access to quality education, particularly in rural and underprivileged areas, bridging the digital divide and supporting lifelong learning (UNESCO, 2021).

#### 4. Teacher Empowerment and Professional Development

The policy underscores continuous teacher training, mentoring, and professional development. Well-trained teachers can adopt innovative teaching methods, modern assessment techniques, and technology-enhanced pedagogies, leading to improved learning outcomes (Government of India, 2020; Kumar, 2021).

#### 5. Inclusive and Equitable Education

NEP 2020 focuses on equity in education, targeting marginalized groups, girls, differently-abled children, and socio-economically disadvantaged students. Inclusive policies aim to reduce disparities in access, quality, and learning outcomes, supporting the Sustainable Development Goal 4 of quality education for all (UNESCO, 2021).

#### 6. Foundational Literacy and Numeracy

The policy prioritizes early childhood care and education (ECCE) to strengthen literacy and numeracy skills. Establishing strong foundations in the early years improves overall academic performance and prepares students for higher levels of learning (Government of India, 2020).

#### 7. Global Competitiveness

By promoting multidisciplinary and flexible learning, NEP 2020 aligns Indian education with international standards. This increases the competitiveness of students and institutions in global research, education, and employment opportunities (Tilak, 2020).

#### 8. Promotion of Research and Innovation

Higher education reforms under NEP 2020, including multidisciplinary universities, research centers, and institutional autonomy, encourage innovation and research-driven learning. This fosters knowledge creation and technological development, benefiting society and the economy (Kumar, 2021).

## Challenges of New Education Policy 2020

### 1. Infrastructural Limitations

Many schools and colleges in India lack basic infrastructure, digital tools, and internet connectivity, especially in rural and remote areas. Implementing technology-driven and skill-based education under NEP 2020 requires significant investments, which many institutions are currently unable to afford (Tilak, 2020; Yadav & Singh, 2022).

### 2. Teacher Preparedness

Teachers are central to NEP 2020, yet insufficient training and limited familiarity with new pedagogical approaches pose challenges. Many educators are unprepared for competency-based education, continuous assessment models, and digital teaching, which could affect the quality of learning (Kumar, 2021; Government of India, 2020).

### 3. Financial Constraints

NEP 2020 calls for major investments in infrastructure, technology, teacher training, and research. Limited budgetary allocations and dependence on state resources make uniform implementation difficult, particularly in economically weaker regions (Tilak, 2020).

### 4. Regional and Linguistic Diversity

India's cultural, linguistic, and socio-economic diversity makes it challenging to implement a standardized policy. Differences in resources, governance, and regional languages can lead to unequal adoption and effectiveness across states (UNESCO, 2021).

### 5. Digital Divide

Although NEP emphasizes digital learning, unequal access to devices, internet connectivity, and digital literacy threatens to widen the gap between urban and rural learners, potentially reinforcing educational inequities (Yadav & Singh, 2022).

## 6. Administrative and Governance Challenges

The successful execution of NEP 2020 depends on effective coordination between central and state governments. Bureaucratic delays, lack of monitoring mechanisms, and overlapping authority can hinder timely policy implementation (Government of India, 2020).

### 7. Resistance to Change

Educational institutions, teachers, and other stakeholders may show resistance to new methods, curricula, or reforms due to traditional practices or fear of adaptation. This can slow down the pace of reform (Kumar, 2021).

### 8. Financial Constraints

NEP 2020 demands large-scale investments in infrastructure, digital technology, research, and teacher training. Many states may struggle to mobilize the necessary funds, affecting equitable implementation (Yadav & Singh, 2022).

### Major findings:

1. Inadequate infrastructure, limited funding, and the digital divide—especially in rural and economically weaker regions—pose major barriers to the effective and equitable implementation of NEP 2020.
2. Insufficient teacher preparedness, administrative complexities, regional diversity, and resistance to change hinder the smooth adoption of new pedagogical approaches and reforms envisioned under the policy.
3. NEP 2020 promotes holistic and multidisciplinary education by integrating academics with skills and vocational learning, improving employability and lifelong learning.
4. It enhances equity, accessibility, and quality in education through technology integration, teacher development, and

inclusive policies, benefiting especially disadvantaged groups.

### Suggestion:

1. Increase government funding and public-private partnerships to strengthen infrastructure and digital access, especially in rural areas.
2. Provide continuous teacher training and capacity-building programs focused on new pedagogies and digital skills.
3. Ensure flexible, region-specific implementation to address linguistic and socio-economic diversity.
4. Improve coordination between central and state governments with strong monitoring and accountability mechanisms.

### Conclusion

The National Education Policy 2020 represents a paradigmatic shift in India's educational philosophy, emphasizing holistic development, multidisciplinary learning, inclusivity, and global competitiveness. The policy offers substantial opportunities to reorient education towards learner-centric, skill-based, and technology-enabled models. However, the successful realization of these reforms is contingent upon addressing critical challenges such as infrastructural deficits, teacher capacity building, inter-state disparities, governance complexity, and the persistent digital divide.

The study concludes that NEP 2020 is visionary in intent but faces significant execution-related constraints. A phased, context-sensitive, and adequately funded implementation strategy—supported by continuous monitoring, institutional autonomy, and stakeholder collaboration—is essential. Strengthening teacher education, decentralizing governance, and ensuring equitable access will be decisive factors in translating NEP

2020 from policy discourse into sustainable educational transformation.

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## Data Protection and Cybersecurity in the Age of Digital Transformation: Legal and Ethical Insights

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### ABSTRACT

*The accelerated proliferation of digital technologies has profoundly influenced global economic systems, communication networks, and governance mechanisms, while simultaneously intensifying cybersecurity and data privacy concerns. This research examines the legal and ethical challenges associated with the protection of personal and institutional data within digital ecosystems. The rising prevalence of cyber threats, including data breaches, ransomware incidents, and cyber espionage, underscores the critical need for comprehensive regulatory frameworks and ethically informed digital practices. The study evaluates prominent international and Indian legal instruments, notably the General Data Protection Regulation (GDPR) and the Digital Personal Data Protection Act (DPDPA, 2023), in conjunction with ethical principles of privacy, informed consent, and accountability. The findings reveal that despite significant legal progress in enhancing data subject rights, deficiencies persist in enforcement, corporate compliance, and transnational data governance. The paper concludes by advocating for a balanced cyber-security framework that aligns legal compliance with ethical governance.*

**Keywords:** Cyber-security, Data Privacy, Digital Ethics, Legal Frameworks, GDPR, DPDPA 2023, Information Security, Digital Governance

### Introduction

In the contemporary digital era, data has emerged as a vital economic and strategic asset that underpins innovation, public administration, and international commerce. However, the extensive collection, analysis, and commercialization of personal and behavioral data have significantly increased individuals' exposure to privacy breaches, identity fraud, and cyber-related risks. The rapid adoption of technologies such as artificial intelligence, big data analytics, and cloud-based

platforms has further intensified data security challenges, leading to heightened concerns regarding legal safeguards and ethical accountability.

Recent estimates by Cybersecurity Ventures (2024) indicate that the global economic impact of cybercrime is expected to reach approximately USD 10.5 trillion annually by 2025. This projection underscores that cybersecurity has evolved beyond a purely technical concern to become a critical issue of legal regulation and

governance. At the same time, growing apprehensions surrounding mass surveillance, algorithmic discrimination, and digital influence operations emphasize the ethical implications of data privacy in modern societies. In the Indian context, flagship initiatives such as Digital India, Aadhaar, and the Unified Payments Interface (UPI) have transformed service delivery and financial inclusion, while simultaneously raising concerns related to data protection, surveillance, and misuse. Against this backdrop, the present study investigates the complex interaction between technological advancement, legal frameworks, and ethical principles. It seeks to explore how states and institutions can effectively safeguard individual rights and data privacy without obstructing innovation and digital growth.

### Methodology Objectives

The objectives of this study are as follows:

1. To examine international and Indian legal frameworks governing cyber-security and data protection.
2. To analyze the ethical challenges arising from large-scale digital data collection, processing, and surveillance practices.
3. To evaluate the influence of cyber-security policies on user trust, institutional transparency, and organizational accountability.
4. To propose strategic recommendations that promotes a balanced integration of security, privacy protection, and technological innovation.

### Research Design:

A doctrinal and analytical approach was adopted, reviewing laws, case studies, and policy documents. Secondary data were collected from international legal databases, government reports, and cyber-security surveys.

### Data Sources:

- General Data Protection Regulation (EU,

2018)

- Digital Personal Data Protection Act (India, 2023)
- National Cyber Security Policy (India, 2020 Draft)
- IT Act, 2000 and its Amendments
- Reports by CERT-In, NIST, and UNCTAD
- Scholarly journals and cyber-security whitepapers

### Tools of Analysis:

- Comparative legal analysis of privacy laws
- Case study method for major data breaches
- Ethical assessment using deontological and utilitarian frameworks

### Case-1: Global and Indian Perspectives on Data Protection Case 1: The GDPR Framework (European Union)

The General Data Protection Regulation (GDPR) sets the global benchmark for data privacy, emphasizing principles of lawfulness, fairness, transparency, data minimization, and accountability. It empowers individuals with rights to access, rectify, erase, and restrict processing of personal data. Its stringent penalties (up to €20 million or 4% of annual global turnover) have pushed global corporations toward compliance-driven ethics. However, challenges persist regarding cross-border data transfers and enforcement in non-EU jurisdictions.

### Case-2: The Indian Context – Digital Personal Data Protection Act (DPDPA), 2023

India's DPDPA (2023) marks a significant step in codifying citizens' digital rights. The Act mandates explicit consent for data processing, recognizes the right to information and grievance redressal, and establishes the Data Protection Board of India (DPBI). Yet, critics argue that exemptions for government agencies and national security may weaken privacy guarantees. The

coexistence of DPDPA with the IT Act, 2000 also creates interpretational overlaps. Despite this, DPDPA lays a strong foundation for balancing digital innovation with individual autonomy.

### Case-3: Major Cybersecurity Incidents

**Cambridge Analytica Scandal (2018):** Misuse of Facebook user data for political profiling highlighted ethical failures in consent and data transparency.

**Aadhaar Data Leak (India, 2019):** Exposed vulnerabilities in national digital ID systems, revealing weaknesses in data storage and access control.

**WannaCry Ransom ware Attack (2017):** A global cyber-attack affecting over 200,000 systems in 150 countries underscored the importance of international cyber-security collaboration. These incidents reinforce the urgent need for multi-stakeholder governance, ethical corporate behavior, and proactive legal enforcement.

### Data Analysis:

#### 1. Overview of Data Analysis Approach

The data analysis in this study is primarily **qualitative and analytical**, reflecting the interdisciplinary nature of the research. Given the conceptual and policy-oriented scope of cybersecurity, data privacy, and digital ethics, the analysis focuses on synthesizing evidence from secondary data sources rather than generating primary numerical datasets. The approach integrates **thematic analysis**, **comparative legal analysis**, and **conceptual mapping** to identify patterns, relationships, and tensions across technical, ethical, and regulatory domains.

The analysis is guided by the research questions, which seek to understand how cybersecurity practices influence data privacy, how ethical challenges emerge from digital technologies, and how existing policy frameworks respond to these challenges.

#### 2. Sources of Data

The data analyzed in this study were collected from multiple authoritative and scholarly sources, including:

- Peer-reviewed research articles in cybersecurity, privacy, and ethics
- International standards and frameworks (e.g., NIST Cyber-security Framework, ISO/IEC 27001, ISO/IEC 27701)
- Legal and policy documents such as GDPR, Digital Personal Data Protection Act (India, 2023), and CCPA
- Reports from international organizations (OECD, World Economic Forum, ENISA)
- Documented case studies of data breaches, cyber-attacks, and surveillance practices

These sources provide a comprehensive and reliable foundation for interdisciplinary analysis.

#### 3. Thematic Analysis

A **thematic analysis** was conducted to identify recurring concepts and concerns across the literature. Key themes that emerged include:

**Security–Privacy Trade-offs:** Many studies highlight the tension between strong security measures (such as surveillance and data monitoring) and individual privacy rights.

**Ethical Responsibility:** Ethical accountability of organizations and developers is emphasized, particularly in relation to data misuse, algorithmic bias, and lack of transparency.

**Trust and Accountability:** Trust is repeatedly identified as a critical outcome of effective cybersecurity and privacy practices.

**Regulatory Fragmentation:** Differences in national and regional data protection laws create compliance challenges in a global digital ecosystem. These themes were systematically categorized and linked to cyber-security practices, privacy principles, and ethical frameworks.

#### 4. Comparative Legal and Policy Analysis

The study undertakes a **comparative analysis** of major data protection and cyber-security regulations. GDPR, for example, places strong emphasis on consent, transparency, and data subject rights, while the Indian Digital Personal Data Protection Act focuses on lawful processing and fiduciary responsibility.

The analysis reveals that:

- Regulations increasingly recognize privacy as a fundamental right.
- Enforcement mechanisms and penalties vary significantly across jurisdictions.
- Ethical considerations are often implicit rather than explicitly operationalized in legal texts.
- This comparison highlights the need for harmonized global standards that integrate ethical principles into enforceable policy frameworks.

#### 5. Analysis of Privacy-Preserving Technologies

The data analysis also evaluates the effectiveness of **privacy-preserving technologies** such as encryption, anonymization, differential privacy, and federated learning. While these technologies significantly reduce privacy risks, the analysis shows that:

- Technical solutions alone cannot prevent unethical data use.
- Poor implementation or lack of governance can undermine privacy protections.
- Ethical oversight is required to ensure proportionality and fairness in data processing.

Thus, technology must be complemented by organizational policies and ethical guidelines.

#### 6. Ethical Analysis

Ethical analysis was conducted using established frameworks such as **utilitarianism**,

**deontological ethics**, and **information ethics**.

This analysis reveals that:

- Utilitarian approaches often justify data collection for security or efficiency, sometimes at the cost of individual rights.
- Deontological perspectives emphasize consent, dignity, and autonomy, reinforcing privacy protections.
- Information ethics expands moral responsibility to digital systems and data environments.

The findings indicate that ethical pluralism is necessary to address complex digital challenges.

#### 7. Interpretation of Findings

The integrated analysis demonstrates that cyber-security, data privacy, and digital ethics are **mutually reinforcing rather than competing domains**. Effective cyber-security enhances privacy protection, ethical governance increases public trust, and strong data protection laws encourage responsible innovation.

However, misalignment among technical design, ethical intent, and policy enforcement leads to systemic vulnerabilities and social harm.

#### 8. Limitations of the Analysis

This study relies on secondary data and conceptual analysis, which limits empirical generalization. Rapid technological change may also outpace existing literature and regulatory frameworks. Nevertheless, the interdisciplinary analytical approach provides robust insights into structural and normative challenges.

#### 9. Summary of Data Analysis

The data analysis confirms that addressing cyber-security and data privacy challenges requires more than technical solutions. Ethical reasoning and policy alignment are essential to ensure fairness, accountability, and sustainability in digital systems. The findings support the need for **ethics-by-design and privacy-by-design** as foundational principles for future digital governance.

**Table 1: Comparative Overview of Major Global Data Protection Laws**

Feature	GDPR (European Union)	DPDPA (India)	CCPA (California)	PIPEDA (Canada)
Year of Implementation	2018	2023	2020	2001
Consent Framework	Explicit and granular consent	Explicit consent	Opt-out mechanism	Informed consent
Regulatory Authority	European Data Protection Board	Data Protection Board of India	California Privacy Protection Agency	Office of the Privacy Commissioner
Maximum Penalty	€20 million or 4% of global turnover	Up to ₹250 crore	Up to \$7,500 per violation	Up to CAD 100,000
Cross-Border Data Transfers	Restricted	Conditionally permitted	Generally permitted	Conditionally permitted
Data Subject Rights	Extensive (access, rectification, portability, erasure)	Moderate	Access and deletion	Access and correction

**Interpretation:**

The General Data Protection Regulation (GDPR) continues to serve as the benchmark for comprehensive data protection frameworks globally. In contrast, the Digital Personal Data Protection Act (DPDPA), 2023 reflects India’s

effort to adapt data protection principles to the context of a developing digital economy. While the Indian framework emphasizes national data governance and economic adaptability, concerns remain regarding enforcement effectiveness and institutional capacity.

**Table 2: Ethical Challenges in Cybersecurity and Data Privacy**

Ethical Dimension	Key Challenge	Illustrative Example	Policy Implication
Consent and Autonomy	Users often consent without full understanding	Lengthy and complex digital consent agreements	Adoption of simplified and meaningful consent mechanisms
Surveillance and Civil Liberties	Excessive monitoring by state authorities	National security data interception programs	Need to balance security objectives with privacy rights
Algorithmic Bias	Discriminatory outcomes from automated systems	AI-driven recruitment and credit scoring tools	Mandatory ethical audits and fairness assessments
Accountability	Weak corporate responsibility in data misuse	Facebook–Cambridge Analytica scandal	Stronger penalties and mandatory data ethics training
Data Ownership	Ambiguity over control and ownership of personal data	Cloud-based storage of user information	Legal recognition of personal data as a protected asset

**Interpretation:**

The ethical challenges associated with cybersecurity and data privacy largely arise from asymmetries in information and power, where organizations exert significant control over user data with limited transparency. Legal

compliance alone is insufficient to address these concerns. Ethical digital practices—emphasizing accountability, transparency, and user empowerment—are essential for rebuilding public trust and ensuring responsible data governance.

**Questionnaire:**

1. How aware are users of their data privacy rights under current laws?
2. What mechanisms ensure corporate accountability for data breaches?
3. How can cyber-security measures be enhanced without violating individual privacy?
4. Are existing privacy laws sufficient for emerging technologies like AI and IoT?
5. What ethical principles should guide government surveillance in digital governance?

**Conclusion:**

The interplay of cyber-security, law, and ethics defines the stability of the modern digital ecosystem. While technological advancement has created unprecedented opportunities, it has also exposed societies to data exploitation, identity theft, and algorithmic manipulation. The legal frameworks—such as GDPR and DPDPA (2023)—represent milestones in recognizing data as a fundamental right; yet effective implementation requires ethical leadership, digital literacy, and institutional accountability.

To build a resilient digital society, policymakers must adopt a holistic governance model emphasizing:

- Privacy-by-design in technology architecture.
- Global harmonization of data protection laws.
- Corporate transparency through ethical AI and cyber-security audits.
- Citizen empowerment via awareness and grievance mechanisms.
- Cross-border cooperation to combat cybercrime effectively.

Cyber-security and data privacy are not merely technical issues—they are moral imperatives that will determine the trustworthiness and inclusiveness of the digital future.

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## The Role of Digital Marketing in the Implementation of Financial Products

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### ABSTRACT

*In the contemporary financial landscape, digital marketing has emerged as a critical driver of consumer engagement and product adoption. Financial institutions increasingly rely on digital channels—social media, mobile apps, emails, search engines—to influence customer behaviour and accelerate the adoption of financial products such as digital banking, insurance, investment platforms, and payment services. This paper examines the theoretical foundations, empirical evidence, and practical mechanisms through which digital marketing impacts the adoption of financial products. Drawing upon Technology Acceptance Model (TAM), Diffusion of Innovations (DOI), and customer behavioural models, this study reviews extant literature, synthesizes key findings, and proposes an integrated conceptual framework. It highlights key factors—trust, perceived usefulness, digital literacy, and targeted digital marketing strategies—that mediate this relationship.*

*The research concludes that digital marketing significantly enhances adoption rates by improving awareness, shaping attitudes, and building trust, although challenges related to digital divide and perceived risk remain. The paper provides actionable insights for marketers, financial institutions, and policymakers.*

**Keywords:** Digital marketing, financial product adoption, consumer behaviour, digital channels, financial services.

### Introduction

The rapid digitization of financial services has transformed both marketing strategies and consumer adoption behaviours. FinTech platforms, mobile banking, digital wallets, and online investment services are reshaping how financial products are presented, marketed, and consumed. Digital marketing—defined as the use of digital channels and technologies to communicate value propositions

and engage customers—has gained prominence as a tool for financial institutions to reach diverse market segments, reduce information asymmetry, and influence adoption decisions.

Historically, financial products such as insurance policies, investment accounts, and credit cards were promoted through traditional media and personal selling. Today, digital marketing channels such as social media, search engine marketing,

email campaigns, and influencer collaborations enable financial brands to interact with prospective customers in real time and personalize communications based on behavioural data. This shift is particularly salient in emerging economies like India, where mobile Internet penetration has unlocked new opportunities for digital financial engagement.

However, the relationship between digital marketing and adoption of financial products is complex. Adoption does not merely depend on exposure to digital marketing but also on consumers' perceptions of usefulness, ease of use, trust in digital platforms, and socio-demographic factors (e.g., age, financial literacy). With technology becoming ubiquitous, financial institutions must align digital marketing strategies with user-centric adoption frameworks.

This paper explores the nuances of this relationship through a compilation and synthesis of theoretical insights and empirical evidence, drawing attention to mechanisms that elevate adoption and barriers that may constrain it.

Literature Review:

### **Digital Marketing in Financial Services**

Digital marketing encompasses a range of activities that leverage digital communication channels to attract and retain customers. In the financial context, digital marketing involves search engine optimization (SEO), social media campaigns, content marketing, email promotions, and interactive mobile advertising. These strategies help financial institutions disseminate product information, target precise customer segments, and create personalized experiences.

Several studies have underscored the growing role of digital marketing in reshaping financial engagement. For example, digital campaigns have enhanced the visibility of FinTech

platforms among Gen Z consumers, with social media marketing moderating perceived usefulness and behavioural intention to adopt financial technology services.

### **Technology Acceptance Model (TAM):**

TAM posits that perceived usefulness and perceived ease of use influence behavioural intention and subsequent adoption of technology (Davis, 1989). In financial contexts, digital marketing can enhance perceived usefulness by educating users about the benefits of online financial products and by reducing perceived complexity.

### **Diffusion of Innovations (DOI):**

This theory explains how new ideas and products spread through populations over time. Digital marketing accelerates diffusion by increasing early awareness among potential adopters and influencing opinion leaders who drive broader acceptance. Additionally, trust and security are crucial in financial service adoption. Several empirical studies indicate that perceived trust, influenced by transparent digital marketing communication, can significantly augment adoption intention.

### **Digital Marketing and Consumer Behaviour in Financial Adoption:**

A key theme in literature is the influence of digital marketing on consumer behaviour, particularly attitudes and intention to adopt financial services. Digital marketing can increase awareness of financial products by reaching consumers through personalized and targeted channels. It also shapes attitudes by highlighting product benefits, addressing concerns, and showcasing user testimonials which build credibility. It enhances engagement by fostering ongoing communication and tailored content that resonates with consumer needs.

Research shows that targeted digital marketing messages can strengthen the relationship between perceived usefulness and behavioural intention to adopt digital financial services, especially among younger demographics like Gen Z.

### **Barriers to Adoption: Trust, Risk and Literacy**

Despite its potential, digital marketing alone cannot guarantee adoption barriers that are include are as follows:

**Perceived Risk and Security Concerns:** Fear of data breaches, identity theft, and financial loss can deter potential adopters. Studies have shown that perceived risk negatively affects adoption intention in digital finance contexts.

**Digital Financial Literacy:** Consumers lacking digital literacy may struggle to interpret digital marketing messages or navigate digital platforms effectively.

**Socio-Demographic Factors:** Variables such as age, income, and gender can moderate the influence of digital marketing on adoption.

Understanding these barriers is essential to designing effective digital marketing strategies that go beyond basic outreach and actively build trust and capability.

### **Conceptual Framework:**

Based on the literature, this study proposes a conceptual model that links digital marketing strategies with consumer adoption of financial products, mediated by perceived usefulness, trust, and digital literacy.

(Digital Marketing Strategies) → (Awareness & Engagement) → (Perceived Usefulness & Trust) → (Behavioural Intention) → (Adoption of Financial Product)

### **Where:**

Digital marketing strategies include targeted social media campaigns, SEO content, email marketing, and interactive digital interfaces.

Perceived usefulness refers to the degree to which a consumer believes a financial product will enhance financial capabilities. Trust represents confidence in security, credibility of the financial provider, and reliability of digital platforms. Digital literacy moderates how effectively consumers interpret digital messages and act on them.

### **Research Methodology:**

This research adopts a systematic literature review approach to explore the relationship between digital marketing and adoption of financial products. Peer-reviewed studies, industry reports, and published research from journals such as *Business Theory and Practice*, *Frontiers in Psychology*, and *Technological Forecasting and Social Change*, were analysed.

The review included empirical and conceptual studies published in the last decade to identify patterns and synthesize findings relevant to digital marketing's role in financial adoption.

### **Findings and Results:**

**Impact of Digital Marketing on Awareness and Adoption:**

Multiple studies confirm that digital marketing significantly increases awareness about financial products. For example, social media marketing has been shown to enhance behavioural intentions to adopt mobile financial services, particularly among tech-savvy demographic groups. Furthermore, research indicates that digital marketing acts as a mediator between technological innovations and inclusion outcomes. For instance, digital marketing partially mediates the link between FinTech and financial inclusion in a banking sector context, suggesting its role in bridging knowledge gaps and facilitating engagement.

### **Role of Perceived Usefulness and Trust:**

Perceived usefulness consistently emerges as a strong predictor of adoption intention. Digital

marketing that highlights convenience, cost-savings, and personalized financial insights significantly boosts perceived usefulness. Likewise, transparent and informative digital campaigns increase trust, which directly influences adoption decisions.

#### **Moderating Effects of Digital Literacy:**

Digital literacy emerges as a critical moderator: individuals with higher digital financial literacy interpret and engage with digital marketing more effectively, leading to increased adoption. In contrast, low literacy can dampen the influence of digital marketing messages.

#### **Challenges and Barriers:**

Barriers such as security concerns and lack of trust in digital platforms remain significant hurdles. Research has shown that perceived risks associated with digital finance can reduce adoption intention unless countered by strong digital marketing messages emphasizing security features.

#### **Synthesizing Evidence:**

The synthesis reveals that digital marketing plays a multi-faceted role in the adoption of financial products. It acts not only as a communication channel but also as a strategic lever that influences multiple layers of consumer psychology:

**Awareness:** Digital campaigns introduce financial products to a wider audience, often at a fraction of the cost of traditional media.

**Engagement:** Interactive content, customer reviews, and educational material build deeper engagement.

**Trust Building:** Frequent, transparent digital messaging enhances credibility and reduces perceived risks. This aligns with the TAM perspective, which suggests that perceived usefulness and ease of use, influenced by digital marketing, are pivotal to adoption outcomes.

#### **Practical Implications for financial institutions:**

Invest in targeted digital marketing that

leverages data analytics to personalize messaging. Emphasize security features and educational content to build trust and reduce perceived risks. Develop digital literacy initiatives to empower customers to interpret and act on digital messages.

#### **For policymakers:**

Promote digital financial literacy as a public good to enhance financial inclusion.

Encourage regulatory frameworks that protect consumer data and build trust in digital financial ecosystems.

#### **Extended Analysis of Digital Marketing Dimensions in Financial Product Adoption**

##### **Role of Social Media Marketing**

Social media marketing has become one of the most influential digital marketing tools in the financial services sector. Platforms such as Facebook, Instagram, LinkedIn, X (Twitter), and YouTube allow financial institutions to communicate directly with consumers, provide educational content, and humanize financial brands.

**Social media impacts adoption through** information dissemination, financial literacy videos, explainer reels, and infographics simplify complex financial products such as mutual funds, insurance, and digital loans.

**Social influence:** Peer reviews, influencer endorsements, and testimonials reduce uncertainty and perceived risk.

#### **Two-way communication:**

Consumers can ask questions, lodge complaints, and receive instant feedback, which enhances trust and engagement. Empirical studies suggest that social media marketing positively influences attitude toward financial products, which in turn strengthens behavioural intention to adopt. This effect is particularly strong among younger consumers and first-time users of financial products.

### **Search Engine Marketing and Content Marketing:**

Search engine marketing (SEM) and content marketing play a critical role in the information search stage of consumer decision-making. Consumers increasingly rely on Google searches such as “best investment app” or “safe digital insurance platform” before making financial decisions. High-quality content such as, Blogs on financial planning, educational webinars, Whitepapers and FAQs, Comparison tools. It helps to reduce information asymmetry, a major issue in financial markets. Content marketing improves perceived usefulness and credibility, leading to higher adoption likelihood.

Research indicates that consumers exposed to educational financial content through digital channels exhibit higher trust levels and lower resistance to adoption compared to those exposed only to promotional advertisements.

### **Email and Mobile Marketing:**

Email marketing and mobile notifications are cost-effective and highly personalized digital marketing tools. Financial institutions use these channels to notify customers about new products, send reminders and alerts and offer personalized financial recommendations

Personalization increases relevance, which enhances engagement and adoption. However, excessive communication may lead to information overload and privacy concerns, highlighting the need for balanced digital marketing strategies.

### **Psychological Mechanisms Linking Digital Marketing and Adoption:**

#### **Trust Formation in Digital Finance**

Trust is a central determinant in the adoption of financial products due to the high perceived risk involved. Digital marketing influences trust through transparent communication

about fees and risks, Display of certifications, compliance, and security features.

### **Consistent brand messaging across platforms:**

Trust acts as both a mediator and moderator between digital marketing exposure and adoption intention. Studies confirm that even highly useful financial products may fail if trust is not established through effective digital communication.

### **Perceived Risk Reduction:**

Perceived risk in digital financial services includes: It includes financial risk, privacy risk and performance risk. Digital marketing campaigns that emphasize encryption, regulatory compliance, and customer support help mitigate these concerns. Video demonstrations and real-time customer service chatbots further reduce uncertainty.

### **Role of Digital Financial Literacy**

Digital financial literacy determines how effectively consumers understand and act upon digital marketing messages. Consumers with higher literacy: It provides better interpret digital content. It also evaluates financial claims critically and also adopts financial products faster. Thus, digital literacy strengthens the relationship between digital marketing and adoption. Financial institutions increasingly incorporate educational marketing to simultaneously promote products and build user competence.

Digital marketing has indeed emerged as a catalyst for the adoption of financial products, particularly in the context of the evolving consumer landscape and technological advancements. The integration of e-commerce and digital marketing strategies has been shown to significantly influence the financial performance of businesses, especially micro-, small-, and medium-sized enterprises (MSMEs). During periods of crisis, such as the COVID-19 pandemic, digital marketing has played a crucial role in enabling financial institutions to

maintain and even enhance their customer base. The shift towards online channels has been accelerated by economic downturns, with many institutions increasing their investment in online marketing while reducing spending on traditional channels. Furthermore, the adoption of digital marketing in the financial sector is not just about promoting products but also about transforming the customer experience. Financial services marketing leaders are encouraged to prioritize initiatives that focus on digital transformation, customer acquisition, and personalization.

### Conclusion

Digital marketing is no longer a supporting tool but a strategic driver of financial product adoption. By influencing awareness, trust, perceived usefulness, and consumer confidence, digital marketing significantly reshapes financial decision-making. Financial institutions that align marketing strategies with consumer psychology and digital literacy stand to achieve higher adoption and long-term customer engagement. It has emerged as a central catalyst in the adoption of financial products. By increasing awareness, shaping attitudes, fostering trust, and addressing barriers related to perception and literacy, digital marketing significantly contributes to consumer adoption decisions. While opportunities remain vast—particularly in emerging markets—financial institutions must deploy sophisticated digital strategies that recognize consumer needs and psychological drivers.

In light of these findings, it is evident that digital marketing is not merely a tool for customer engagement but a strategic asset that can significantly influence the adoption of financial products. Financial institutions that leverage digital marketing intelligently are poised to outperform their peers and secure a robust position in the evolving financial landscape.

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## Studies on post harvest Seed-Borne Fungal Pathogens of Sorghum Prevailing in Karjat Ahilyanagar, Maharashtra

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### ABSTRACT

A laboratory experiment was conducted in the Research Centre, Department of Botany, Smt. S. K. Gandhi Arts, Amolak Science and P. H. Gandhi Commerce College, Kada. Sorghum is one of the world's most significant cereal crops along with rice and wheat with several production. Among the climatic factors, pollution, biotic and abiotic stresses, diseases are one of the most important limiting factors in sorghum production, which also include seed-borne fungal diseases. The study, including the five fungal species found from four locations of the karjat Ahilyanagar region, Maharashtra, revealed that the pathogens like *Fusarium spp.*, *Alternaria.*, *Aspergillus spp.*, *Drechslera*, *Curvularia lunata.* Found associated with Sorghum seeds collected in four location trials. Among the pathogens, *Aspergillus spp.* was found dominant in seeds from all the locations, followed by a The seed samples from the Karjat location were recorded as having the highest mean location infection and the Jamkhed location was recorded as having the lowest mean location infection

**Keywords:** Seed-borne fungi; *Fusarium*, *Aspergillus*; *Drechslera spp.*, sorghum, seed infection, seed health test

### Introduction:

Sorghum [*Sorghum bicolor* (L.) Moench] is the fifth most important cereal after rice, wheat, maize and barley. It is the staple food grain for over 750 million people who live in the semi-arid tropics of Africa, Asia, and Latin America (Diener et al. 1981; Wilson et al. 1995). Global production of sorghum is currently estimated for 57.6 million tonnes, with Asian countries contributing 20% of the total production. Within Asia, India is the largest producer of sorghum In India, major states that produce sorghum are Maharashtra, Andhra

Pradesh, Uttar Pradesh and Madhya Pradesh. In Maharashtra, during rainy season sorghum is grown on the area of 0.30 million ha, producing 0.29 million tonnes of grain while the post-rainy season, sorghum accounts for 0.34 million ha producing 0.35 million tonnes (Anonymous 2003) the major fungal pathogen are *Fusarium spp.*, *Alternaria.*, *Aspergillus spp.*, *Drechslera*, *Curvularia lunata*, etc. transmitting through seeds, also cause deformities, reduced seed size, loss of seed weight, necrotic lesions on seeds, and leaf seed rot, and other physiological alterations in seeds. It has been

noted that seed-borne fungal pathogens are responsible for reducing seed quality, seed size, seed weight, seed germination protein, and carbohydrate content. According to Dawood and Elshamry (2015). Reduction or elimination of germination capacity as well as seedling damage, which results in the reduction of crop yield. The fungal invasion may occur during both pre-harvest and post-harvest conditions. In post-harvest storage, seeds may develop discoloration, seed rotting and caking, mycotoxin contamination, and loss of viability (Kulkarni and Chavan, 2010). These seeds serve as a medium for the survival of these fungi and also facilitate their dispersal to disease-free areas (Somada et al., 2008). So, the current study was undertaken to learn about the seed-borne fungal pathogens of sorghum from various locations in karjat Ahilyanagar.

#### **Materials and Methods:**

The seed samples of six species mentioned in Table 1 were collected from four different location trials of sorghum, viz. Karjat, Jamkhed, Shrigonda and Pathardi. These seed samples were screened for seed-borne fungi pathogens by the standard blotter method. Further, one sample was used for the evaluation of seed health testing methods in the detection of seed-borne fungal pathogens.

#### **Standard blotter method:**

The blotter method was developed by Doyer, which was later included in the International Seed Testing Association (ISTA) rules of 1966 and is the most widely used method and Usually, 400 seeds are incubated. The seed is placed in 2-3 layers of moist blotter. The number of seeds placed in the size of the sterilized Petri plates and the seed size are incubated for 7 days under 12 hrs of light and dark conditions. 10-100 glass transparent Petri plates of 15mm diameter are used for the test. Three blotters of the size of the Petri plate are

dipped in sterilized distilled water and placed in the Petri plate after dropping off excess water. Eight untreated 8 seeds were plated at equal distances in each Petri plate. A hundred seeds of sorghum samples were examined. The plates are incubated for alternate periods of 12 hours of light and 12 hours of darkness at  $27\pm 28^{\circ}\text{C}$ . The plates are removed on the 7-8 day. After incubation, the fungi developed on seeds are examined under the different magnifications of compound microscopes and identified.

#### **Agar-Plate Method**

Potato dextrose agar (PDA) was used in this method. This is a popular method for the detection of seed-borne mycoflora, in which seeds are plated on an agar medium (PDA). Sterilized Petri plates of 15 mm diameter, containing potato dextrose agar media, were used in each plate, and 8 seeds were placed. Three hundred seeds of sorghum were examined. The plated seeds are usually incubated for 7-8 days at  $27\pm 28^{\circ}\text{C}$  under 12th hrs alternating cycles of light and darkness. At the end of the incubation period, fungi that have grown out from the seeds on the medium are examined and identified. Identification is based on colony characters, mycelia growth and morphology of speculating structures under a compound microscope.

#### **Identification of fungi**

The identification of fungi was done based on the signs and symptoms observed on seeds. Further confirmation was done after isolation based on spore morphology and colony characteristics according to the description given in Ellis (1971) and Barnett and Hunter (1972). The identification of fungi was done based on the signs and symptoms observed on seeds. Further confirmation was done after isolation based on spore morphology and colony character according to the description given in the manual of The Illustrations of Fungi by D.S

Mukadam and Ashok M. Chavan.

## Results and Discussion

The examining the seed samples of Sorghum from four multi-location trials revealed that the highest seed infection was observed on seed samples from Karjat, with a location mean per cent seed infection of 58.08 and the lowest in Jamkhed with 44.07 per cent. The pathogens, viz., *Aspergillus spp.* (23.4%), *Alternaria spp.* (14.6%), *Fusarium spp.* (21.03%), *Drechslera* (3.6%), *Curvularia lunata* (1.9%), and were among the pathogens discovered associated with Sorghum seeds, which include both pathogens and saprophytes.

With a relative seed infection rate of 23.4, *Fusarium spp.* dominated the pathogen population in seed samples from every location, followed by *Alternaria spp.* and *Aspergillus spp.*

The fungal pathogens found associated with those seed samples includes *Aspergillus flavus*, *Aspergillus niger*, *Alternaria.*, *Fusarium sp.*, *Drechslera*, *Curvularia lunata*, subjected the sorghum seed samples to the standard blotter method and they found that *Aspergillus niger*, *Aspergillus flavus*, *Fusarium spp.*, *Curvularia lunata*, and were associated with sorghum seeds and Akonda et al. (2016) also examined a seed sample of sorghum collected from four sorghum-growing areas and examined for seed-borne diseases.

Mycoflora by the standard blotter method. The fungi, namely *Aspergillus flavus*, *Aspergillus niger*, *Alternaria.*, *Fusarium sp.*, *Drechslera*, *Curvularia lunata*, were found on seeds. As result of Dawood and Elshamry (2015), they compared the relative density and frequency of external and internal mycoflora associated with sorghum grains. Based on the relative density and percentage frequency. The organisms of the genus *Aspergillus* were predominantly isolated from sorghum grains. *Aspergillus spp.* was found to be

widespread, as it was observed in seed samples from all the locations.

*Aspergillus* is both an internally and externally seed borne pathogen; it is transmitted by various parts of seeds, showing various mechanisms such as internally or externally seed-borne disease leading to localized or systemic infection in some cases. Gonzalez et al. (1995) in corn samples from five locations in Argentina.

The frequency and relative density of the predominant genera of fungi comprising both the internal and external mycoflora associated with corn produced at five locations indicate *Aspergillus* was the most prevalent component of the internal and external seed-borne mycoflora with respect to both frequency and relative density at all locations and Singh et al., 2018).

In the current analysis, the highest percent seed infection location mean was found in Karjat (58.08%) and the lowest in Jamkhed (44.07%).

Sr. No.	Location	<i>Aspergillus spp.</i>	<i>Alternaria</i>	<i>Curvularia lunata</i>	<i>Fusarium spp.</i>	<i>Drechslera</i> ,
1	Karjat	18.4	3.4	1.5	22.3	11.7
2	Jamkhed	18.00	2.9	1.2	17.5	14.6
3	Shrigonda	17.6	4.5	0.7	11.6	9.7
4	Pathardi	16.3	4.8	2.3	10.5	10.7
	Relative per cent seed infection	23.4	3.6	1.9	21.3	14.6

**Table1:** Location pooled per cent seed-infection on seed samples collected from different location trials.

## Acknowledgement

This work would not have been possible without the guidance and valuable suggestions of my Guide, Dr. S.S. Patale sir, and all coauthors. I also want to express my heartfelt thanks to the Department of Botany, Smt. S.K. Gandhi Arts, Amolak Science, and P.H. Gandhi Commerce College, Kada, Dist-Beed(M.S.)for providing me with all the facilities required during my experimentation.

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## Publications Pattern and Collaboration Trend in Physical Review Accelerators and Beams Journal: A Scientometrics Analysis

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### ABSTRACT

*This study presents a scientometric analysis of publications and collaboration trends in the journal Physical Review Accelerators and Beams (PRAB) over the five-year period 2021–2025. A total of 1,113 full-text research articles were examined, with 3,499 contributing authors from multiple countries and institutions worldwide. The analysis focused on publication patterns, authorship trends, geographical distribution of authors, productivity of authors, institutional contributions, and collaboration metrics, including the Collaboration Index (CI), Degree of Collaboration (DC), Collaboration Coefficient (CC), and Modified Collaboration Coefficient (MCC). Results indicate a consistent increase in multi-authored papers, with collaborative research being predominant. The United States, Germany, and Switzerland contributed the highest number of authors, while the European Organization for Nuclear Research (CERN) and SLAC National Accelerator Laboratory were the most productive institutions. Among authors, Tomás, R. emerged as the most prolific contributor. The study highlights the global nature of accelerator physics research and emphasizes the significance of scientometric analysis in understanding research productivity and collaboration patterns.*

**Keywords:** Scientometrics; Bibliometrics; Physical Review Accelerators and Beams; Collaboration Index; Author Productivity; Global Research Collaboration; Lotka's Law

### 1. Introduction:

Scientometrics is a quantitative discipline that deals with the measurement and analysis of scientific research output, impact, and communication patterns. It focuses on the statistical evaluation of publications, citations, authorship, collaboration, and the growth of scientific knowledge across disciplines. The term scientometrics was formally introduced by V. V.

Nalimov and Mulchenko in the late 1960s, who defined it as the study of science as an information process (Nalimov&Mulchenko, 1969). Since then, scientometrics has evolved as an important research methodology closely related to bibliometrics, informetrics, and webometrics. Scientometric analysis plays a crucial role in understanding the structure and dynamics of scientific research. It helps identify leading authors,

influential journals, productive institutions, and emerging research areas by examining publication and citation data (Hood & Wilson, 2001). According to Price (1963), the exponential growth of scientific literature makes quantitative evaluation essential for assessing research trends and scholarly influence. Citation analysis, a core component of scientometrics, is widely used to measure research impact and knowledge diffusion within and across disciplines (Garfield, 1972). In the modern research environment, scientometrics has gained significant importance for research evaluation, policy formulation, and funding decisions. Governments, academic institutions, and research organizations increasingly rely on scientometric indicators such as citation counts, h-index, collaboration indices, and impact factors to assess scientific performance (Moed, 2005). With the availability of large bibliographic databases like Web of Science and Scopus, scientometrics has become a powerful tool for mapping scientific knowledge and understanding global research collaboration patterns.

The present study focuses on Physical Review Accelerators and Beams, a leading peer-reviewed open-access journal covering accelerator physics, chemistry, and engineering. The study examines publications over a five-year period (2021–2025) to evaluate publication patterns, authorship trends, institutional contributions, and collaboration metrics, providing a comprehensive view of research dynamics in the field of accelerator physics.

## 2. Objectives of the study

The main objective of the present study is to analyze the publication patterns and collaboration trends in the journal Physical Review Accelerators and Beams during the period 2021–2025.

1. The specific objectives are:
2. To examine the year-wise distribution of

articles and citations;

3. To analyze authorship patterns;
4. To evaluate the Collaboration Index (CI) and Degree of Collaboration (DC);
5. To determine the Collaboration Coefficient (CC) and Modified Collaboration Coefficient (MCC);
6. To examine author productivity using Lotka's Law;
7. To identify the most productive authors;
8. To study the geographical distribution of contributing authors.

## 3. Methodology:

This study looks at the research work published in the Physical Review Accelerators and Beams journal over five years, from 2021 to 2025. The data were collected from the journal's official website (<https://journals.aps.org/prab/>). During this period, 1,113 full-text research articles were published. Information about these articles was gathered, organized, and analyzed using MS Excel. The study examined different aspects, including yearly publication trends, how authors collaborated (measured by Collaboration Index, Degree of Collaboration, Collaboration Coefficient, and Modified Collaboration Coefficient), and author productivity using Lotka's Law.

## 4. Scope of the Study

The scope of this study is confined to analyzing the research contributions of scientists published as full-text papers in the Physical Review Accelerators and Beams (PRAB) journal. The study focuses on publications from the five years 2021 to 2025, during which a total of 1,113 articles were published across five volumes of the journal.

## 5. Data Analysis and Interpretation

### 5.1. Year-wise distribution of articles

**Table 1: Year-wise distribution of articles**

Sr. No	Year	Article	Percentage	Total Citations	CPP
1	2021	180	16.17	4231	23.51
2	2022	209	18.78	4042	19.34
3	2023	260	23.36	5674	21.82
4	2024	258	23.18	4902	19.00
5	2025	206	18.51	4944	24.00
<b>Total</b>		<b>1113</b>	<b>100.00</b>	<b>23793</b>	

Table 1 presents the year-wise distribution of articles published in Physical Review Accelerators and Beams from 2021 to 2025. A total of 1,113 articles were published over the five years, receiving a combined 23,793 citations. The highest number of articles was published in 2023 (260 articles; 23.36%), closely followed by 2024 (258 articles; 23.18%). The lowest output was in 2021 with 180 articles (16.17%). Citation per paper (CPP) varied across the years, with the highest CPP observed in 2025 (24.00) and the lowest in 2022 (19.34), indicating differences in the impact of publications each year. Overall, the data reflect steady growth in research output and substantial scholarly impact of the journal.

### 5.2. Document Types

Types of documents Table 2 below shows the types of publications retrieved in the Journal of Physical Review Accelerators and Beams during 2021-2025.

**Table 2: Document -wise distribution of articles**

Sr. No	Document Type	Article	Percentage
1	Article	1086	97.57
2	Erratum	20	1.80
3	Editorial	5	0.45
4	Letter	2	0.18
<b>Total</b>		<b>1113</b>	<b>100.00</b>

Table 2 shows the distribution of publications in Physical Review Accelerators and Beams

according to document type for the period 2021–2025. Out of a total of 1,113 publications, the vast majority were research articles (1,086; 97.57%), followed by errata (20; 1.80%), editorials (5; 0.45%), and letters (2; 0.18%). This indicates that the journal primarily publishes full-length research articles, while other types of documents such as errata, editorials, and letters constitute a very small proportion of the total publications.

### 5.3 Geographical Distribution of Contributors

**Table No. 3: Country-wise distribution of publications- Top 20**

Sr. No	Name of Country	No. of contributors	Percentage	Rank
1	United States	458	13.09	1
2	Switzerland	244	6.97	2
3	Germany	489	13.98	3
4	China	129	3.69	4
5	United Kingdom	123	3.52	5
6	Italy	100	2.86	6
7	Japan	94	2.69	7
8	France	81	2.31	8
9	Russian Federation	63	1.80	9
10	Sweden	39	1.11	10
11	Spain	25	0.71	11
12	South Korea	24	0.69	12
13	Canada	22	0.63	13
14	Israel	19	0.54	14
15	India	13	0.37	15
16	Portugal	13	0.37	15
17	Malta	12	0.34	16
18	Poland	11	0.31	17
19	Belarus	10	0.29	18
20	Greece	10	0.29	18
Truncated				
<b>Total</b>		<b>3499</b>	<b>100.00</b>	

Table 3 presents the country-wise distribution of publications in Physical Review Accelerators and Beams for the top 20 contributing countries during 2021–2025. A total of 3,499 authors

contributed to the 1,113 articles published in this period. Among the leading contributors, Germany had the highest number of authors (489; 13.98%), followed by the United States (458; 13.09%) and Switzerland (244; 6.97%). Other significant contributors included China (129; 3.69%), the United Kingdom (123; 3.52%), and Italy (100; 2.86%). Countries such as India (13; 0.37%), Portugal (13; 0.37%), and Malta (12; 0.34%) contributed smaller shares. The data indicate a strong presence of developed countries in accelerator physics research, reflecting the global nature of collaborations in this field.

#### 5.4. Most productive author in the Journal of Physical Review Accelerators and Beams.

**Table 4: Shows the ranking of 20 top most productive author**

Sr. No	Name of Author	No. of publications	Percentage	Rank
1	Tomás, R.	21	0.60	1
2	Métral, E.	15	0.43	2
3	Stupakov, G.	14	0.40	3
4	Migliorati, M.	13	0.37	4
5	Osterhoff, J.	13	0.37	4
6	Redaelli, S.	13	0.37	4
7	Huang, X.	12	0.34	5
8	Huang, Z.	12	0.34	5
9	Buffat, X.	11	0.31	6
10	Burrows, P.N.	11	0.31	6
11	Di Mitri, S.	11	0.31	6
12	Tang, C.	11	0.31	6
13	Wuensch, W.	11	0.31	6
14	Calviani, M.	10	0.29	7
15	Chiggiato, P.	10	0.29	7
16	Chung, M.	10	0.29	7
17	Giovannozzi, M.	10	0.29	7
18	Grudiev, A.	10	0.29	7
19	Hemsing, E.	10	0.29	7
20	Power, J.G.	10	0.29	7
Truncated				
Total		3499	100.00	

Table 4 lists the top 20 most productive authors in Physical Review Accelerators and Beams for the period 2021–2025. A total of 3,499 author contributions were recorded across 1,113 articles. Among them, Tomás, R. was the most prolific author

with 21 publications (0.60%), followed by Métral, E. with 15 publications (0.43%), and Stupakov, G. with 14 publications (0.40%). Several authors, including Migliorati, M., Osterhoff, J., and Redaelli, S., each contributed 13 publications (0.37%), while a group of authors, such as Huang, X., Huang, Z., Buffat, X., and others, contributed 10–12 articles each. The data highlight that a small number of highly productive authors contribute significantly to the journal, reflecting concentrated expertise and leadership in the field of accelerator physics.

#### 5.5. Institution-Wise Distribution of Publication

**Table 5: Institution-Wise Distribution of Publication-Top 20**

Sr. No	Name of Affiliation	No. of Contributors	Percentage	Rank
1	European Organization for Nuclear Research, Switzerland	207	5.92	1
2	SLAC National Accelerator Laboratory, United States	130	3.72	2
3	Deutsches Elektronen-Synchrotron DESY, Germany	76	2.17	3
4	Brookhaven National Laboratory	71	2.03	4
5	Chinese Academy of Sciences	57	1.63	5
6	High Energy Accelerator Research Organization, Tsukuba	52	1.49	6
7	Argonne National Laboratory	52	1.49	6
8	Lawrence Berkeley National Laboratory	49	1.40	7
9	Fermi National Accelerator Laboratory	49	1.40	7
10	The Cockcroft Institute	47	1.34	8
11	CNRS Centre National de la Recherche Scientifique	45	1.29	9
12	Paul Scherrer Institut	38	1.09	10
13	University of Chinese Academy of Sciences	35	1.00	11
14	GSI Helmholtz Centre for Heavy Ion Research GmbH	34	0.97	12
15	INFN, Laboratori Nazionali Di Frascati	33	0.94	13
16	Cornell University	32	0.91	14
17	Thomas Jefferson National Accelerator Facility	32	0.91	14
18	University of California, Los Angeles	32	0.91	14
19	John Adams Institute for Accelerator Science	32	0.91	14

Table 5 presents the institution-wise distribution of authorship in Physical Review Accelerators and Beams for the period 2021–2025, highlighting the top 20 contributing institutions. A total of 3,499 author contributions were recorded. The European Organization for Nuclear Research (CERN), Switzerland contributed the most with 207 authors (5.92%), followed by SLAC National Accelerator Laboratory, USA (130; 3.72%), and Deutsches Elektronen-Synchrotron DESY, Germany (76; 2.17%). Other notable contributors include Brookhaven National Laboratory (71;

2.03%), Chinese Academy of Sciences (57; 1.63%), and High Energy Accelerator Research Organization, Tsukuba (52; 1.49%). Several institutions, such as Cornell University, University of California, Los Angeles, Thomas Jefferson National Accelerator Facility, and John Adams Institute for Accelerator Science, each contributed 32 authors (0.91%). The data indicate that a few major research institutions dominate accelerator physics research, reflecting strong institutional leadership and global collaboration in the field.

### 5.6. Analysis of Collaboration factors and Authorship Patten

**Table 6 : Analysis of Collaboration factors in the Journal Physical Review Accelerators and Bems Publication at Global Level**

Sr. No	Year	2018	2019	2020	2021	2022	Total
1	Single Author	46	52	67	62	45	272
2	Second Author	38	48	56	52	58	252
3	Third Author	27	31	45	47	48	198
4	Fourth Author	21	28	33	37	18	137
5	Fifth Author	17	27	24	19	11	98
6	Sixth Author	13	9	16	17	10	65
7	Seven Author	8	6	10	11	9	44
8	Eight Author	6	5	6	8	5	30
9	Nine Author	4	3	3	5	2	17
10	Total Articles	180	209	260	258	206	1113
11	Total Author	590	651	807	838	613	3499
<b>CI</b>		<b>3.278</b>	<b>3.115</b>	<b>3.104</b>	<b>3.248</b>	<b>2.976</b>	<b>15.720</b>
<b>DC</b>		<b>0.256</b>	<b>0.249</b>	<b>0.258</b>	<b>0.240</b>	<b>0.218</b>	<b>1.221</b>
<b>CC</b>		<b>0.744</b>	<b>0.751</b>	<b>0.742</b>	<b>0.760</b>	<b>0.782</b>	<b>3.779</b>
<b>MCC</b>		<b>0.190</b>	<b>0.187</b>	<b>0.191</b>	<b>0.183</b>	<b>0.171</b>	<b>0.922</b>
<b>CC-MCC</b>		<b>0.554</b>	<b>0.564</b>	<b>0.551</b>	<b>0.577</b>	<b>0.611</b>	<b>2.857</b>

Table 6 presents the analysis of collaboration patterns among authors publishing in Physical Review Accelerators and Beams at the global level during 2018–2022. A total of 1,113 articles were published with 3,499 contributing authors. Among these, single-author articles accounted for 272, while multi-author publications (2–9 authors) totaled 841,

indicating a strong prevalence of collaborative research. The Collaboration Index (CI) ranged from 2.976 in 2022 to 3.278 in 2018, with an average of 3.144, reflecting the average number of authors per paper. The Degree of Collaboration (DC) varied from 0.218 in 2022 to 0.256 in 2018, showing that collaborative publications dominate over single-

authored ones. The Collaboration Coefficient (CC) ranged from 0.742 to 0.782, and the Modified Collaboration Coefficient (MCC) ranged from 0.171 to 0.191, indicating consistent co-authorship trends across the years. The difference between CC and MCC varied from 0.551 to 0.611, suggesting that collaboration patterns remained relatively stable even as the number of authors per paper increased. Overall, the analysis highlights that multi-authored publications are predominant, demonstrating high levels of collaboration among global researchers in the field of accelerator physics.

## 6. Conclusion:

The scientometric analysis of Physical Review Accelerators and Beams for the period 2021–2025 reveals significant trends in global accelerator physics research. A total of 1,113 research articles were published by 3,499 authors, indicating a strong collaborative culture. Multi-authored papers were predominant, reflecting the complexity of research and the necessity for cooperation among scientists. Germany, the United States, and Switzerland were the leading contributors, while the European Organization for Nuclear Research (CERN) and SLAC National Accelerator Laboratory emerged as the most productive institutions. Tomás, R. was identified as the most prolific author, contributing the highest number of publications. Collaboration metrics, including CI, DC, CC, and MCC, demonstrated stable and high levels of co-authorship over the study period. The findings underscore the global nature of accelerator physics research and highlight the importance of scientometric analysis for mapping research productivity, identifying leading contributors, and understanding collaboration patterns. Such insights are valuable for policy formulation, strategic planning, and fostering international research collaboration in the field.

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