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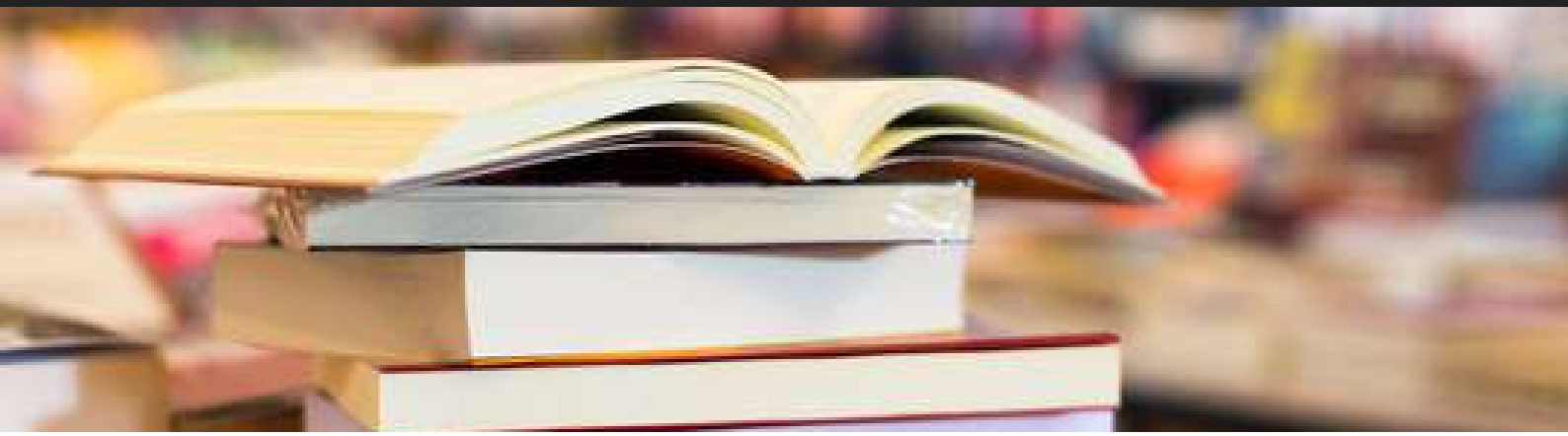

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Original Article

Privacy and Security in Artificial Intelligence

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Abstract

Artificial Intelligence (AI) is rapidly transforming various sectors by enabling automation, intelligent decision-making, and data-driven insights. However, the widespread adoption of AI raises critical concerns regarding privacy and security. This paper explores how AI systems interact with sensitive data, the potential risks involved, and the techniques used to ensure privacy and security. It also highlights how AI can be used as a tool to enhance cybersecurity and protect user data. The study concludes that with proper design, regulation, and implementation, AI can be both secure and privacy-preserving.

Keywords: *Artificial Intelligence, Privacy, Security, Data Protection, Cybersecurity, Machine Learning*

Introduction:

Artificial Intelligence (AI) refers to technologies that enable machines to simulate human intelligence, including learning, reasoning, and problem-solving. AI systems rely heavily on data, often including personal and sensitive information. As a result, privacy and security have become major concerns in AI development and deployment. With the increasing use of AI in applications such as healthcare, finance, and social media, ensuring the protection of user data is essential. While AI introduces certain risks, it also provides powerful tools to enhance security and safeguard privacy.

1. Privacy in AI

Privacy refers to the protection of personal and sensitive information from unauthorized access or misuse. AI systems often collect and process large datasets, which may include:

- Personal identification data
- Financial information
- Behavioral patterns

Ensuring privacy is essential to maintain user trust and comply with legal regulations.

2. Security in AI

Security focuses on protecting systems, networks, and data from cyber threats. AI systems must be secure to prevent:

- Data breaches
- Unauthorized access
- System manipulation

Strong security mechanisms ensure the reliability and integrity of AI systems.

Objectives:

1. To study and analyze how **Artificial Intelligence ensures privacy and security** in modern digital systems
2. **To understand the role of AI in data security**
   a. Study how AI detects threats, fraud, and cyber-attacks.
3. **To analyse privacy challenges in AI systems**

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a. Identify risks like data leakage, misuse, and unauthorised access.

4. **To explore AI-based security techniques,**

a. Learn methods like encryption, anomaly detection, and authentication.

5. **To study privacy-preserving methods in AI**

a. Focus on techniques like:

i. Differential Privacy

ii. Federated Learning

6. **To evaluate how AI improves cybersecurity systems,**

a. Compare traditional security vs AI-based security.

7. **To propose secure and privacy-friendly AI models,**

a. Suggest better approaches for safe AI implementation.

Block Diagram:

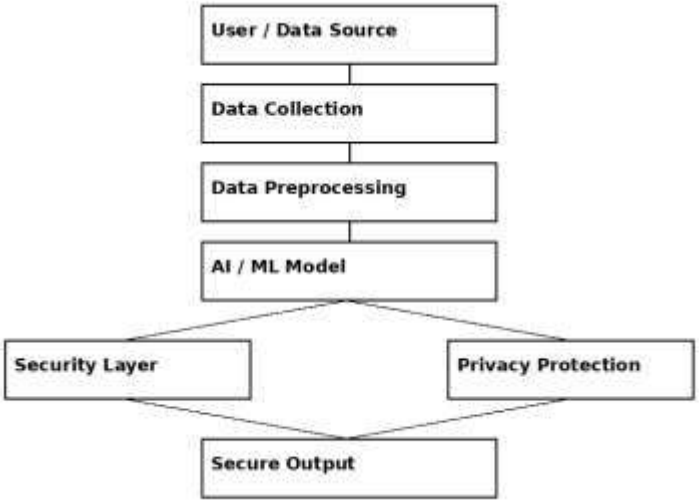

Fig. Block Diagram

Working:

To address these challenges, several techniques are used:

1. Data Encryption

Encrypting data ensures that it cannot be accessed by unauthorized users.

2. Differential Privacy

This technique adds noise to data to protect individual identities.

3. Federated Learning

Data remains on local devices, and only model updates are shared, reducing privacy risks.

4. Access Control Mechanisms

Restricting access to sensitive data improves system security.

Future Directions:

Future research should focus on:

- Explainable AI (XAI) for better transparency
- Stronger legal frameworks for data protection
- Development of privacy-by-design AI systems
- Integration of AI with advanced encryption technologies

Conclusion:

Privacy and security are critical aspects of Artificial Intelligence. While AI systems pose certain risks, they also offer powerful tools to enhance data protection and cybersecurity. By implementing proper security measures and privacy-preserving techniques, AI can be used safely and effectively. A balanced approach that combines innovation with ethical responsibility is essential for the future of AI.

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I would like to express my sincere gratitude to all those who supported and guided me in completing this project on Privacy and Security in Artificial Intelligence.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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Role of Women in Entrepreneurship Development in India: An Empirical Analysis

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Abstract

The role of women in entrepreneurship development is extremely important in developing and democratic countries like India that have adopted mixed economies. Creating awareness about financial inclusion and the financial sector is the need of the hour for women to establish their place in entrepreneurship development. It is an encouraging thing from the country's perspective to include women in India in the flow of economic development and create awareness among them about the financial sector in order to develop a developing nation. If women are economically empowered, they will generate a large amount of employment and will be able to perform stimulating roles in bringing about innovation and community development.

Keywords: *Women Entrepreneurship, Development, Awareness, Financial Inclusion, Economy, Empowerment, Innovation etc.*

Introduction:

The need of the hour is to inspire women from all walks of life in a way that creates awareness and motivates them to take proactive action to address every challenge they face. Making women financially literate will make them self-reliant and will help India develop by taking an important decision in a developing nation like India. Because the fact that a patriarchal culture is promoted to a large extent in India is wrong from the perspective of a developing nation. Therefore, if efforts are made in developing countries like India to provide equal justice to women economically and in all sectors, the role of women will be crucial in India's development. Women perform these family duties extremely well, and at the same time, it is the need of the hour to inspire them to perform proactively for economic independence and social progress. If women are economically empowered, a large number of employment opportunities will be available, and competitiveness in the service sector will also increase, creating a new approach for women to set up businesses. In developing countries like India, it is essential to empower women financially and create awareness about the financial sector. Because women need recommendations from many banks, credit unions, or financial institutions that provide financial services, but they have very little land or property in their names. Making women financially literate and keeping them financially secure through loan savings insurance is the need of the hour.

Problems of the Study:

A part of the development of the Indian economy is accomplished through industry. Therefore, it is very important for women to enter this industry and utilize their abilities, inherent strength, and qualities in the field of industry and business. For this reason, the present article highlights the role of women entrepreneurs in the economy. When we say entrepreneur, the image of a man comes to mind. However, efforts are being made to bring forward the image of women as entrepreneurs on this basis

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Similarly, the functions and roles of women entrepreneurs, the role of women entrepreneurs' organizations, women entrepreneurs' organizations, women's economic development corporations, women's urban cooperative banks, as well as the difficulties faced by women entrepreneurs.

Objectives of the Study:

To study the role of women in entrepreneurship development in India and their participation in financial inclusion and financial empowerment of women. The main purpose of the research is to identify some specific objectives that have been set by the researchers as follows.

1. To Study the role of women entrepreneurs in India.
2. To Study the factors affecting the development of women entrepreneurship.
3. To Study the economic empowerment of women in entrepreneurship development.

Significance of the Study:

Empowering women entrepreneurs is essential to develop the Indian economy. Women empowerment is the need of the hour. Therefore, it is necessary to give women opportunities, rights and encouragement so that they can take charge of the economy. India's economy is based on many factors. The main factor among these factors is the economic development of the country. Therefore, considering economic development as a criterion, the entire world is divided into developed and developing countries. The process of development includes an increase in national income and productivity, a socially just distribution of income, and the creation of a new cultural image. Human beings must be considered the centerpiece for economic development.

Scope of the Study:

People with visionary initiative, recruitment and professional expertise find opportunities and make the most of them. The need of the hour is to encourage individuals with new visions who strive to create a developed nation of opportunity. Entrepreneurship is the only productive factor in society. If we think about the entrepreneurial world, we find that India has a male-dominated culture. We will see the same in the entrepreneurial world as well. Indian women, who are the foundation of the Indian family system, are rarely seen among entrepreneurs. The proportion is as low as 9 % in almost all countries and states. The incoming government has set a goal of increasing the proportion of women entrepreneurs from 9 % to 20 % through effective implementation of women policies.

Limitation of the Study:

The government should strive to create an independent system for women to start businesses. Women entrepreneurs who provide employment opportunities to themselves as well as others. Women entrepreneurs who provide employment opportunities to themselves as well as others. Employment helps in increasing the source of income. The important role that income and productivity play in the economic development process means that calculating this income and productivity contributes to developing the country's economy.

Period of the Study:

To study the current status of women's financial empowerment and development in India, data from 2025-26 has been reviewed.

Research Methodology:

Indian entrepreneurship development has gained importance from the perspective of a developing nation as it generates large amounts of employment and contributes to poverty alleviation. A wide range of secondary sources have been used in conducting a detailed study of women's entrepreneurship in India and their role in financial empowerment. The researchers used a variety of secondary sources to conduct this research. These include research papers, articles, journals, newspapers, audio, video, and references.

Research Method:

Entrepreneurship development is an important concept from the perspective of a developing nation. Even though India is an agricultural country, entrepreneurship has gained an important place in the current situation. Women entrepreneurship development and economic empowerment of women are important issues. To conduct this research, the researcher has used descriptive analysis method to clarify the role of women entrepreneurs in development.

Results and Discussion:

Women are capable of qualities such as patience, perseverance, determination, concentration, business acumen, flexibility, strength and decision-making accuracy. Based on these qualities in women, they are encouraged to explore potential opportunities, take risks, and face financial uncertainty in order to start new businesses as women entrepreneurs. A woman entrepreneur can successfully perform tasks and roles such as innovation, coordination, administration, control, and daily monitoring. A woman entrepreneur is a woman or group of women who takes the initiative to start a business, organizes everyone, and runs the business.

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Women Entrepreneurship:

Women are changing from necessity to housewives, home industries, working entrepreneurs, industrial women. But the pace of women becoming entrepreneurs is slow. Some women entrepreneurial organizations are playing their role to promote this. Women's entrepreneurship organizations have been established at state, national and international levels to develop women's entrepreneurship. The main objective of these organizations is to create an environment conducive to the development of women entrepreneurship in both rural and urban areas. For this, providing them with a platform, organizing development programs, providing various concessions, grants and assistance, organizing activities, these organizations carry out activities such as organizing seminars and conferences, redressing grievances etc.

Innovation and Entrepreneurship:

When it comes to industry and business, many tasks have to be performed to develop it. Just like male entrepreneurs, female entrepreneurs also have to perform tasks. It involves exploring potential opportunities, taking risks, dealing with uncertainty, innovating, establishing coordination, with a view to starting a new business. Women entrepreneurs use their abilities and qualities while performing tasks such as administration and control and supervising daily operations. While performing all these roles, entrepreneurial qualities such as planning, transactions, financial budgeting, communication skills, and coordination are always present. Overcoming shortcomings and standing on one's own feet gives a different perspective. To become successful entrepreneurs, women should explore their latent qualities and delve into business as much as possible.

Challenges Before Women Entrepreneurs:

While women have inherent qualities and abilities, they also have certain responsibilities to fulfill. Responsibilities often become obstacles in the development of women entrepreneurs like; Family responsibilities, Restrictions on migration, social trends, Limited risk-taking capacity, Lack of capital and difficulties in obtaining loans without collateral, Competition with male-dominated industries, Sensitive and reserved nature, Complex legal framework etc. Some women entrepreneurs may face these challenges, but we see women entrepreneurs who have the courage to overcome these challenges and reach the heights of success.

Employment and Empowerment:

Just as women successfully fulfilled the responsibility of managing the home, they also fulfilled the responsibility of being successful female entrepreneurs in the business sector. This pace of success, though slow and sluggish, is gradually changing the perceptions of society. There is an increasing trend of girls pursuing career-oriented studies. This is a satisfactory prospect. The inclusion of women in industry will lead to progress. The development of industry will certainly contribute to strengthening the country's economy. Providing employment through small-scale industries is a sign of prosperity. Both one's own prosperity and the prosperity of the country.

Role of Women and Motivation:

Woman and man are components of the social system and both of them have a complementary role. The existence, progress and advancement of every family depend on the mutual role of these two classes. Although the field of entrepreneurship is generally dominated by men, women have also contributed directly or indirectly to the healthy growth of entrepreneurship. Women entrepreneurs have become a major driving force for greater development in many countries. In modern times, women in both developed and developing societies are ready to take the initiative and play the role of entrepreneurs. Women are actively participating in large numbers in the areas of trade, productivity, processing and services.

Government Policy and Self-Help Group:

Women seek male support because entrepreneurship is primarily male driven. Since women entrepreneurs come from middle class, upper middle class and wealthy families, they have a positive influence on them and are motivated by the entrepreneurs. They are growing their industry by getting concessions through various government schemes. With the advent of the concept of self-help groups, women's self-help groups were formed. Compared to other self-help groups, the number of women's self-help savings groups is higher, and the amount of loans allocated for industries is higher, which has increased the rate of women's entrepreneurship and provided a golden path for women's education. To create women entrepreneurs and increase women entrepreneurship, the Maharashtra State Government is encouraging women entrepreneurship and has established an Entrepreneurs Corporation for the development of women entrepreneurship. Many organizations are also working to increase women's entrepreneurship.

Conclusion:

The number of women entrepreneurs is very low today. However, the government has been

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trying to increase this number for many years. Policies have been formulated to encourage women to come forward and start businesses. Policies have been formulated to encourage women to come forward and start businesses. In order to utilize the capabilities of women in business. The main objective of the policy is to create awareness among women and encourage them to become successful entrepreneurs in the future. The Government of India, while defining a woman entrepreneur, has said that a business in which at least 51 % of the employees are women should be called a woman entrepreneur.

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Original Article

GST Reform impact on seller

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Abstract

The present research paper discusses the challenges of the first phase (1.0) of the Goods and Services Tax system and proposes the Goods and Services Tax Reform 2.0 (GST 2.0) This reform came into effect from September 22, 2025. What kind of benefit has this reform given to the consumer and the industry and the seller? In the GST 2.0 restructuring, two tax slabs were reduced from four tax slabs and the Goods and Services Tax Council has tried to simplify the structure of GST. It did not stop at just reducing the tax slabs, but some policy decisions have also been taken in this, due to which the Goods and Services Tax Reform 2.0 has done a great job in the interest of the consumer and the development of industry and commerce. The main objective of this research is to analyze that reform.

Keyword*: GST reform, seller compliances, consumer tax burden, GST 2.0*

Introduction:

India is a federal republic. In India, the central government, state government, local self-government bodies look after their regional affairs. To carry out their regional development work, the Constitution has given the central government, state government, local self-government bodies the power to collect revenue by levying various taxes. The burden of more than 17 such taxes was causing difficulties for businesses, administration, and consumers. To bring about the rationalization of indirect taxes, the Goods and Services Tax came into effect on July 1, 2017. Due to the Goods and Services Tax, the previously existing indirect taxes such as VAT, sales tax, luxury tax, entertainment tax, lottery tax, service tax, etc. were abolished and merged into a single tax, the Goods and Services Tax, which reduced the burden of tax compliance on the seller and the sellers and provided a simpler tax system. Along with this, the previous tax system where the customer had to pay tax on the goods and services tax before the goods and services tax was abolished and the one nation, one tax system became a relief for the customers. In this new goods and services tax system, 4 tax slabs were given. And the cess was also added to it. In this tax system, essential goods were kept in tax slabs from zero to five and luxury goods were kept in tax slabs from 12 to 18. And super luxury goods were classified as cess. GST has been in effect for eight years, from 2017 to 2025. During this eight-year period, sellers Classification confusion, inverted fee structure, multiple tax slabs, compliance burden on sellers, Tax evasion loopholes, administrative burden, business dissatisfaction, tax evasion tendencies, capital shortages in business, adverse effects on business profits have created problems. To overcome these, GST 2.0, the next generation tax system, was introduced. The following objectives have been set to study the results achieved through this system.

Research objectives

To study the impact of GST 2.0 on retailers.

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Research hypotheses

- The seller's profit did not increase. (H0)
- The seller's profit increased. (H1)

Research information sources

Secondary sources of information have been used for this research. Various websites, GST websites, published research papers, press notes, news etc. have been used for this.

Research methods

Analytical research methods have been used in this research to analyze and interpret the available secondary information.

Review of reference literature

Kumar, R. (2025). In his research, it has been stated that GST 2.0 has reduced the tax slab, which has increased demand, and real-time invoicing has reduced the burden on compliance, saved time, increased compliance accuracy,

(Karthik & Sahoo, 2025) concluded that the reduction in GST tax rates had a positive impact on small and medium enterprises, as their tax liability has decreased and their flexibility has increased. Their sustainability and viability have increased.

Discussion

Changes in GST 2.0

Rationalizing the GST Rate Structure: Merit, Standard, and De-merit Rates		
Aspect	Previous GST structure	Revised GST structure
Rate slabs	Four GST slabs: 5 percent 12 percent 18 percent 28 percent	5 percent (merit rate) 18 percent (standard rate) New special rate of 40 percent for luxury and harmful products (for example, luxury cars, tobacco, aerated drinks, gambling services)*

Source: (Briefing, 2025)

From the above table, we understand that the tax slabs of 12% and 28% have been removed. And only two tax slabs of 5% and 18% have been kept in GST 2.0, which will reduce the complexity for traders and businessmen while determining the tax rates.

Gst 2.0 Rate Deduction Sep-2025

Category	Item	From GST	To GST 2.0
Daily Essentials	Hair Oil, Shampoo, Toothpaste, Toilet Soap Bar, Tooth Brushes, Shaving Cream	18%	5%
	Butter, Ghee, Cheese & Dairy Spreads	12%	5%
	Pre-packaged Namkeens, Bhujia & Mixtures	12%	5%
	Utensils	12%	5%
	Feeding Bottles, Napkins for Babies & Clinical Diapers	12%	5%
	Sewing Machines & Parts	12%	5%
Healthcare	Individual Health & Life Insurance	18%	Nil

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	Thermometer	18%	5%
	Medical Grade Oxygen	12%	5%
	All Diagnostic Kits & Reagents	12%	5%
	Glucometer & Test Strips	12%	5%
	Corrective Spectacles	12%	5%
Education	Maps, Charts & Globes	12%	NIL
	Pencils, Sharpeners, Crayons & Pastels	12%	NIL
	Exercise Books & Notebooks	12%	NIL
	Eraser	5%	NIL
Farming & Agriculture	Tractor Tyres & Parts	18%	5%
	Tractors	12%	5%
	Specified Bio-Pesticides, Micro-Nutrients	12%	5%
	Drip Irrigation System & Sprinklers	12%	5%
	Agricultural, Horticultural or Forestry Machines for Soil Preparation, Cultivation, Harvesting & Threshing	12%	5%
Automobiles	Petrol & Petrol Hybrid, LPG, CNG Cars (not exceeding - 1200 cc & 4000mm)	28%	18%
	Diesel & Diesel Hybrid Cars (not exceeding - 1500 cc & 4000mm)	28%	18%
	3 Wheeled Vehicles	28%	18%
	Motor Cycles (350 cc & below)	28%	18%
	Motor Vehicles for Transport of Goods	28%	18%

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Electronics	Air Conditioners	28%	18%
	Televisions (above 32", including LED & LCD TVs)	28%	18%
	Monitors & Projectors	28%	18%
	Dish Washing Machines	28%	18%
Construction	Cement	28%	18%

Source: (*New GST Rates 2025: GST 2.0 Reform Bill Explained*, 2026)

In the table given above, the daily life items have become cheaper by reducing the tax from 18% to 5%. Due to this, it has become easier for people to live. Life insurance, health insurance has become zero from 18% and thermometer has become 5% from 18%. Other health related treatment items have become 5% from 12%, that is, relief has been given to the consumer during illness. All educational items were previously 12% and 5%, but now they have been reduced to 0% tax rate. Due to this, education has been made cheaper, all items in agriculture between 12% and 18% have now been reduced to 5%, so agriculture has been relieved, the automobile industry has been reduced from 28% to 18%, so the country's transportation will be cheaper. Also, electronic items have been reduced from 28% to 18%. Cement required for the construction sector has been reduced from 28% to 18%, so building houses has become cheaper.

Tax rates on 200 items have been reduced. 90% of items have been reduced from 28% to 18%, while 99% of items have been reduced from 12% to 5%.

This means that most of the items have become cheaper, so the demand in the market will increase, which will increase the seller's turnover and increase the seller's profit. This is understood from observation.

Problems in GST 1.0 are improved in GST 2.0

Along with experiencing difficult times, the higher tax burden on consumers had an adverse impact on their purchasing power.

Classification confusion

Of the same thing Classification There was confusion about compliance due to different slabs, so the opposition repeatedly raised the issue in Parliament. Trade associations made statements, for example, in bakery products,

Old GST vs New GST Rates for Bakery Products

Bakery Product	HSN Code	Old GST Rate	New GST Rate (After Sep 2025)
Unbranded fresh bread	1905	0%	0%
Branded or packaged bread	1905	5%	5%
Cakes (fresh or packaged)	1905	18%	5%
Pastries & muffins	1905	18%	5%
Biscuits & cookies	1905	18%	5%

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(seleniumkitchen, 2025)

This confusion has been reduced due to the reduction in rates in GST 2.0.

Reverse charge structure

In GST 1.0 the GST rate on raw materials was high and the GST rate on finished goods was low, so it was difficult for the seller to get ITC. For example, a company manufacturing good shoes had to pay 18% GST on purchasing raw materials, i.e. leather, but had to sell the finished goods at a rate of 5%, so it did not get ITC.

In GST 2.0, most of the inputs in the business have been brought at lower rates. Due to this, the business will get ITC and its profits will increase.

Compliance burden on sellers

In GST 1.0, there were 4 slabs which created compliance complications. Sellers found it difficult to classify goods in tax rates while preparing invoices, hence the need to reduce the number of tax slabs.

The 2 slabs in GST 2.0 have reduced the complexity of compliance. It has reduced the difficulty for sellers in classifying goods in tax rates while preparing invoices.

Tax evasion loopholes

In GST 1.0, many traders intentionally took advantage of the confusion above to show compliance in the four lower rates. This gave scope for tax evasion. Coconut oil used in beauty products was 18 percent while edible coconut was 5%, so these companies would show edible oil as compliance and sell the coconut oil used in beauty products. In GST 2.0, four slabs have been reduced to two, which will reduce the confusion of classification. Tax evasion will be reduced and stability in business will increase.

Problems of working capital in business

In GST 1.0, due to higher tax slabs, traders used to get more money stuck in ITC, which affected the pace of business. Because a lot of money gets stuck in purchasing goods at higher tax rates. Due to the reduction in tax slabs in GST 2.0, less money will have to be paid in taxes at the time of purchasing goods than before, which is likely to increase working capital and increase profits.

Adverse impact on business profits

In GST 1.0, the higher tax rate affects the purchasing power of the consumer. With limited income, he can buy a limited number of goods. If the tax rate is higher, he will consume a larger share of the income, so he will consume less goods or buy low-quality goods, which will reduce his purchasing power. For example.The impact of the change in GST rate on the purchasing power of the customer (within the limit of ₹5000) and the seller is shown in the table below.

Basic assumptions: To make the calculation easier, the original price of one bag of cement (excluding tax) **₹300**

Details	**GST 1.0 Pre (28% GST)**	**After GST 2.0 (18% GST)**	**Seller Benefit**
Base Price	₹300.00	₹300.00	Profit Stability
Tax Rate (%)	28%	18%	Reduced Compliance Burden
Tax amount	₹84.00 (28% of ₹300)	₹54.00 (18% of ₹300)	Working Capital Relief
Consumer Price	₹384.00 (₹300 + ₹84)	₹354.00 (₹300 + ₹54)	Reduced Price and **Increased Demand**
Quantity bought with ₹5000	**≈ 13.02 nos.** (₹5000 / ₹384)	**≈ 14.12 pieces** (₹5000 / ₹354)	**Sales increase** (Because customers bought more) = Increase in profit

Benefits to the seller (how it happens):

The reduction in GST rates (from 28% to 18%) makes goods cheaper and increases the purchasing power of consumers, which increases market demand.

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Conclusion

Rationalization of the tax system:

The reformulation has been done by reducing the four slabs in GST 1.0 to two slabs in GST 2.0. It reduces the complexity of the tax system and creates a conducive environment for business. This will definitely benefit the business by increasing its profits.

Increase in consumer purchasing power

Due to the reduction in GST tax rate on consumer goods such as daily necessities, health items, education items, essential items, the consumer has saved money and increased his purchasing power, which will result in increased demand for businesses and increased profits.

Benefits for sellers and businesses: GST 2.0 has overcome the problems of GST 1.0 such as classification confusion, reverse charge structure, and compliance burden.

- Two slabs made compliance easier, reducing stress on sellers and saving time.
- The reduction in tariffs on raw materials has eliminated the reverse charge structure, which will help in getting ITC and increase profits in the business.
- Due to the reduction in tax slabs, traders will not have more money stuck in ITC, which will benefit them. **Working capital will increase**.

Increase in sellers' profits: The reduction in GST rates increases the purchasing power of consumers, which increases demand in the market and consequently increases the turnover and profits of sellers.1

Acceptance of the research hypothesis: This observation confirms the research hypothesis that 'seller's profit increased' (H1).

Overall, GST 2.0 is a visionary reform that has made the tax system more transparent, simple, and business-friendly by reducing loopholes for tax evasion.

Recommendations

- An independent, in-depth study should be conducted on the extent to which tax evasion has actually decreased after the implementation of GST 2.0, and the impact on government revenue.
- It would be useful to study the long-term impact of GST 2.0 on the savings and investments of ordinary citizens.

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Original Article

Social Development Disparities between PESA and Non-PESA Villages in Junnar Tahsil, Maharashtra

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Abstract

Spatial inequality in tribal regions remains a persistent challenge to inclusive development in India. Tribal communities, particularly those residing in Scheduled Areas, continue to experience limited access to education, healthcare, infrastructure, and basic public services despite constitutional safeguards and targeted welfare interventions. In this context, the Panchayats (Extension to Scheduled Areas) Act, 1996 (PESA) was enacted to promote decentralized governance, strengthen Gram Sabhas, and empower tribal communities through participatory decision-making and control over natural resources. The present study assesses the effectiveness of PESA in reducing spatial inequality by conducting a comparative analysis of social development levels between PESA and Non-PESA villages in Junnar Tahsil of Pune district, Maharashtra.

The research is based on secondary data and 17 social development indicators. The Kendall's ranking coefficient method was employed to construct a composite social development index and classify regions into high and less developed categories. The findings reveal significant spatial disparities in social development. Non-PESA regions exhibit a higher overall level of development, with a lower average ranking coefficient (1.29) compared to PESA regions (1.65). The results suggest that while PESA has the institutional potential to promote participatory governance and empower tribal communities, its effectiveness largely depends on the quality of implementation, administrative support, and active involvement of Gram Sabhas. The study concludes that tribal regions under PESA in Junnar Tahsil remain comparatively less developed than their non-PESA counterparts, particularly in higher-level educational and infrastructural facilities. To achieve balanced and inclusive regional development, stronger institutional capacity, improved resource allocation, and effective enforcement of PESA provisions are essential. The findings underscore the need for targeted, region-specific policy interventions to translate legal empowerment into measurable social outcomes and reduce persistent spatial inequalities in tribal areas.

Keywords: *PESA Act, Social Development, Spatial Inequality, Tribal Areas*

Introduction:

Spatial inequality in India, particularly in tribal areas, remains one of the most significant challenges to inclusive development. Tribal communities, located mostly in remote, ecologically sensitive, and economically marginalized regions, face systemic challenges such as lack of basic infrastructure, limited access to healthcare and education, inadequate political representation, and vulnerability to land alienation and resource exploitation. In this context, the **Panchayats (Extension to Scheduled Areas) Act (PESA)**, 1996, was introduced with the aim of empowering tribal communities and addressing these disparities. PESA marks a shift from representative to participatory democracy by granting decision-making powers directly to the Gram Sabhas. [1] PESA has the potential to restore traditional tribal institutions and customary rights, fostering a governance system aligned with indigenous values.

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[2] Resource rights are central to tribal identity and sustainability. [3] Empowered Gram Sabhas can influence development outcomes through better prioritization of needs and monitoring of welfare schemes. [4] The Panchayats (Extension to Scheduled Areas) Act (PESA), 1996, has been a landmark legislative measure aimed at empowering tribal communities through decentralized self-governance and management of natural resources. [5] The socio-economic impact of government schemes aimed at improving education among tribal communities in Maharashtra. [6] The importance of women's empowerment in achieving sustainable development and highlights the need for targeted policies to address gender disparities. [7] The variations in social development indicators such as education, health, and income, and emphasizes the need for region-specific policies to address these disparities. [8] Development process involves reorientation of economic and social system. Development main objective is enhancing standard of living of people by improving social and economic wellbeing. It requires a resource transfer in the backward regions through a number of subsidies and govt. assistance. The economic development is not declining over the time shows regional disparity. [9] The PESA Act seeks to extend the provisions of the Panchayati Raj system to tribal areas, ensuring greater participation of tribals in local governance, decision-making, and resource management. However, the effectiveness of the PESA Act in reducing spatial inequalities and improving the living conditions of tribal communities' remains debated. This research aims to assess the effectiveness of the PESA Act in addressing spatial inequality.

Significance of the Study:

The present study systematically comparing social development levels between PESA and Non-PESA villages in Junnar Tahsil, the research provides empirical evidence on the actual outcomes of the Panchayats (Extension to Scheduled Areas) Act (PESA), 1996, moving beyond its theoretical intent.

First, the study contributes to the existing body of knowledge on tribal development and spatial inequality by applying Kendall's ranking coefficient to assess multi-dimensional social development. This methodological approach offers a comprehensive and comparable framework for evaluating regional disparities, which can be replicated in other Scheduled Areas for similar assessments.

Second, the findings highlight critical gaps between policy objectives and ground-level realities. Despite constitutional safeguards and decentralized governance mechanisms under PESA, tribal regions continue to lag behind in higher education, healthcare, drinking water, sanitation, transport, and public services. This underscores the need to re-examine institutional effectiveness, governance capacity, and resource allocation in PESA regions.

Third, the study has practical significance for policymakers, planners, and administrators. By identifying specific indicators where PESA villages underperform, the research provides a data-driven basis for targeted interventions, region-specific development strategies, and capacity-building initiatives for Gram Sabhas. It also emphasizes the importance of strengthening local institutions to translate legal empowerment into tangible social outcomes.

Finally, at the regional level, the study serves as an important input for decentralized planning in Junnar Tahsil. Understanding spatial variations in social development can assist district authorities in prioritizing investments, reducing regional imbalances, and promoting inclusive growth in tribal and remote areas. Overall, the study reinforces the necessity of effective implementation of PESA to achieve equitable and sustainable social development in Scheduled Areas.

Study Area:

Junnar Tahsil is located in the northern zone of the Pune district. It occurs in the section of steep isohyetal gradient having rainfall around 50 to 250 cm. The rainfall and humidity decrease from west to east. The latitudinal extent of the Tahsil is 19° 00' to 19° 24' north and longitudinal extent is 73° 40' to 74° 18' east. The area of the Tahsil is 1474.77 Sq.km. Junnar is mainly rural in character as 183 villages are there, according to 2011 census. Junnar Tahsil has the human population as about 3, 99,302. The rural population is 93.66 %, while the urban population is 6.34 %. The Junnar Tahsil mainly divided into nine circles namely Junnar, Nimgaonsava, Otur, Belhe, Aptale, Narayangaon, Vadgaon Anand, Dingore and Rajur. The Tahsil has 67 villages categorized as tribal villages in which the human resource development is on lower side. The tribal population is found in the western part of the tahsil which is hilly region. Further, spatial variations in regional development have been significant in the Junnar Tahsil. Therefore, it is interesting to study the facts and factors related to social development in the Tahsil. This may help in regional planning of the Tahsil.

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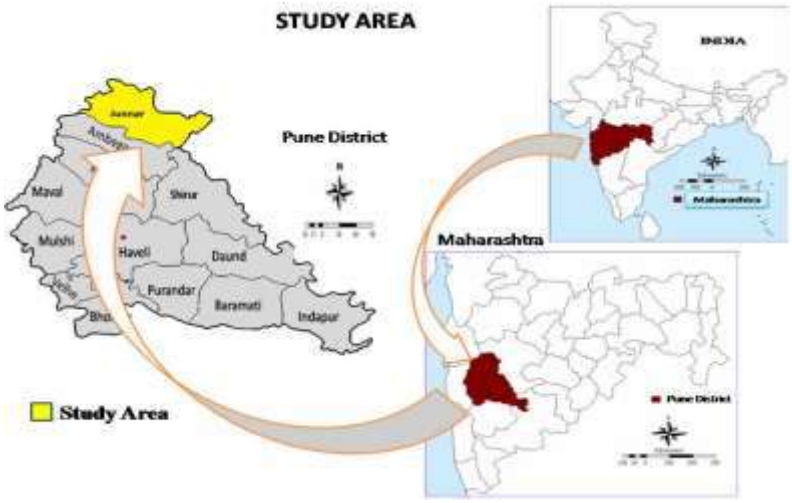

Fig. No. 1.1 Study Area Map

Research Questions:

The research will seek to answer the following questions:

Has the implementation of the PESA Act reduced spatial inequality in the social development in tribal regions?

Hypothesis:

While PESA has the potential to enhance access to essential services such as healthcare, education, and employment, its impact on reducing spatial inequality largely depends on the strengthening of local governance systems and the efficient mobilization of resources. The degree to which PESA mitigates spatial disparities is closely linked to the quality of its implementation and the active involvement of tribal communities in decision-making. Effective execution of the Act contributes significantly to narrowing the social gap between tribal and non-tribal regions.

Objectives:

The main aim of this study is to evaluate how effectively the Panchayats (Extension to Scheduled Areas) Act (PESA) addresses spatial inequalities in tribal regions, with particular emphasis on its influence on governance, socio-economic development, and resource utilization. The study pursues the following specific objectives:

- To examine the social conditions of tribal communities, especially their access to essential services such as education, healthcare, and physical infrastructure.
- To conduct a comparative analysis of PESA and non-PESA areas, identifying the contextual factors that shape the effectiveness of PESA in reducing spatial disparities in social development.

Methodology:

The study adopts a qualitative and quantitative research approach to assess the effectiveness of the Panchayats (Extension to Scheduled Areas) Act (PESA) in addressing spatial inequality. The research is based on secondary data from the District Statistical Handbook and Census Data for 2011. Kendall's ranking co-efficient method was used to analyze the spatial variation in social development in the Junnar tahsil. The differences in regional development are caused by differences in the nature of social, development, therefore 17 indicators are chosen for social development. The 67 villages under PESA area selected for the study.

Kendall's rank order score method:

An attempt has been made to examine the development of Junnar Tahsil at the village level using these data and indicators. The Kendall ranking co-efficient method was used to investigate the spatial variation in social development. Region wise differentiation was used to analyze the development of social amenities in Junnar Tahsil. Various types of indicators were used for this. These indicators have been ranked in order of their total number. The region with the most social amenities was assigned rank 1, and the other was ranked 2. As a result, the average of all indicators has been calculated, and the region with the highest average score falls into the low developed category, while the region with the lowest average score falls into the high developed category.

Pesa Act:

The PESA Act has had a mixed impact on addressing spatial inequality in tribal areas. While it has empowered tribal communities in some respects, it has faced significant challenges in full and consistent implementation. The effectiveness of the Act in addressing spatial inequality will depend

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on stronger political will, better administrative support, and active engagement of tribal communities in governance. To truly address spatial inequality, a comprehensive approach that combines legal empowerment with socio-economic development, infrastructure improvement, and local governance is needed.

Social Development:

Development is a comprehensive and dynamic process that involves restructuring and transforming the entire social system. It requires balanced growth in human resources to ensure sustainable progress. In many countries, development initiatives are carried out through structured five-year plans aimed at enhancing the quality of life by ensuring access to basic needs and strengthening social well-being. To reduce regional disparities, governments channel resources to less developed areas through policies, subsidies, and financial assistance.

Development goes beyond economic growth; it also includes social and political transformation that benefits large sections of the population. Socioeconomic factors play a crucial role in shaping regional progress, as they influence access to opportunities and public services. Improvements in education, healthcare, communication, safe drinking water, electricity, and employment opportunities significantly enhance the overall living standards of people in a region. This study focuses on examining the interconnections between social development and key factors such as agriculture, infrastructure, and literacy levels within the tahsil.

Analysis and Discussion:

Regional disparities in the level of Social Development

There are numerous reasons for social disparities, ranging from past to present status in education, health, infrastructure, and other such amenities. The level of social development has been calculated using the combined rank score of 17 indicators. Various types of indicators were used have been ranked in order of their total number. The region with the most social amenities was assigned rank 1, and the other was ranked 2. As a result, the average of all indicators has been calculated, and the region with the highest average score falls into the low developed category, while the region with the lowest average score falls into the high developed category.

Table 1.2 Regional disparities in the level of Social Development

Sr. No.	Social Development Indicator	PESA Region	Rank	Non – PESA Region	Rank
1	Percentage of Pre-Primary School	100	1	98.28	2
2	Percentage of Primary School	98.51	1	98.28	2
3	Percentage of Higher Secondary school	16.42	2	50.86	1
4	Percentage of Primary Health Centers	4.48	2	7.76	1
5	Percentage of Sub Health Centers	38.81	2	43.10	1
6	Percentage of Safe Drinking Water Facilities	47.76	2	88.79	1
7	Percentage of Drainage Facilities	70.15	2	92.24	1
8	Percentage of Post Office	0	2	24.14	1
9	Percentage of Public Bus Services	86.57	2	97.41	1
10	Percentage of Electricity	100	1	100	1
11	Percentage of Public Distribution System	59.70	2	84.48	1
12	Percentage of Pucca Road	95.52	1	93.10	2
13	Population Density	145	2	321	1
14	Sex Ratio	1111	1	870	2
15	Literacy	70.05	1	69.59	2
16	Male Literacy	78.00	2	80.92	1
17	Female Literacy	62.03	2	69.52	1
	Total rank		28		22
	Average Rank		1.65		1.29
	Rank		2		1

Source: Calculated by Author

The table shows a clear contrast in social development between PESA and Non-PESA regions. While both regions perform similarly in pre-primary and primary schooling (above 98%) and have universal electricity coverage, major

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differences appear in higher secondary education, where non-PESA regions (50.86%) far exceed PESA regions (16.42%), indicating limited access to advanced education in PESA areas. Basic infrastructure such as safe drinking water (88.79% vs. 47.76%), drainage (92.24% vs. 70.15%), post offices (24.14% vs. 0%), health centers, and public distribution systems is significantly better in non-PESA regions, showing stronger service delivery and civic amenities. Although PESA regions have slightly better pucca road coverage and a remarkably higher sex ratio (1111 compared to 870), suggesting better gender balance, they lag in female literacy and overall institutional development. Population density is much higher in non-PESA regions (321 vs. 145), reflecting greater urbanization and concentration of services. Overall, non-PESA regions demonstrate stronger infrastructure and educational attainment, while PESA regions show better gender balance but weaker access to higher-level services and facilities.

The composite index of all selected social sector indicators provided an overall picture of region-wide disparity and social development in the tahsil. To explain the prevalent region-wide disparities in social development, the study area was divided into two levels: highly developed and less developed.

Table 1.3 Social Development Index of Junnar Tahsil.

Sr. No.	Ranking Coefficient	Development Grade	Name of Region
1	Below 1.47	High	Non - PESA
2	Above 1.47	Less	PESA

Source: Compiled by Author.

Table 1.3 presents the social development status of regions within Junnar Tahsil based on a ranking coefficient. The table categorizes the regions into two development grades: Highly Developed and Less Developed. This classification highlights a clear disparity in social development between the two regions.

High developed region:

Regions with a ranking coefficient below 1.47 are classified as High Developed, and in this case, the non-PESA region falls into this category. The non-PESA region, with better access to education, healthcare, infrastructure, and public services, has achieved a higher level of social development.

Less developed region:

In contrast, regions with a ranking coefficient above 1.47 are classified as Less Developed, which corresponds to the PESA region. Conversely, the PESA region lags behind, indicating the need for focused development policies, investments, and targeted interventions to address the specific challenges faced by tribal and remote communities in order to achieve balanced and inclusive regional development across the tahsil.

Conclusion:

The comparative analysis reveals a clear development disparity between Tribal and Non-Tribal regions. Non-Tribal regions exhibit a higher level of overall social development, as reflected by lower ranking coefficients and superior performance in most indicators. Tribal regions, despite constitutional safeguards, remain comparatively less developed, particularly in higher education, healthcare facilities, drinking water supply, sanitation, transport, and public services. Basic educational access (pre-primary and primary levels) is relatively strong in Tribal regions, indicating success in elementary education outreach. Higher secondary education availability is significantly lower in Tribal regions, limiting educational progression and skill development. Infrastructure and service delivery (health centers, drainage, safe drinking water, public distribution system, and postal services) are consistently better in non-tribal regions. Literacy levels are marginally higher in non-tribal region than Tribal areas. Sex ratio is notably more favorable in Tribal regions, suggesting stronger social balance and community structure.

The findings emphasize the need for targeted and region-specific policy interventions to strengthen healthcare, higher education, and infrastructure in Tribal regions. Effective implementation of PESA provisions, coupled with improved governance and investment, is essential to bridge the observed development gap. Overall, the study underscores the importance of balanced and inclusive regional development to ensure equitable social progress across both Tribal and Non-Tribal regions.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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Original Article

Role of E-Administration in Local Self-Government Institutions: Literature Review

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Abstract

The utilisation of Information and Communication Technology (ICT) in governance has highly changed public administration systems all over the world. E-administration, as an essential part of e-governance, has become an important tool for enhancing administrative efficiency, transparency, accountability, and public participation. Local Self-Government Institutions (LSGIs), particularly in developing countries like India, have a important role in supporting decentralized governance and grassroots-level development. However, these institutions have long faced challenges with issues such as inefficiency, lack of transparency, and low levels of citizen participation.

This research paper provides complete and detailed review of literature on the role of e-administration in local self-government institutions. It analyses theoretical basis, global approaches, Indian experiences and research findings from various studies. The review highlights that e-administration has significantly improved governance processes by digitizing administrative systems, enhancing service delivery, and promoting participatory governance. At the same time, it brings out main issues as digital gap, Infrastructure deficiencies and opposition to novelty.

The paper draws a conclusion that while e-administration has ability to introduce change, its success depends on inclusive technology-driven policies, capacity building, and well-established institutional mechanisms.

Keywords: *E-administration, E-governance, Local Self-Government, Panchayati Raj, ICT, Digital Governance, Decentralization*

Introduction:

Idea of governance has passed through a perspective transformation with the beginning of digital technologies. Governments all over the world are increasingly adopting ICT tools to improve administrative processes and service delivery. E-administration denotes a shift from traditional bureaucratic systems to modern, technology-driven governance frameworks.

Local Self-Government Institutions (LSGIs) are key factors of participatory governance, particularly in countries like India where localisation is required by law. The 73rd and 74th Constitutional Amendments instituted Panchayats and Municipalities as self-governing bodies selected with local development and service delivery. In spite of their significance, LSGIs have historically met with a number of challenges:

- Poorly functioning administrative systems
- Non-transparency
- Dishonesty and administrative delays
- Minimal citizen involvement

E-administration has been adopted as a solution to these challenges by combining ICT into governance systems. It enables governments to improve efficiency, enhance transparency, and promote citizen-centric governance. Research suggests that ICT has become a significant tool for strengthening local governance and improving service delivery mechanisms [6].

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Conceptual and Theoretical Framework

1. Concept of E-Administration

E-administration, also pointed out as electronic administration, is the coordination of Information and Communication Technology (ICT) into the processes of public administration to increase efficiency, transparency, and accountability. It shows a fundamental shift in the way administrative tasks are managed, moving away from traditional paper-based methods toward digital workflows and automated systems. By digitizing records, automating routine tasks, and linking different information systems, e-administration enables governments to handle large volumes of administrative work more accurately and efficiently [1]. This change reduces hand operated errors, promotes decision-making, and sharpens service delivery to citizens.

Different from e-governance, which widely involves the use of ICT to contribute citizens, businesses, and other stakeholders in governance, e-administration correctly concentrates on internal government operations. These involve human resource management, budgeting, procurement, record-keeping, and internal reporting. By optimizing these internal processes, e-administration contributes to better resource management and policy implementation within governmental organizations [2]. In core, it boosts the administrative base of governance, which in turn increases the entire productivity of e-governance program.

Scholars have highlighted that e-administration is not merely about the use of technology but also about re-engineering administrative processes to align with digital workflows [3]. Define e-administration as a mechanism that improves traditional governance by simplifying online communication, easy exchange of knowledge and sound decision-making. The application of e-administration tools permit government departments to communicate skilfully with one another, securing rapidly processing of information and reducing bureaucratic delays. For example, online portals for document filing, process management systems, and centralized databases shows practical applications of e-administration that upgrade administrative capability.

Strengths of e-administration are particularly important in developing countries like India, where the capacity l of administrative tasks is vast and poor performances have historically affected government institutions. By implementing e-administration, public organizations can ensure better accountability as digital systems provide a clear audit trail for all transactions and decisions. Transparency is enhanced because information can be accessed and monitored more effectively, thereby reducing opportunities for corruption and administrative lapses [4]. Moreover, e-administration sets the foundation for citizen-centric services by simplifying internal processes, which finally upgrades responsiveness to public requirements.

As a result, e-administration is a core component of governance that utilizes ICT to enhance the internal activity of government institutions. By automating processes, facilitating digital communication, and ensuring transparency and accountability, it strengthens the capacity of public administration to deliver productive and trustworthy services. Scholars agree that its implementation is essential for modernizing governance structures and supporting broader e-governance objectives [1,3,4].

Theoretical approach

1. New Public Management (NPM)

New Public Management is a theory in public administration that efforts to generate government work more like a business. It emphasizes on productivity, performance measurement, eliminating inefficiency and gratifying citizens. NPM recommends that government services should be quick, economical and results-driven, encouraging innovation and rivalry within public organisations. E-administration corresponds NPM because it uses digital tools to digitise work, shorten processing time, reduce inefficiencies and strengthen service quality, forming public services more productive to people's needs.

2. Good Governance Theory

Good Governance Theory describes how government should work in a unbiased, transparent and accountable way. It shows vital morals such as transparency (open information), accountability (responsibility), people's involvement, rule of law, adaptability and justice so that people trust the system and gain from services. E-administration assists these principles by using digital platforms that authorise uncomplicated information access, citizen collaboration and supervision of public operations. Digital tools assist governments share information neatly, engage people more actively, and make decisions honestly. Thus, e-administration assists create a reliable, participatory, and people-centred governance system.

3. Digital Governance Theory

Digital Governance Theory emphasizes on how modern governance utilise digital technologies

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to change the method public services are scheduled, implemented and administered. This theory focuses the apply of information communication technology (ICT) for real-time data, best decision-making, and strengthened service delivery. E-administration shows this concept by co-ordinating digital tools. For example, online communication channels and automated systems into government work. These technologies guide governments reply immediately, speed up processes and deliver reliable services efficiently. Digital governance believes technology as an important part of governing. Facilitating citizen not only access to services but efficiency also.

3. Ingredients of E-Administration

- Digital record management
- Workflow automation
- E-office systems
- Online grievance redressal
- Data analytics and monitoring

These components jointly strengthen governance efficiency and effectiveness.

Progress of E-Administration in Local Governance

1. Preliminary Stage: Digitization

The preliminary stage of e-administration focused on digitizing essential records, including land ownership, taxation, and administrative documents. This stage aimed to replace paper-based systems with electronic records, making information storage, retrieval, and management more efficient. Digitization minimised manual errors, minimized physical storage requirements and improved data accessibility for officials. It also laid the foundation for subsequent digital initiatives, ensuring that government departments could later integrate networking and online services effectively. This stage represents the first step towards modern governance, as it enables faster information flow and better record-keeping [1,5].

2. Developmental Stage: Networking

In the developmental stage, government departments began using digital networks to enhance coordination and communication. Networking connected different offices, per meeting for real-time data sharing, improved teamwork and simplified workflows. This stage empowered departments to interact information productively, minimising delays in administrative processes. Networking also fostered transparency by allowing centralized monitoring and reporting of departmental activities. By establishing an interconnected system, governments could prepare for citizen-centric online services, ensuring responsiveness and accountability. The developmental stage highlights the importance of ICT infrastructure in improving administrative efficiency and interdepartmental cooperation [5].

3. Expansion Stage: Online Services

During the expansion stage, governments introduced online services for citizens, transforming the way public services were delivered. Services such as online applications for certificates, tax payments, and grievance redressal became accessible from anywhere, reducing the need for physical visits to offices. This stage enhanced citizen convenience, reduced administrative delays, and improved transparency. Online platforms also provided feedback mechanisms, enabling authorities to monitor service quality and respond efficiently. By extending digital services directly to citizens, governments could increase participation and trust. This stage shows how e-administration can make governance more inclusive, efficient, and citizen-oriented [5].

4. Transformation Stage: Smart Governance

The transformation stage involves integrating advanced technologies such as artificial intelligence (AI), big data analytics, and mobile governance into administrative processes. Smart governance focuses on real-time decision-making, predictive analysis, and enhanced citizen engagement. AI can automate routine tasks, while big data helps in policy formulation based on evidence. Mobile governance ensures accessibility, even in remote areas. This stage represents a mature form of e-administration, where technology not only streamlines operations but also improves responsiveness, transparency, and participatory governance. ICT-enabled systems at this stage fundamentally transform how local governments operate and interact with citizens [1,5].

Literature Review

1. ICT and Local Governance

Information and Communication Technology (ICT) has become a vital tool in strengthening local governance institutions. By supporting efficient information dissemination, ICT improves coordination among government departments and facilitates timely decision-making. Systems such as centralized databases and digital workflows enhance administrative efficiency, reduce delays, and minimize manual errors. Initiatives under the National e-Governance Plan (NeGP) have promoted ICT acceptance in local governance, Leading to enhanced service provision and better citizen engagement. Overall, ICT acts as a catalyst for modern, transparent, and accountable governance at the local level [6].

2. E-Governance in Local Administration

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E-governance initiatives have transformed local administration by enhancing efficiency and citizen pleasure. Online platforms, automated workflows, and digital records minimize bureaucratic lags and errors while providing more convenient reach to services. Studies in regions like Tamil Nadu show that e-governance activities are effective in improving administrative functions; however, progress in rural areas is slower due to infrastructure limitations and low digital literacy. Despite these challenges, digital tools have proven to be instrumental in streamlining operations and promoting responsive governance, making public administration more transparent, accountable, and citizen-focused [7].

3. Transparency and Accountability

E-administration contributes significantly to transparency and accountability in governance. Digital systems provide citizens with access to information about policies, schemes, and departmental actions, building audit trails that minimize corruption. Automated procedures also enable monitoring of government activities, ensuring officials are answerable for their decisions. ICT-based platforms foster trust between citizens and government by making data and decisions visible and verifiable. Studies confirm that implementing digital governance tools strengthens institutional accountability, improves oversight, and enhances public confidence in government operations [11].

4. Citizen involvement

Digital governance supports citizen participation by offering online platforms for engagement, feedback, and communication. Citizens can interact with local authorities, submit grievances, and participate in policy decision-making through e-services. This enhances democratic governance by empowering communities and ensuring that citizen voices influence administrative processes. E-administration systems enable inclusivity, transparency, and real-time responses to public needs. Research demonstrates that such platforms increase involvement and accountability, fostering trust and collaboration between the government and the public. Local governance becomes more citizen-centric and responsive to community requirements by integrating technology.

5. Service Delivery

E-administration has improved service delivery by reducing costs, saving time, and enhancing accessibility. Digital platforms allow citizens to access government services such as certificates, tax payments, and grievance redressal without visiting offices physically. Automation ensures faster processing of applications and reduces human errors. Studies indicate that ICT-enabled services provide efficient, convenient, and user-friendly solutions, which improve citizen satisfaction and administrative performance. By streamlining operations and integrating services online, governments can ensure timely delivery, increase transparency, and strengthen trust in public institutions [9].

6. Digital Gram Panchayat

Digital Gram Panchayat systems are crucial for rural governance, offering services like certificate issuance, grievance handling, and information dissemination online. These platforms improve operational efficiency, communication between citizens and officials, and service transparency. They also enable remote access to administrative services, minimizing travel and delays for rural residents. Research highlights that such digital systems strengthen local institutions, enhance accountability, and foster citizen participation. Implementing Digital Gram Panchayats is essential to modernize rural governance and ensure equitable access to services in line with broader e-governance objectives [8].

7. Smart Governance and Innovation

Smart governance represents the integration of advanced technologies such as AI, big data, and mobile platforms into governance systems. These innovations enable real-time decision-making, predictive analysis, and improved responsiveness to citizens' needs. Institutional and technological innovation are critical for effective e-governance implementation, ensuring that local governments can provide efficient, transparent, and citizen-focused services. Research suggests that adopting smart governance frameworks not only enhances operational efficiency but also strengthens public trust, participation, and innovation capacity within local administration [10].

Role of E-Administration in Local Self-Government Institutions

1. Improving Effectiveness of Administration

E-administration improves efficiency of government operations by reducing paperwork and automating steps, enabling quick processing of applications and decisions. Automation minimizes human errors, saves time, and improves coordination across departments. These improvements allow local governments to deliver services more effectively while optimizing resources. Digital systems thus play a critical role in modern governance by making administrative processes more efficient, responsive, and citizen-oriented [1,5].

2. Enhancing Clarity

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Digital platforms provide real-time access to information, ensuring clarity in governance. Citizens can track government actions, view project statuses and monitor public expenditure online. This openness reduces corruption, builds public trust, and strengthens institutional credibility. By making data and decisions visible and accessible, e-administration ensures that citizens are informed and that governance is transparent and accountable [11].

3. Improving Governance Accountability

E-administration creates audit trails and electronic records that make officials accountable for their actions. Automated reporting, monitoring tools, and digital documentation help identify delays or irregularities. This ensures that public servants perform their duties responsibly, reducing corruption and increasing reliability. ICT-based accountability mechanisms support ethical administration and reinforce public confidence in governance processes [5,6].

4. Strengthening Democratic Participation

Digital tools allow citizens to engage with government institutions, submit grievances, provide feedback and participate in policy decisions. Online portals, mobile apps, and social media platforms encourage inclusive and participatory governance, ensuring that citizen voices influence local administration. E-administration thus strengthens democracy by fostering interaction between officials and communities, enhancing responsiveness, and promoting active citizen involvement [9].

5. Strengthening Fiscal Management

E-administration ensures transparency in financial transactions, reduces manual errors, and minimizes opportunities for corruption. Digital accounting, online payments, and audit systems enable accurate monitoring of budgets, expenditures, and revenues. These systems improve financial discipline, grow efficiency of fund utilization, and build public trust in government institutions. ICT-enabled financial management supports accountability while promoting responsible and transparent governance [5,8].

6. Strengthening Decentralization

ICT supports local governments to operate more independently and efficiently, enabling decentralized decision-making. Digital communication, online reporting, and automated processes reduce dependency on higher authorities while enhancing operational control. This strengthens local self-governance, ensures quicker service delivery, and fosters community-oriented administration. E-administration facilitates resource management, planning, and monitoring at the local level, promoting effective and responsive decentralized governance [6,10].

Challenges in E-Administration

1. Technology Gap

The digital gap is a main challenge in applying e-administration, particularly in rural and remote areas. Many citizens lack access to computers, smartphones, or internet connectivity, creating inequality in access to digital services. This gap limits participation in e-governance and reduces the effectiveness of ICT initiatives. Bridging the technological gap is essential to ensure inclusive and equitable access to government services [6].

2. Lack of Infrastructure

Limited infrastructure such as electricity, internet connectivity, and computing hardware significantly affects the adoption of e-governance. Poor network coverage, unreliable power supply, and outdated equipment hinder digital service delivery and reduce efficiency. Without adequate infrastructure, digital platforms cannot function effectively, delaying service provision and reducing public satisfaction. Strengthening ICT infrastructure is crucial for successful implementation of e-administration in local governance [8,5].

3. Digital Literacy

Digital literacy, or the ability to use technology effectively, is often low among citizens and government officials. Lack of technical skills limits the use of online services, slows adoption of ICT tools, and creates dependency on manual processes. Training programs and awareness campaigns are necessary to improve competence. Enhancing digital literacy ensures effective participation in e-governance and allows citizens and officials to benefit from digital administrative systems [7,9].

4. Resistance to Change

Resistance from administrative staff and local officials can slow the adoption of new technologies. Employees may prefer traditional manual processes due to fear of job loss, unfamiliarity with ICT tools, or reluctance to change routines. Such resistance delays workflow automation and reduces the efficiency of e-administration. Overcoming this requires training, motivation, and institutional support to ensure smooth digital transformation in governance [1,5].

5. Data Protection Challenges

Digital governance systems face risks relate with data security and privacy, including hacking, data breaches, and unauthorized access. Sensitive information, such as citizen records and financial transactions, must be protected to maintain trust. Weak security infrastructure can undermine the effectiveness of e-administration

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and reduce public confidence. Strengthening cybersecurity measures and implementing robust policies are essential for safe and reliable digital governance [10,11].

Research Gap

The literature reveals several gaps:
1. Limited district-level studies
2. Lack of empirical data
3. Insufficient focus on rural governance
4. Need for comparative analysis

Discussion

The review of literature shows that e-administration has importantly transformed governance frameworks by improving efficiency, transparency, accountability, and civic engagement. Digital platforms, automated workflows, and online service delivery have enabled local governments to provide faster and more reliable services, reducing manual errors and bureaucratic delays.

On the other hand, the desired outcome of e-administration depends on several critical factors. Sufficient infrastructue including electricity, internet connectivity, and computing hardware is important for ensure seamless implementation of digital systems, particularly in rural and remote areas [8]. Strong policy support is necessary to create an enabling environment, define standards, and provide legal backing for digital governance initiatives [5]. Capacity building of officials and staff through training programs is crucial to ensure effective use of technology and smooth workflow automation. Finally, digital literacy among citizens is important for meaningful participation, as lack of technical skills can limit access and reduce the inclusivity of e-governance programs [7,9].

Conclusively, we can say that ICT has the capability to revolutionize local governance, its impact realises on cooperation to strengthen infrastructure, policies, human capacity, and citizen awareness. Tackling these factors confirm that e-administration fullfills its purposed aim of transparency, efficiency, and inclusiveness.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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Original Article

Impacts of Dam Construction on Regional Development: Geographical Study of Nashik District

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Abstract

This review paper critically examines the multifaceted environmental and social repercussions of dam construction in Nashik, considering the region's unique geographical, ecological, and socio-economic contexts. Through an interdisciplinary lens, we analyze the consequences of dam projects on the local ecosystems, biodiversity, water quality, and land use patterns. Additionally, we delve into the social dimensions, evaluating the impact on communities, livelihoods, and cultural heritage. Drawing on a comprehensive synthesis of existing literature, case studies, and empirical evidence, this review aims to provide a nuanced understanding of the interconnected environmental and social challenges posed by dams in Nashik. By highlighting both positive and adverse effects, we contribute to informed decision-making and sustainable development practices in the region.

Keywords: *Environment Protection, Social Impact, Constructional Aspects to Environment and Society.*

Introduction:

Dams, monumental structures designed to harness water resources, have played a pivotal role in shaping landscapes, meeting energy demands, and facilitating agricultural development. While their benefits in providing water storage, flood control, and hydropower are undeniable, the construction and operation of dams also impose significant environmental impacts that require careful consideration. This introduction delves into the multifaceted environmental consequences associated with dam projects, exploring alterations in river ecosystems, sedimentation issues, water quality concerns, effects on biodiversity, and broader ecological transformations. One of the most profound environmental impacts stems from the alteration of river ecosystems. Dams regulate the natural flow of rivers, disrupting established patterns that are vital for the migration of fish, sediment transport, and nutrient cycling. These changes can lead to habitat modification as reservoirs form, creating new ecosystems that may not fully support the diversity of species found in natural riverine environments. The impoundment created by dams alters water temperature, substrate composition, and sediment transport, influencing the availability of suitable habitats for aquatic organisms. This, in turn, can impact the biodiversity of both plant and animal species dependent on the river ecosystem. Sedimentation and siltation emerge as critical concerns during dam construction. Various activities, including excavation works, quarrying operations, and the creation of spoil areas, contribute to the discharge of sediment into the water. The altered sediment load released into rivers can lead to downstream erosion, habitat degradation, and changes in the physical characteristics of river channels. Carefully managing sedimentation is crucial to maintaining the ecological balance of river systems and preventing adverse effects on downstream habitats. Water quality concerns represent another facet of environmental impact associated with dam projects.

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Construction sites can serve as sources of water pollution due to inadequately managed activities, potentially releasing excessive sediment loads and various chemicals into nearby water bodies. Storage and processing of substances like gasoline, lubricants, explosives, and construction-related chemicals pose risks of leakage or accidental discharge.

Effluents from concrete truck cleaning, containing elevated pH levels and contaminants, can further compromise downstream water quality if released directly into rivers. Ensuring preventive management procedures, including proper storage practices and contingency plans, is essential to mitigate the risk of water pollution. Dams also exert significant effects on biodiversity, especially concerning fish migration. The construction of dams can impede the natural migration routes of fish, disrupt their life cycles and leading to declines in fish populations. Species relying on migratory patterns for spawning or feeding face challenges in reaching their preferred habitats, impacting both aquatic ecosystems and the communities dependent on these fishery resources.

The environmental impacts extend beyond the construction phase into the reservoir filling process. The flooding caused by reservoir filling can result in out-migration and drowning of terrestrial fauna, with implications for public health and crop pests. The displacement of rodents and carnivores may disturb the human health environment, while crop pests could become more problematic for fields near the reservoir. Drowning of animals, especially small flightless terrestrial mammals and immature or injured animals, contributes to the biomass decomposition in the reservoir. In navigating the complex landscape of dam- related environmental impacts, it becomes imperative to adopt sustainable practices, implement effective management measures, and carefully assess the policies and regulations governing dam construction. The subsequent sections of this exploration will delve into each aspect of environmental impact in greater detail, providing a comprehensive understanding of the challenges and considerations associated with the development and operation of dams.

Profile of the Region

Nashik is a significant and renowned historic city in Maharashtra. Situated on the banks of the Godavari River, this district headquarters is positioned at an elevation of 565 metres above mean sea level (MSL). There are two possible interpretations for the origin of the word 'NASHIK'. The first is related to the town being situated on nine peaks (Navshikhar), and the second is related to an incident in the Ramayana when Lakshmana is supposed to have chopped off the nose (Nashik) of Shurpanakha, a sister of Lankadhipati Ravan. This location boasts a wealth of historical and cultural significance, and has since evolved into a bustling metropolis with a population of almost 1.1 million. The banks or Ghats of the river Godavari has religious significance as people perform sacred rituals by taking a holy dip in the "Kundas" (Ponds) built along the river banks. The Godavari River is known as the "Dakshin Ganga" and Ramkund is a significant holy site, particularly during the Kumbhamela. Nashik is a significant industrial town in Northern Maharashtra, situated at Latitude 19° 0' - 33' and 20° 53' North, and Longitude 73° 0' - 16' and 75° 6' East. It is approximately 180 kilometres away from Mumbai (Bombay), 210 kilometres from Pune, 165 kilometres from Ahmednagar, and 180 kilometres from Aurangabad.

The city has a population of 1.5 million and a transportation network spanning 850 kilometres. Furthermore, there is the Mumbai Agra National Highway No.3, spanning a distance of 1000 kilometres, and the Nashik Pune National Highway No.50, which covers a distance of 210 km. The primary rivers coursing through the district include Godavari, Kashyapi, Darna, Girna, Kadwa, and Nasardi (Nandini). There are two industrial estates: Satpur, which covers an area of 1600 acres and has 750 units, and Ambad, which spans 1400 acres and has 850 units.

Nashik possesses a distinctiveness stemming from its mythical, historical, social, and cultural significance. The city, characterised by its dynamism and engagement in the industrial, political, social, and cultural spheres, has exerted a profound influence on the lives of numerous eminent individuals. The city is traversed by the river Godavari. Nashik has become a highly revered destination for Hindus worldwide due to the presence of temples and ghats along the banks of the Godavari River. Religious sites like Trimbakeshwar, Panchavati, and Tapovan are renowned throughout India.

The establishment of Nashik Municipality took place in 1864, coinciding with the elevation of Nashik to a fully-fledged district including 13 Talukas. Currently, there are a total of 15 Talukas in Nashik district, namely Nashik, Peth, Dindori, Surgana, Kalvan, Baglan (Satana), Devla, Trimbakeshwar, Malegaon, Chandwad, Nandgaon, Yeola, Niphad, Sinnar, and Igatpuri. Nashik District is a prominent agricultural hub renowned for its cultivation of grapes, onions, flowers, sugar cane, rice, and famous vegetables. Grapes, onions, and flowers are globally exported. The proportion of

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land that is used for cultivation is around 56% of the total land area. Nashik is rich in forest resources. The forest is located in the western region of the district. The Surgana, Kalwan, Peth, Dindori, Nashik, and Igatpuri Talukas possess a significant number of forested areas.

Background Of Dams in Nashik District

Table 1: Dam Profile of Nashik district of Maharashtra

Sr. No	Dam	Type of dam (Medium, Major)	Source of River
1	Gangapur Dam	Major	Godavari River
2	Kashyapi Dam	Medium	Godavari River
4	Gautami Godavari DAM	Medium	Godavari River
5	Alandi Dam	Medium	Alandi River
6	Palkhed Dam	Medium	Kadva River
7	Karanjwan Dam	Major	Kadva River
8	Waghad Dam	Medium	Kolwan River
9	Ozarkhed Dam	Medium	Unanda River
10	Punegaon Dam	Medium	Unanda River
11	Tisgaon Dam	Medium	Parashri River
12	Darna Dam	Major	Darna River
13	Bhavali Dam	Medium	Bham River
14	Mukane Dam	Major	Aundha River
15	Waldevi Dam	Medium	Waldevi River
16	Kadwa Dam	Major	Kadwa River
17	Nandur Madhmeshwar Dam	Medium	Bandara River
18	Khojapur Dam	Medium	Maha lungi River
19	Chankapur Dam	Major	Girna River
19	Chankapur Dam	Major	Girna River
20	Haranbari Dam	Medium	Mosam River
21	Kelzar Dam	Medium	Aram River
22	Nagysakya Dam	Medium	Panzan River
23	Girna Dam	Major	Girna River
24	Punad Dam	Medium	Punad River
25	Manik Punj Dam	Medium	Manyad River

The table catalogs a series of dams, distinguishing between medium and major types, along with their associated rivers. Notable examples include the Gangapur Dam, a major structure on the Godavari River, and the Chankapur Dam, classified as major and situated on the Girna River. This compilation highlights the strategic utilization of different water sources for dam construction in the region.

Evolution of Dam Construction in Nashik

The evolution of dam construction in Nashik reflects a journey intertwined with the region's historical, cultural, and economic developments. Over the years, the construction of dams in Nashik has played a pivotal role in shaping the landscape, fostering agricultural growth, and addressing the water needs of the local communities. Nashik, situated on the banks of the Godavari River, has a rich history dating back to ancient times. The people of this region, primarily dependent on agriculture, recognized the vital importance of water for their existence. Early inhabitants developed ingenious water harvesting methods to conserve water from precipitation, ensuring a steady supply during dry months (Anandakrishnan, 2012). This ancient wisdom laid the foundation for the later, more sophisticated dam construction endeavors. In Nashik, the construction of dams gained momentum as a means to harness the abundant water resources of the region. Gangapur Dam, a major structure on the Godavari River, became a key milestone in this evolution. It served multifaceted purposes, including irrigation, flood control, and water storage. As Nashik developed into an industrial hub, the demand for water increased, prompting the construction of medium-sized dams like Kashyapi Dam and Gautami Godavari Dam, both situated on the Godavari River.

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Fig 1: An Overview of Dam Construction in Nashik

The Alandi Dam, strategically located on the Alandi River, exemplifies the region's commitment to comprehensive water resource management. Its construction aimed at addressing the specific needs of the local geography. Similarly, dams like Palkhed on the Kadva River and Karanjwan on the same river contributed significantly to the irrigation and water supply infrastructure. While Nashik embraced the idea of dams for economic development, it faced challenges in adapting models from developed countries like the TVA. The DVC in India, despite its ambitious goals of multipurpose benefits, encountered obstacles due to the transfer of technology between nations with distinct physical, technical, social, cultural, economic, and institutional conditions. The repercussions of these challenges continue to affect the people in the DVC area. The late twentieth century witnessed a global shift in dam construction trends. Developed countries completed their large dam programs by 1975, while developing nations like Brazil, China, India, Indonesia, Malaysia, Thailand, Turkey, and others initiated their dam projects in subsequent years. Nashik, with its rich agricultural heritage, actively participated in this global movement.

India's first Prime Minister, Jawaharlal Nehru, articulated a vision where dams were considered the new temples of modern India. Iconic dams like Bhakra and Hirakud were celebrated as symbols of progress. Nashik, aligning with this vision, continued to invest in dam construction projects that addressed the region's growing water demands. The journey of dam construction in Nashik has not been without challenges. As the region developed, so did the complexities associate with water management. Environmental concerns, technological advancements, and evolving socio-economic landscapes influenced the design and execution of dams. Nashik, however, demonstrated resilience in adapting to these changes, ensuring a sustainable approach to water resource development.

In recent times, Nashik has witnessed the completion of dam projects, each contributing to the overall socio-economic development of the region. The comprehensive network of dams on rivers such as Girna, Darna, Kadwa, and Nasardi (Nandini) showcases Nashik's commitment to holistic water management. The impact of dam construction on the environment and the surrounding areas is a subject of increasing importance. Nashik's experience with dam construction provides valuable insights into the challenges and benefits associated with large-scale water infrastructure projects. The ecological balance, water conservation, and the welfare of local communities are integral aspects that demand careful consideration in the evolution of future dam projects. As Nashik looks toward the future, the evolution of dam construction will likely continue to be shaped by technological advancements, environmental consciousness, and the evolving needs of the region. Sustainable practices, community engagement, and a holistic approach to water resource management will be paramount in ensuring that the legacy of dam construction in Nashik contributes positively to the well-being of its people and the environment for generations to come.

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Environmental Impacts of Dams

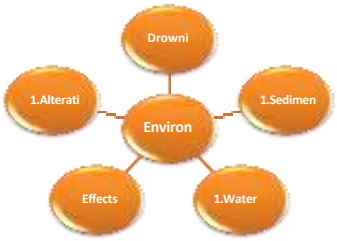

Fig 2: An Overview of Different Environmental Impact

There are many potential impacts of dams on the physical and biological environment at the construction site, reservoir area and downs stream areas. These impacts were summarized.

Alteration of River Ecosystems

The alteration of river ecosystems due to the construction of dams is a multifaceted and significant environmental impact that has both immediate and long-term consequences. Dams, while serving various purposes such as water storage, flood control, and hydroelectric power generation, can profoundly influence the natural balance of river ecosystems. This section explores the key alterations observed in river ecosystems as a result of dam construction.

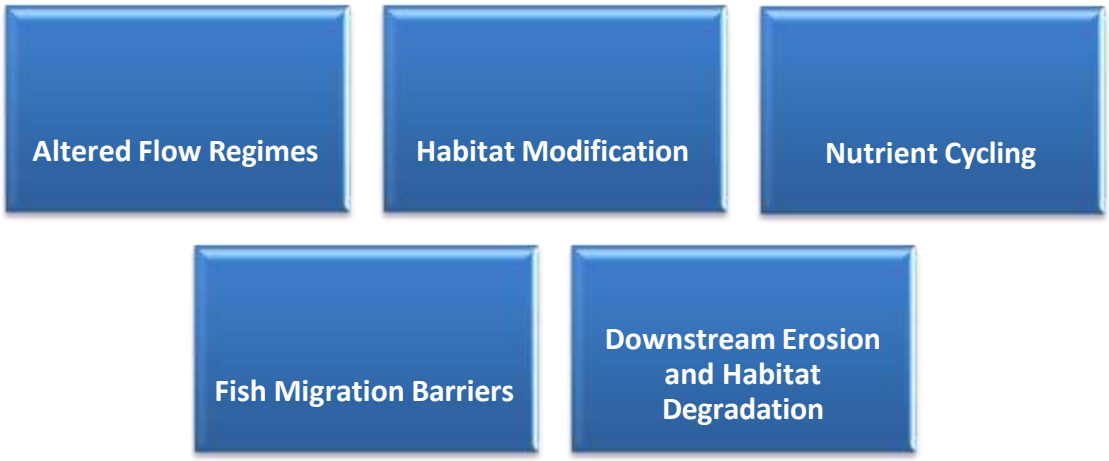

Fig 3: Different Components of River Alteration

The impact of dams on river ecosystems is a complex and multifaceted issue that involves both ecological and hydrological changes. While dams provide various benefits, such as water storage, flood control, and electricity generation, they also bring about significant alterations to the natural flow of rivers, water quality, and the habitats that rivers support. Understanding these impacts is crucial for sustainable water resource management and conservation of river ecosystems.

Altered Flow Regimes:

Dams regulate the flow of rivers by controlling water release. This alteration in natural flow regimes can have profound effects on the downstream ecosystems. Changes in flow patterns can disrupt the seasonal cues that trigger fish migration, affect sediment transport, and impact the natural flushing of nutrients downstream.

- **Habitat Modification:** The impoundment created by dams leads to the formation of reservoirs, altering the river's physical structure and creating new habitats. While some species may thrive in reservoirs, others that depend on the natural riverine environment may face challenges. Changes in water temperature, sediment transport, and substrate composition can affect the availability of suitable habitats for aquatic organisms.
- **Nutrient Cycling:** The natural flow of rivers contributes to nutrient cycling by transporting organic matter downstream. Dams can alter nutrient dynamics by trapping sediments and organic material within reservoirs. This disruption affects nutrient availability

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downstream, potentially impacting the productivity of aquatic ecosystems.

- **Fish Migration Barriers:** Dams can impede the natural migration of fish, disrupting their life cycles and impacting fish populations. Species that rely on migratory patterns for spawning, feeding, or completing their life cycle may face challenges in reaching their desired habitats.
- **Downstream Erosion and Habitat Degradation:** The altered sediment transport downstream can lead to increased erosion, habitat degradation, and changes in the physical characteristics of river channels. This can affect not only aquatic habitats but also the surrounding riparian ecosystems.

Sedimentation and Siltation Issues

The discharge of a substantial sediment load into the water is likely to occur primarily during activities conducted within or in close proximity to the riverbed. These activities include the construction of diversion channels, excavation works at the dam site, the erection of protection dikes and coffer-dams, quarrying operations, sand borrowing from the riverbed, and the creation of spoil areas either too close to the riverbank or with unstable slopes. Each of these activities holds the potential for significant impacts on the sediment load released into the river. Most of these construction activities are scheduled during the dry season when river flows are at their lowest. During these works, water that infiltrates from the alluvial aquifer into the excavation needs to be pumped out. Frequently, water pumped out carries a heavy sediment load and is discharged into the nearby stream, typically consisting of a low flow of very clean water drained from superficial aquifers. The period when the high sediment loads may enter the river coincides with the onset of the rainy season.

During the initial heavy storms of this season, unstable slopes of spoils or bare soils in construction sites, camps, or along access roads may be washed out, contributing to increased sedimentation in the river. However, the impact during this period is somewhat mitigated due to the significantly higher flows in the river, which already carry a substantial sediment content. To address these challenges and minimize environmental impact, it is crucial to implement effective measures and management practices. This includes adopting construction techniques that reduce soil erosion, establishing proper sedimentation ponds or basins to capture sediment-laden water before discharge, and carefully planning the location of spoil areas to prevent instability. Additionally, during the pumping of water from excavations, employing proper sediment control measures can help prevent the discharge of water with heavy sediment loads into nearby streams. Regular monitoring and adherence to environmental regulations are essential components of responsible construction practices near riverbeds to safeguard aquatic ecosystems and downstream water quality.

Water Quality Concerns

The construction of dams has become imperative in response to the rising needs for water and energy. However, despite their undeniable benefits, dams also give rise to adverse environmental impacts. Throughout the construction phase, the sites may serve as sources of water pollution due to inadequately managed and monitored activities, subsequently impacting downstream water quality. Commonly observed consequences in such situations involve the excessive release of sediment loads into the river stream and the discharge of chemicals. Furthermore, the distribution and cycling of chemical compounds within water bodies, including dams, are intricately linked to water movement in the landscape and are subject to alterations influenced by shifts in hydrological and biological cycles.

During the construction of dams, substantial quantities of gasoline, lubricant products, explosives, and various chemicals (such as concrete topping, solvents, paints, thinners, and acids) are stored and processed at the construction site, posing a potential risk of leakage or accidental discharge into the surroundings. This risk can be effectively mitigated through the implementation of preventive management procedures by the contractor. This includes selecting appropriate locations for storage areas in accordance with international best practices (utilizing bonded storage), implementing the collection and recycling of used oils, and closely monitoring all hazardous products with specific handling procedures and contingency plans . Another potential source of pollution arises from batching plants, particularly the effluent generated during the cleaning of concrete trucks.

Effects On Biodiversity

The primary sources of noise and dust along construction paths, roads, and transmission lines are the vehicles transporting materials, people, and equipment. Construction site activities, including the operation of vehicles, earth-moving equipment, lifting equipment, cutting and blasting equipment, as well as sirens, contribute to noise and dust emissions. In borrowing areas, where materials are sourced, additional noise and dust arise from

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vehicles, earth-moving equipment, sirens, and occasional explosive detonations.

These paths intersect various land habitats where a variety of mammals, including sand foxes, porcupines, rattlesnakes, civets, porpoises, hedgehogs, and wild cats, may be present. While none of these mammals are endangered or of significant environmental importance, the construction activities can still impact their habitats. In the dam construction and borrowing areas within riverine habitats, the wildlife primarily consists of birds, but other species such as pigs, green monkeys, crocodiles, and snakes may also be present. The inundation event during reservoir filling has complex impacts on terrestrial fauna, leading to reactions such as out-migration and drowning. Timber and biomass clearance may disturb larger animals, prompting them to leave the area. Even without such activities, larger and highly mobile small animals tend to evacuate as the water level rises. The 24-hour inundation process presents challenges for strictly nocturnal and diurnal animals. Displaced animals may survive drowning in some cases, but the rapid displacement often leads to high mortality rates. Even animals successfully establishing themselves post-displacement may face higher mortality rates until population pressures decrease through natural regulation processes.

1. Drowning of Animals: Rapidly moving fauna often leave the inundation area during biomass destruction. Those that remain or return may become trapped on temporary islands formed during reservoir filling. Due to the absence of permanent islands, animals trapped on these temporary landmasses will eventually drown unless they can swim to the shore.

The animals most vulnerable to drowning include small flightless terrestrial mammals, immature and injured animals unable to move, and soil fauna. The bodies of drowned animals contribute to the total biomass decomposition in the reservoir.

2. **Social Impacts of Dams:** The construction and operation of dams in the Nashik region have multifaceted social impacts, influencing various aspects of the local communities' lives and the broader sociocultural fabric. One significant aspect is the transformative effect on livelihoods, particularly in areas where agriculture is prevalent. The regulation of water flow through dams enables better irrigation practices, positively affecting crop yields and promoting agricultural productivity. This, in turn, contributes to economic growth within the farming communities, providing them with a reliable water source for cultivation. Additionally, the availability of water for irrigation supports diversification into cash crops, enhancing income opportunities for farmers. The establishment of dams often leads to the creation of reservoirs, introducing new opportunities for fisheries and aquaculture. Local communities can benefit from increased fish stocks, contributing to both dietary and economic aspects. The fishing industry becomes a source of employment and income, offering a sustainable livelihood for those engaged in this activity. Moreover, the reservoirs may become recreational spaces, attract tourists and foster the growth of local businesses catering to tourism-related needs. Dams also play a crucial role in addressing water scarcity, a persistent challenge in many regions. The regulated release of water from dams ensures a more consistent water supply for domestic use, reducing dependency on seasonal variations. This, in turn, enhances the quality of life for residents who now have improved access to clean and reliable water for daily needs. Additionally, the availability of water facilitates the growth of urban areas, promoting infrastructural development and contributing to the overall urbanization of Nashik.

Furthermore, the development of dams necessitates the establishment of governance structures and regulatory frameworks to manage water resources effectively. This may involve the creation of local water management committees or engagement with existing local governance structures to ensure that the benefits and responsibilities associated with water use are distributed equitably among different sections of society.

The social impacts of dams in Nashik are dynamic and multifaceted, influencing livelihoods, culture, and community dynamics. While dams contribute significantly to agricultural productivity, water availability, and economic growth, they also pose challenges related to displacement, cultural changes, and potential inequalities. Strategic planning, inclusive policies, and community participation are crucial in navigating these complexities and ensuring that the benefits of dam development are shared equitably among all members of the society.

Conclusion

In conclusion, our review underscores the intricate relationship between dam construction and its far-reaching consequences on the environment and society in Nashik. The environmental impact assessment reveals that dams have significantly altered local ecosystems, affecting biodiversity, water quality, and land use. Simultaneously, the social dimensions of dam projects expose a spectrum of effects on

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communities, livelihoods, and cultural heritage, both positive and negative. The synthesis of diverse studies and empirical evidence emphasizes the need for a balanced approach in dam development, considering the delicate equilibrium between ecological preservation and socio-economic progress.

While dams offer essential benefits such as water supply, irrigation, and power generation, our review advocates for an integrated and sustainable management strategy. Future dam projects in Nashik should prioritize ecological restoration, community engagement, and participatory decision-making processes to mitigate adverse impacts. Additionally, the incorporation of modern technologies and innovative solutions can enhance the efficiency of dam operations while minimizing negative consequences. As Nashik continues to evolve, policymakers, environmentalists, and local communities must collaborate to formulate and implement policies that prioritize the preservation of the region's unique environment and the well-being of its inhabitants. By recognizing the interconnectedness of environmental and social factors, Nashik can strive for a harmonious coexistence between dam infrastructure and sustainable development. Ultimately, this review serves as a foundation for informed decision-making, fostering a future where the benefits of dam projects are maximized, and their adverse impacts are minimized for the collective welfare of Nashik's environment and society.

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The authors declare that there are no conflicts of interest regarding the publication of this paper.

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Original Article

An Analytical Study on UPI as The Major Reform in Digital Banking in India

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Abstract

In today's age of advanced technology, Unified Payments Interface (UPI) has emerged as a revolutionary digital payment system in India. It provides the best facility of fast, real-time and interoperable fund transfer system. In India, UPI was invented by the National Payments Corporation of India (NPCI) in 2016 and has become a major catalyst for the country's digital banking ecosystem. A simple interface, smartphone access and government initiatives like Digital India have increased adoption of this system in both urban and rural areas. Today, UPI has become a major part of the digital payment system in India. UPI has made significant strides in terms of volume and value of transactions in India. Hence, it has bypassed traditional payment methods such as RTGS, NEFT, IMPS and card payments. Its integration of fintech, e-commerce and banking apps further confirms its position as India's leading digital payment system. It has democratized digital banking by providing accessible and low-cost payment systems. For banks and financial institutions, UPI has reduced transaction costs. It has contributed for strengthening the Indian economy. The primary objective of this research is to study the role of UPI as a key segment of digital banking in India. Researcher also intending to understand and analyze the challenges and future potentials of UPI in strengthening India's digital financial ecosystem on the basis of secondary data available with recognized sources.

Keywords: *UPI, Digital Banking, Digital Payments, Fintech, UPI Apps.*

Introduction:

The Department of Payment and Settlement Systems (DPSS) gave in-principle approval to the National Payments Corporation of India (NPCI) on 24 September 2009 to operate various retail payment systems in the country and officially certified the operation of the National Financial Switch (NFS) ATM network from 15 October 2009. On 14 December 2009, regulations were drawn up to register all banks in the country as members with a view to launching a nationwide online payment system. NPCI is a major organization operating the retail payments and settlement system in India. In 2007, the Payment and Settlement Systems Act, 2007 was enacted at the initiative of the Reserve Bank of India (RBI) and the Indian Banks Association (IBA) to build a robust payment and settlement infrastructure.

NPCI has been recognized as a "not for profit" company as per the provisions of Section 25 of the Companies Act, 1956 (now Section 8 of the Companies Act, 2013) for the purpose of providing infrastructure for physical as well as electronic payment systems to the entire banking system in India. It focuses on innovation in retail payment system by adopting modern technology. The ten major promoter banks of NPCI are State Bank of India (SBI), Punjab National Bank (PNB), Canara Bank, Bank of Baroda (BOB), Union Bank of India (UBI), Bank of India, Industrial Credit and Investment Corporation of India (ICICI) Bank Limited, Housing Development Finance Corporation (HDFC) Bank Limited, Citibank and The Hongkong and Shanghai Banking Corporation (HSBC) Bank. In all, 56 more banks were inducted as members of NCPI in 2016. In 2020, Reserve Bank of India (RBI) regulated through the Companies Act to incorporate payment service operators, payment banks, small finance banks etc. by issuing equity shares on private placement basis.

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Introduction of UPI (Unified Payments Interface):

UPI (Unified Payments Interface) is not a technology imported by India. This is India's own technology. It has been launched in collaboration with RBI, NPCI and Indian Banks as mentioned above. Apart from many global technologies, India has imported in the past, UPI is a technology developed by India. Under the guidance of NPCI officials Nandan Nilekani, Dilip Asbe and their team created the UPI system and the then RBI Governor Dr. Raghuram Rajan started by officially endorsing it. The UPI technology system demonstrates India's ability to build and implement a world-class financial system.

It is clear that the NPCI has played an important role in developing theUPI and is the owner and operator of UPI. It is a real-time instant inter-bank payment system in India. NPCI is responsible for prescribing and enforcing rules, regulations and guidelines for UPI participants. UPI has emerged as an easy, fast and secure way of sending money. UPI enables users to link multiple bank accounts with a single mobile application. This system facilitates instant transfer of funds to bank accounts on a 24x7 basis through mobile devices.

The genesis of UPI is not only an invention of India's digital revolution but also about the progress of humanity as a whole. UPI has saved a lot of time of people by providing quick, secure and low-cost transactions. UPI has voted on issues such as waiting in bank queues, cash handling, delay in cheque clearing etc. Business activity has also picked up speed. UPI has done a lot to make the overall economy more efficient. Hence, UPI is not just a payment app but an innovation that provides digital literacy to the society.

Research Methodology

a) Objectives of Research Study:

1. To understand the conceptual background of Unified Payment Interface (UPI).
2. To analyze the growth and development of Unified Payment Interface (UPI) system in Digital Banking in India
3. To study the impact of UPI on the digital banking in India.
4. To examine the challenges, security concerns, and future prospects of UPI in India.

b) Data Sources: This research paper is based on the secondary data collected from concerned websites, research papers published in national and international journals, articles, data published by related institutions, banks, organizations etc. on their websites etc.

c) Literature Review:

(2021) Mahesh A and Ganesh Bhat jointly conducted a study on 'Digital Payment Service in India - A Case Study of Unified Payment Interface' which revealed that UPI offers superior advantages through variety of services. The growth of users of smartphones and internet penetration is the key factor in growth and progress of UPI service.

(2023) Akshaya Kumar Sahu, Dasarathi Sahu, Debananda Patra jointly conducted a study on 'An Empirical study of Unified Payment Interface (UPI) in Indian Digital Payment System'. The study revealed the facts that UPI aims to improve flawless integration & customer satisfaction by standardizing and offering a single interface for all NPCI systems. The prevalent use of android/IOS phones, the affordability of an online credible authenticity, global banking availability & the inclusion of fingerprint in phone actively promote the utilization of electronic payment systems in India, resulting in a cashless society.

(2024) Ms Manisha Tripathi, Mithul Bhat, Anubhav Chand, Nishith S Shetty, Naman Kothari, Varun Gowda R jointly studied the 'Impact of Growth of UPI on The Indian Economy'. Their study highlighted that, UPI adoption ranging from enhanced financial inclusion to the promotion of cashless transactions and upholding traditional banking services.

Popular Modes Of Digital Payment Transactions In India:

- **Payment by Debit Card :** It is a popular payment method in India. Under this system, payment is made by deducting money from the bank account. It is an easy and convenient payment method, as it does not require cash. All expense details can be saved in summary form. However, there is also a potential risk of card theft.
- **Payment by Credit Card :** It is also known as a popular method of payment in India. This method provides the facility of purchasing goods and paying for them at a later date with the help of credit facility. However, if the credit card is not used properly and the amount is not repaid promptly, the debt can accumulate due to high interest charges.
- For payment acceptance in both of above methods, businesses need to have a payment gateway machine and partner with a payment processor. E.g. POS (Point of Sale) system.
- **Autopay :** It is a convenient and efficient online payment method. In this method, the payment is automatically deducted from the bank account or credit card of the bank account holder. Such payment is made by giving a

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standing instruction to the bank to deduct a specified amount for bill payment, insurance premium, online subscription, EMI (Equal Monthly Instalments) or other expenses on a particular day of the month.

- **Net Banking :** It is a convenient, fast and secure payment method. This digital payment facility is provided to the bank account holders using the bank web or mobile APP with the help of computer, mobile and internet. It provides the facility to easily transfer funds and make payments to the bank accounts of businesses or individuals who are owed money.
- **UPI (Unified Payment Interface) :** UPI is the most popular payment method in India today in the digital world. It is mainly operated through smart phones, UPI payment application and internet. Payment can be made easily by mobile number, bank account details or scanning QR code (Quick Response Code). It can be used in all parts of the country where there is internet connectivity. UPI payment is convenient for all and it is also safe and cost effective. Various banks through their Banking Applications facilitate UPI payment services.
- **POS (Point of Sale) Terminal :** POS terminals are commonly used for payment acceptance in retail stores across India. Payment is accepted by swiping a debit or credit card and entering a personal PIN (Personal Identification Number). POS payments facilitate efficient and quick transactions. It requires a POS machine and a stable internet connection.
- **Digital Wallets :** Digital wallet is a convenient and fast way of payments, with little risk of fraud. The wallet needs to be recharged with any amount and online payments can be made anywhere and anytime. Additionally, modern digital wallets are designed to keep payment information secure. It requires smartphone to have compatible apps downloaded and internet access.

Upi Applications In India:

UPI is became popular source for online payment and receipts system in India. UPI service is mostly operated through mobile phones.

[A] Some Unique Features of UPI Applications:

- **Send / Receive Money:** Using this medium users can send money by entering their VPA (Virtual Payment Address) i.e. UPI ID, Account Number and QR scan. Also, they can receive money from others through their mobile number.
- **Pay by Scanning QR :** Under this system money sent by scanning receiver's UPI QR Code and receive money by sending own UPI QR to others.
- **Transaction History:** The transaction history is easily saved in the original server by this payment system.
- **Linking of Bank Accounts:** Users also have the option to add one or more bank accounts in the UPI method. The user can link his preferred bank account with the UPI app.
- **Language Selection :** UPI Apps provide an option for employees to choose the language as per their own convenience. BHIM App is available in more than 20 languages, like Hindi, English, Tamil, Telugu, Malayalam, Bengali, etc.
- **UPI ID and PIN :** The UPI service user set his own UPI ID as UPI Service Identity. It provides Permanent Identification Number (PIN) for security of App data and transactions.
- **Instant Processing:** After operating the transaction, the UPI linked bank verifies the details, confirms the PIN and completes the transaction instantly.
- **Secure and Real-Time Payments**: Under UPI system every transaction is encrypted and verified, ensuring quick, safe and reliable money transfers at any time.
- **Wide User Base:** As of 2024, India crossed 450 million UPI users which continues to grow as smartphone and internet penetration expand even into Tier 2 and Tier 3 cities.
- **Low Cost :** The cost of UPI transactions is comparatively less. The cost-effective choice of UPI App is available to the users.
- **24 x 7 Service :** UPI is available 24 x7 basis, operated either by internet or mobile service.
- **Multi-functional :** UPI service provides multiple functions like as installments (split) option, cash withdrawal, various bills payment, mobile recharge, changes in cash etc.

[B] Popular UPI Apps in India

Classification of UPI Apps in India :

- **NPCI-Backed Apps** – The official UPI Interface (Bhim UPI App)
- **Third-Party Apps** – Fintechs and E-commerce Platforms. (Phone Pay, Google Pay, Paytm etc.)
- **Bank-Specific Apps** – Digital Banking Apps Providing UPI Services. (BHIM SBI Pay, BHIM Baroda Pay, iMobile pay (ICICI), **BHIM Axis Pay, Industrial Development Bank of India (IDBI) Bank GO Mobile+)**

Top 10 UPI Apps in India

- **Phonepay :** It is Bengaluru-based fintech, launched in 2016. Phone Pay is one of the most popular among all UPI apps in India. It is highly dominating App in UPI market having

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highest number of Users. It offers facilities like fast payments, easy bill payments and investments like gold and mutual funds. *[No. of Installations: **100M+**, Rating out of 5: **4.4**, Market Share: **47.8%**]*

- **Google Pay :** The Google Pay UPI app is known for its simple and easy-to-use design. The app provides easy money transfers, rewards and quick bill payments by connecting directly to bank accounts. *[No. of Installations: **100M+**, Rating out of 5 :**4.1**, Market Share: **37%**]*
- **Mobikwik :** This UPI App enables fast and seamless money transfer. Provides cashback offers on recharges, bill payments and online shopping. Provides instant loan services and credit options. Provides easy recharge facility for mobile phones and DTH services. *[No. of Installations: **50M+**, Rating out of 5 :**4.2**, Market Share: **23%** (in prepaid Wallet transactions)]*
- **PayZap :** This UPI app developed by HDFC Bank. This app provides facilities like prepaid/postpaid mobile bill recharge, DTH/cable bill, hotel room booking, flight/railway/bus ticket booking etc. It allows linking of Debit / Credit card without bank account. It provides a three-layer security protocol to complete transactions. *[No. of Installations: **10M+**, Rating out of 5 :**3.9**, Market Share :**8%**]*
- **Paytm :** Initially, Paytm started as an e-wallet. Today it has emerged as a robust UPI App. This app provides UPI account transfers, shopping payments, bill payments and flight and movie booking services in a single app. *[No. of Installations: 100M+, Rating out of 5 :4.4, Market Share: 7%]*
- **BHIM (Bharat Interface for Money) UPI App**: This UPI App was launched by NPCI in 2016. It is government of India's UPI App facilitates easy and fast payment transactions. It is used for sending or depositing money from one bank to another bank using only a mobile number or virtual payment address (UPI ID). It provides cashback offer on some transactions. *[No. of Installations: **50M+**, Rating out of 5: **4.2**, Market Share: **0.8%**]*
- **Amazon Pay :** Amazon Pay UPI is a great payment option for customers who make frequent purchases through Amazon, an e-commerce operator. It provides convenience of shopping and bill payments along with cashback and rewards on UPI transactions. *[No. of Installations: **100M+**, Rating out of 5 :**4.1**, Market Share: **0.6%**]*
- **WhatsApp Pay :** This app is owned by Facebook and launched in India in November 2020. This UPI-based payment service allows to send and receive money through WhatsApp contact list. *[No. of Installations: **5B+**, Rating out of 5 :**4.1**]*
- **CRED:** CRED is an invitational fintech app suitable for users with a credit score of 750 or above. This app primarily helps manage credit card bills. Users can receive CRED coins on bill payments and redeem them for brand offers, fare discounts and lifestyle perks. The app provides features such as expense tracking, credit monitoring, UPI transfers and personal loans. *[No. of Installations: **13M+**, Market Share: **1%**]*
- **Navi Money:** Navi Money is the 4th largest UPI app in India by volume. It avails multiple facilities like as UPI payments, loans, insurance and investments under single platform. It also offers instant personal loans of up to ₹20 lakh. It also facilitates commission-free SIPs (Systematic Investment Plans) in mutual funds or buying digital gold at any time. *[No. of Installations: **260M+**, Market Share: **1%**]*

Year-Wise Comparative Analysis Of Upi Payments And Other Digital Payments:

Table No. 1 : Year-wise analysis of Volume of Digital Payment Modes

Item	2020-21 Volume (lakh)	2021-22 Volume (lakh)	2022-23 Volume (lakh)	2023-24 Volume (lakh)	2024-25 Volume (lakh)
I. Settlement Systems					
CCIL Operated Systems	28	33	41	43	47
II. Payment Systems					
1. Large Value Credit Transfers – RTGS	1592	2078	2426	2700	3025
2. Credit Transfers					
2.1 AePS (Fund Transfers)	11	10	6	4	4
2.2 APBS	14373	12573	17898	25888	32964
2.3 ECS Cr	0	0	0	0	0
2.4 IMPS	32783	46625	56533	60053	56250
2.5 NACH Cr	16465	18758	19267	16227	16939

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2.6 NEFT	30928	40407	52847	72640	96198
2.7 UPI	**223307**	**459561**	**837144**	**1319163**	**1858608**
[A] TOTAL	**317867**	**577934**	**983695**	**1493975**	**2060963**
3. Debit Transfers and Direct Debits					
3.1 BHIM Aadhaar Pay	161	228	214	194	230
3.2 ECS Dr	0	0	0	0	0
3.3 NACH Dr	9646	10755	13503	16246	19762
3.4 NETC (Linked to Bank Account)	650	1207	1626	1629	1668
[B] TOTAL	**10457**	**12190**	**15343**	**18069**	**21660**
4. Card Payments					
4.1 Credit Cards	17641	22399	29145	35610	47741
4.2 Debit Cards	40146	39384	34199	22860	16120
[C] TOTAL	**57787**	**61783**	**63344**	**58470**	**63861**
[D] Prepaid Payment Instruments	49366	65783	74667	78775	70254
[E] Paper-based Instruments	6704	6999	7088	6632	6095
Total Retail Payments [A+B+C+D+E]	442181	724689	1144137	1655921	2222833
Total Digital Payments [1+A+B+C+D]	437069	719768	1139475	1651989	2219763
Total Payments [1+A+B+C+D+E]	443773	726767	1146563	1658621	2225858

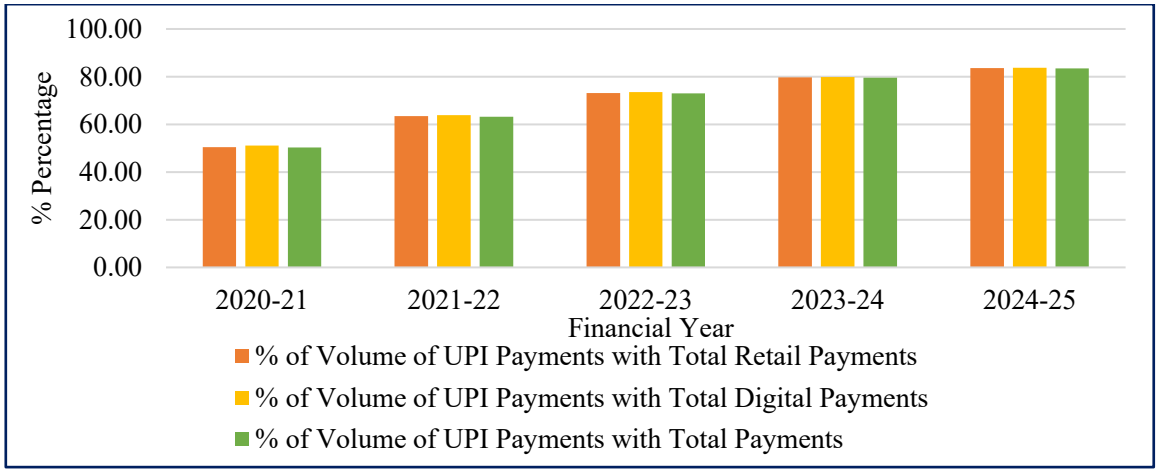
(Source : Compiled by researcher from the statistical data published by RBI)

CCIL -	The Clearing Corporation of India Limited	**ECS -**	Electronic Clearing Service
Dr -	Debit	**IMPS -**	Immediate Payment Service
RTGS -	Real Time Gross Settlement	**NACH -**	National Automated Clearing House
AePS -	The Aadhaar Enabled Payment System	**UPI -**	Unified Payment Interface
APBS -	Aadhaar Payment Bridge System	**NEFT -**	National Electronic Funds Transfer
Cr -	Credit	**NETC -**	National Electronic Toll Collection

(Source : Compiled by researcher from the statistical data published by RBI)

Observations : The volume of total Digital Payments show a strong and consistent growth, rising from 437069 lakh (2020-21) to 2219763 lakh (2024-25). It reflects rapid digital adoption and increased smartphone/internet penetration in India. The volume of UPI is the fastest-growing component, jumping from 223307 lakh (2020-21) to 1858608 lakh (2024-25). It is observed that UPI dominates retail payments due to ease of use, instant settlement and low cost. Thus, UPI is the backbone of India's digital payment ecosystem, contributing the largest share to the volume of total payments. Definitely it is boosting the cashless economy of India.

Bar Chart No. 1: Year wise Volume of UPI Payments in Total Retail Payments, Total Digital Payments and Total Payments:



Observations: Observed consistent and strong increase in the volume of UPI payments over the financial years 2020-21 to 2024-25 across all three categories. The percentage rises steadily from about

50% in 2020-21 to around 83-84% in 2024-25, indicating that UPI has become the dominant mode for retail digital transactions in India. The chart highlights the rapid adoption, trust and widespread usage of UPI.

Table No. 2 : Year-wise analysis of Value of Digital Payment Modes

Item	2020-21 Value (₹ lakh crore)	2021-22 Value (₹ lakh crore)	2022-23 Value (₹ lakh crore)	2023-24 Value (₹ lakh crore)	2024-25 Value (₹ lakh crore)
I. Settlement Systems					
CCIL Operated Systems	1619.43	2068.73	2587.97	2592.10	2962.20
II. Payment Systems					
1. Large Value Credit Transfers – RTGS	1056.00	1286.58	1499.46	1708.90	2013.90
2. Credit Transfers					
2.1 AePS (Fund Transfers)	0.01	0.01	0.00	0.00	0.00
2.2 APBS	1.11	1.33	2.48	3.90	5.50
2.3 ECS Cr	0.00	0.00	0.00	0.00	0.00
2.4 IMPS	29.41	41.71	55.85	65.00	71.40
2.5 NACH Cr	12.17	12.82	15.44	15.30	16.70
2.6 NEFT	251.31	287.25	337.20	391.40	443.60
2.7 UPI	**41.04**	**84.16**	**139.15**	**200.00**	**262.10**
[A] TOTAL	335.05	427.28	550.12	675.60	799.30
3. Debit Transfers and Direct Debits					
3.1 BHIM Aadhaar Pay	0.03	0.06	0.00	0.10	0.10
3.2 ECS Dr	0.00	0.00	0.00	0.00	0.00
3.3 NACH Dr	8.62	10.27	12.80	16.80	22.00
3.4 NETC (Linked to Bank Account)	0.01	0.02	0.03	0.03	0.02
[B] TOTAL	8.66	10.35	12.83	16.93	22.12
4. Card Payments					
4.1 Credit Cards	6.30	9.72	14.32	18.30	21.10
4.2 Debit Cards	6.61	7.30	7.20	5.90	5.00
[C] TOTAL	12.91	17.02	21.52	24.20	26.10
[D] Prepaid Payment Instruments	1.97	2.79	2.87	2.80	2.20
[E] Paper-based Instruments	56.27	66.50	71.63	72.10	91.90
Total Retail Payments [A+B+C+D+E]	414.86	523.94	658.97	791.63	941.62
Total Digital Payments [1+A+B+C+D]	1414.59	1744.02	2086.80	2428.43	2863.62
Total Payments [1+A+B+C+D+E]	1470.86	1810.52	2158.43	2500.53	2955.52

(**Source :** Compiled by researcher from the statistical data published by RBI)

Observations : The total value of digital payments has increased consistently from 2020-21 to 2024-25, showing strong growth in India's digital payment ecosystem and indicating rapid adoption of digital modes. RTGS shows significant growth from ₹1056.00 lakh crore to ₹ 2013.90 lakh crore from 2020-21 to 2024-25. However UPI driven Retail digital payments show remarkable expansion in value which increased from **₹41.04 lakh crore to ₹262.10 lakh crore**, becoming the most popular retail payment mode in India. The data clearly shows a shift from cash and card-based payments to instant digital platforms, especially **UPI** and RTGS.

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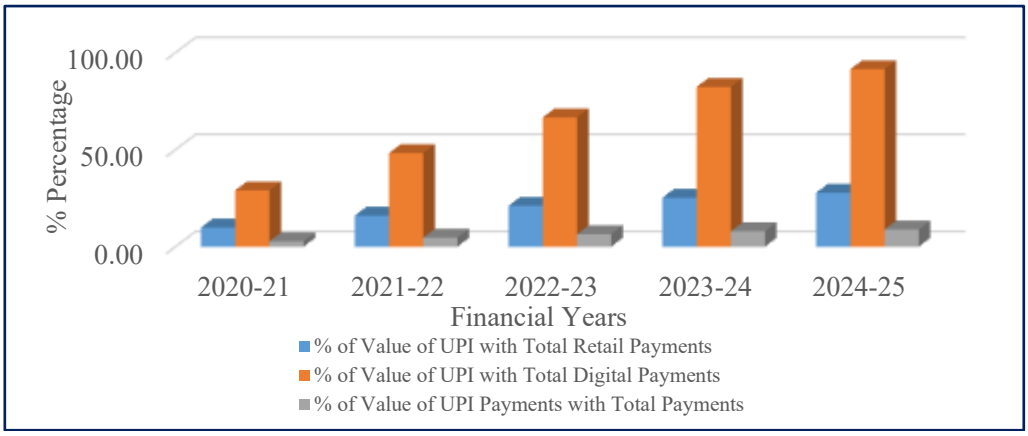

Bar Chart No. 2 : Year wise Value of UPI Payments in Total Retail Payments, Total Digital Payments and Total Payments:

Observations : It is observed consistent rise in the share of UPI payments across all categories from 2020-21 to 2024-25, highlighting the rapid adoption of UPI in India's payment ecosystem. The percentage of UPI value in total digital payments has increased sharply, growing from about 35% in 2020-21 to nearly 100% in 2024-25, indicating that UPI has become the dominant mode of digital transactions over the years. Similarly, the percentage of UPI value in total retail payments has steadily increased from around 15% to about 35%, showing that UPI is not only leading digital payments but is also gaining significant importance in overall retail transactions. It reflects growing consumer trust, ease of use, and widespread acceptance of UPI among merchants and customers. The percentage of UPI value in total payments (digital + non-digital), though lower in comparison, has also shown a gradual rise from approximately 8% to 15%. This indicates that while cash and other payment modes still exist, UPI's contribution to the entire payment system is steadily strengthening. Overall, the trend demonstrates UPI's transformation into a backbone of India's payment infrastructure.

Challenges And Opportunities Of UPI

1. Challenges:

- **Centralised System failure:** UPI transactions are centrally controlled by NPCI which leads to a Single Point of Failure (SPoF). System failure effects on all Payment Service Providers (PSPs) and banks.
- **Server Outages:** Excess volume of transactions creates the issue in transactions compliances. For example, in March-April 2025 excess **"Check Transaction"** requests overloaded NPCI system resulted in downtimes which affected millions of G-Pays and Phone Pe users.
- **No incentives to Banks:** Bank incur ₹ 0.80 cost per transaction. But UPI system allows Zero **Merchants Discount Rate (MDR).** It discourages banks from earning transaction fees.
- **Low Quality Monitoring Standards:** UPI lacks stringent Service Level Agreement (SLA) and real-time regulatory controll, leading to slower responses during system failures.
- **Cybersecurity Issues:** It is observed **24% rise** in digital frauds in the year **2024**. UPI must enhance its security and encryption protocols to provide high security and prevent UPI transaction crimes.
- **Low Awareness:** Many people particularly in rural areas are unaware about UPI knowledge and skills, digital literacy, operating of smartphones etc. It leads to limit widespread UPI adoption across the country.
- **Poor Grievance redressal system**: As per reviews from UPI users, they face delay in resolving complaints related to failed transactions, wrong debits, frauds etc.
- **Delayed Transactions**: In UPI payment system sometimes, transactions remain pending for hours or days. It causes inconvenience insecure feeling among users.

UPI system enables multiple authentication steps. It is necessary for security but may lead to irritating the users and slow down the payment process.

2. Opportunities:

- **Targeting Semi-Urban and Rural Areas of India :** Considering the growing use of smartphones and mobile internet, encouraging the use of UPI in semi-urban and rural areas where UPI services are not fully available. Thus, it will be possible to increase the spread of UPI in all parts of the country.
- **Linking UPI with International Payment Systems :** Linking UPI with international payment systems will enable seamless international transactions easily. Integration of

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Indian UPI Apps and global payment systems can increase international acceptance of Indian UPI.

- **Strong Inter-Banking Network:** Effective expansion of UPI requires expansion of the internal network of various banks in India. For this there is a need for smooth integration between banks and financial institutions.
- **Expanding the Scope of other Banking Services:** Apart from payment and receipt transactions through the UPI system, priority should be given to providing services such as loans, investments, insurance and subscription management. Many UPI Apps are providing such diverse services.
- **Promotion of Government's Digital India Programme:** UPI digital banking system has the largest number of users in India. The government has implemented Digital India initiative to increase digital literacy. UPI system needs to be widely disseminated to make it successful.
- **Enhance Cybersecurity Framework:** Upgrade encryption protocols, implement multi-factor authentication, and deploy AI-powered fraud detection to ensure user security.

Conclusion :

Unified Payments Interface (UPI) has brought a major revolution in digital banking in India by making financial transactions fast, secure, and convenient. It has significantly boosted the cashless economy by reducing dependence on physical cash and encouraging digital payments even for small daily transactions. UPI has emerged as the dominant digital payment platform in India due to its large user base and high transaction volume, supported by multiple banks and popular UPI apps. Its user-friendly features, such as QR codes, instant transfers, and minimal technical requirements, have made it widely acceptable. However, UPI faces challenges like rising cybercrime and online fraud, which require stronger security measures and users awareness. At the same time, UPI offers high opportunities for integration with global payment systems, enabling international transactions. Intense competition among various UPI service providers calls for regulatory control to ensure stability. Despite its success, UPI also poses a threat by reducing traditional employment opportunities in the banking sector, highlighting the need for reskilling and adaptation.

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Original Article

An Analytical Study of APMC And Direct Farmers Market: which is benefits for Farmers development in Ahilyanagar District

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Abstract

Agriculture is very important for the Indian economy, and farmers' income largely depends on how their agricultural products are sold. To help regulate the market and protect farmers from being taken advantage of by middlemen, Agricultural Produce Market Committees (APMC) were set up. But in recent years, a new way of selling has come up called Direct Farmers Markets. In this system, farmers can sell their products directly to buyers without going through middlemen. This study looks at how APMC markets and Direct Farmers Markets work, and compares their effects on farmers' income and development. The research covers things like how prices are set, whether the market is fair and open, and how well these systems work. It also finds out the good and bad parts of each system for farmers. The results of this study should help decide which method is better for farmers and suggest ways to improve agricultural marketing for their overall growth.

Keywords: *APMC, Agricultural Marketing, Farmers' Development, Market Reforms, Farmer Welfare, Agricultural Produce, Rural Development, Transparent Pricing, APMC Market in Ahilyanagar*

Introduction:

Agriculture is the support of the Indian economy, and many people rely on farming for their living. It's very important to sell agricultural products in a way that gives farmers fair prices and helps them earn more. In India, APMC markets were created to control the buying and selling of farm goods and stop unfair trade practices. But over time, problems such as the use of middlemen, extra fees, and a lack of clear pricing have made APMC markets seem less effective. to deal with these issues, Direct Farmers Markets have been started in many areas. In this system, farmers sell their products straight to customers, which helps them get better prices and cut out the middlemen.

Farmer development does not only mean increased income but also includes access to better market opportunities, awareness, reduced dependency on middlemen, and improved decision-making power. APMC markets contribute to farmer development by creating an organized environment for agricultural trade. this study aims to understand the recent role of APMC markets in improving farmers' development. it also highlights the benefits, challenges, and future scope of the APMC system in the agricultural marketing sector. Better price realization is a central objective. Additionally, the study examines new revenue-generating models to ensure the long-term sustainability of the agricultural supply chain.

Agriculture is one of the most important sectors of the Indian economy, providing employment and livelihood to a large population. Farmers rely not only on production but also on effective marketing systems to receive fair prices for their produce. In this context, the Agricultural Produce Market Committee (APMC) plays a significant role in regulating

Objective

- To Study how APMC markets work in Ahilyanagar District.
- To Study what direct farmers' markets are and how they help in selling farm produce.

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- To comparative study of APMC markets and direct farmers' markets based on price, transparency, and how well they market agricultural goods.
- To find out the advantages farmers get from using APMC and direct farmers' markets.
- To find out the advantages farmers get from using APMC markets.
- To Study which marketing system helps farmers earn more and develop better.

Working APMC Market in Ahilyanagar District:

Agricultural Produce Market Committee in Ahilyanagar was set up on October 1, 1954. At the grain yard in Ahilyanagar, grains are collected from Beed, Sambhajinagar, and Pune districts. Also, a lot of dried chillies are brought in from Andhra Pradesh. Ahilyanagar is a big market for green gram, tamarind, and jaggery. Right now, there are markets for grains, fruits and vegetables, flowers, and fodder operating at the main yard. In some villages of Nagar Taluka, people grow a lot of flowers, so the committee gave some shops to the sons of farmers in the vegetable section and started a flower market there, which has helped farmers earn more money. At the main yard in Ahilyanagar, onions arrive from Beed, Sambhajinagar, Nashik, and Pune in large amounts, which made the yard too small for all the business. On days when onions are auctioned, there is heavy traffic of trucks and it causes full blockages of roads in Ahilyanagar, so the market committee bought 29 acres of land in Nepti and built an onion grading shed of 72,000 square feet. Out of these 29 acres, the shed was built on 21 acres and 423 trader and commercial shops were developed. Now, 7 acres of land remain unused in the Nepti sub-market yard because existing space is limited, so a new onion auction shed, internal roads, electricity lines, walls, etc., will be built on those 7 acres. With the construction of the grading shed, farmers' produce is protected from the sun, wind, and rain. The annual onion arrival at the Nepti sub-market is 33 to 35 lakh quintals, so this shed is needed. The expected cost of this shed is Rs. 13 crore 72 lakh. Also, the market committee owns 11 acres of land in Chichondi Patil. Farmers had asked repeatedly for a grain market and a livestock market there and had submitted requests to Hon. MLA Shri Shivajirao Kardile Saheb. Because of this, under his guidance, the current Board of Directors has decided to set up a grain market and a livestock market in Chichondi Patil. The estimated cost for this is Rs. 10.26 crore. In the current situation, the income for the year 2024-2025 has reached Rs. 23 crore 25 lakh. The committee also owns 28 acres of land at the main market yard in Ahilyanagar, 29 acres at the Nepti sub-market, and 11 acres at the Chichondi Patil sub-market yard.

Direct farmers' markets, also called Apni Mandis, Rythu Bazaars, Uzhavar Santhai, and Shetkari Bazaars, are places where farmers sell their fruits, vegetables, and other products directly to people who buy them. These markets help farmers get better prices for their goods and avoid the middlemen who usually buy from them. They also help consumers get fresh, local food at lower prices.

APMC System

Most Indian states created APMC laws between the 1960s and 1970s to organize how agricultural products are sold. These laws require the government to choose certain towns as market places, called mandis, where farmers must sell their crops. In these mandis, a group called the APMC manages the selling process through auctions. Traders and licensed agents compete by bidding on the crops and pay various fees. The idea is that this system ensures fair competition and quick payment to farmers. but in reality, the APMC rules can make it hard for farmers to sell their goods outside the system, which can hurt them.

They also have to pay many different fees, like market charges, commissions, and license fees, at each mandi. This creates a lot of middlemen in the supply chain, which reduces the amount of money farmers actually get. In some areas, only a few traders control the mandis, making it difficult for others to compete.even though APMCs are meant to help farmers, high costs and limited buyers can lower the final price farmers receive.

Direct Marketing Channels

Unlike APMC mandis, direct channels allow farmers to skip traditional middlemen and sell their products more directly. Here are some common forms:

- **Farmer-consumer markets:** These markets are supported by the government and don't involve traders at all. A 2013 government report mentioned that states such as Maharashtra have "farmers' markets" where farmers and buyers meet directly, which helps reduce the number of middlemen.
- **Online trading platforms:** The National Agriculture Market (e-NAM) is a nationwide online platform launched in 2016.It connects all existing APMC mandis across the country into one digital marketplace. Farmers can sell their products at any enabled mandi to buyers anywhere in India. The platform gives real-time updates on prices and arrivals and ensures farmers get paid through e-wallets. As of 2024, e-NAM has connected over 1,389 mandis in 23 states and 4 Union Territories. More than 1.77 crore farmers and 2.5 lakh traders are using the platform. Official data

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shows that e-NAM's transparent online bidding process has improved price discovery and given farmers better access to markets.

- **Contract farming:** In this system, private companies such as agribusinesses, exporters, and processors make agreements with farmers before harvest. these deals set the quantity and price in advance, and often include support like supplies or technical guidance. The 2024 Draft National Marketing Policy states that contract farming ensures farmers have a guaranteed market at a fixed price. The government's model APMC Act (2003) also included rules for contract farming, requiring contracts to be registered and mandi fees to be waived if crops are sold outside APMC markets. This helps farmers grow crops for export or high-value markets without facing the inefficiencies of mandis.
- **Farmer Producer Organisations (FPOs) and cooperatives:** These are not marketing channels themselves, but groups of farmers that often sell their products in bulk. FPOs can directly negotiate with supermarkets, processors, or exporters, acting as a single seller for many farmers. This collective approach often works together with direct channels

for example: an FPO might use e-NAM to auction its produce or sell it through a contract.

Comparing APMC and Direct Models

- **Efficiency and Costs:** The traditional APMC model brings all trade to physical markets, which works well for handling large amounts of goods but makes it harder for farmers.They have to travel and wait, and there are many middlemen who take a cut. This makes the process slower and more expensive. Direct methods, on the other hand, usually cut out some of these middlemen. For example, in an e-NAM sale, a farmer's goods can be bought by buyers from far away without any middlemen, saving money on fees. Farmers' markets also let farmers sell directly without going to a market at all. Removing these extra steps lowers the cost for farmers and helps them sell their goods faster. But direct selling might mean farmers have to spend more time or money, like preparing their produce for local buyers or learning how to use an online platform. In some states, APMC fees can take up 5 to 8% of the crop's value, which direct trade avoids.
- **Farmer Income:** Direct channels usually let farmers keep a bigger part of the money that customers pay. However, not all farmers can switch to direct sales easily. Some still prefer selling all their crops in a single auction because of the convenience.
- **Price Discovery**: APMCs use open outcry or electronic auctions where people bid openly. in theory, this is a fair way to set prices. But in practice, prices can be affected by unfair practices or lack of information among farmers. E-NAM, on the other hand, provides real-time price data across the country and lets many buyers bid, making the process fairer. E-NAM says it gives farmers better chances to sell and more transparent price information through its online system. In farmers' markets or through contracts, prices are either set on the spot or agreed upon in advance. This can lead to higher prices for quality or branded products, but farmers might also face pressure to accept lower prices during bargaining.
- **Transparency:** Mandis are regulated and often have official weighing stations, quality checks, and records, which help protect farmers. but some reports say that local officials and middlemen aren't always accountable, and extra charges can be hidden. Digital systems automatically record all transactions, making the process more transparent. For instance, every sale and payment in e-NAM is logged online. These new methods make it easier for farmers to check prices and get paid on time. They also help regulators keep track of trade activity.
- **Access and Choice:** APMCs provide a common place for trade, which is important in areas where there are no other buyers. but these markets can be far from some villages, and only licensed traders can take part. Direct channels offer more choices: with e-NAM, farmers in any connected market can sell to buyers anywhere in the country. Farmers' markets bring customers to rural areas, and contracts link farmers directly to companies. This increased competition gives farmers more options to sell their goods. It also helps city buyers or exporters reach village farmers more easily.

Advantages of buying directly from farmers include:

- **Better Prices:** Farmers get fair payment for their products, which is good for both them and the people who buy from them.
- **Freshness and Quality**: When farmers sell directly, their products are still fresh and of good quality because they don't have to travel far or wait long before being sold.
- **Public Support**: These markets help build stronger ties between farmers and the people in

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their communities, as customers can give direct feedback on the quality of the products.

- **Opportunities:** These markets create jobs and help small farms grow and stay in business.
- **Supportable Practices:** Farmer's markets support eco-friendly farming methods, which help the environment by cutting down on the waste and pollution from transporting food over long distances.

Comparative Study:

APMC markets offer structured infrastructure and regulated trading environments, but they often involve intermediaries that lower farmers' profits. Direct Farmers Markets allow farmers to sell directly to consumers, leading to higher income, though this model may not be feasible for all due to logistical and marketing difficulties. in Ahilyanagar district, APMC markets are important because they offer organized setups, auction systems, storage spaces, grading services, and many buyers. These facilities are especially helpful for farmers growing large amounts of crops like onions, grains, and vegetables.

Conclusion:

The current study looked at how APMC markets and Direct Farmers Markets help increase farmers' income and development in Ahilyanagar District. Marketing is very important for farmers because getting fair prices and having good access to markets directly affects their living conditions. the study found that APMC markets have a structured and controlled way of trading with things like auction areas, storage spaces, grading areas, and many buyers.

In Ahilyanagar, the APMC has helped a lot with selling big amounts of crops like onions, grains, green gram, jaggery, and vegetables. Projects like the Nepti onion grading shed and planned markets at Chichondi Patil show that APMC markets are growing to better support farmers and improve their marketing.

However, the study also shows that Direct Farmers Markets have some benefits, especially for small farmers and those selling quick-to-rot products like fruits, vegetables, and flowers.by cutting out middlemen, these markets let farmers get a bigger share of the final price and build direct links with customers. Systems like farmers' markets, e-NAM, contract farming, and Farmer Producer Organizations (FPOs) help make prices clearer and improve how farmers can get to markets. the study compared both systems and found they each have their own good and not-so-good parts.

APMC markets are better for big-scale trade and bulk items, while Direct Farmers Markets are useful for smaller producers and perishable goods were selling directly can bring more profit. So, the study says that the best way to help farmers in Ahilyanagar is to have a balanced and combined system that uses APMC markets, direct farmer markets, and digital tools like e-NAM. improving market facilities, lowering extra costs, and promoting direct selling can make the whole marketing system better and support long-term farmer growth.

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I would like to express my sincere gratitude to all those who have supported and guided me in the successful completion of my project titled "An Analytical Study of APMC and Direct Farmers Market: Which is Beneficial for Farmers' Development in Ahilyanagar District."

First and foremost, I am deeply thankful to my project guide/mentor for their invaluable guidance, constant encouragement, and insightful suggestions throughout the course of this study. Their support helped me understand the dynamics of agricultural marketing systems and their impact on farmers' development.

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Original Article

Agriculture in Tribal Areas: A Geographical Study of Agricultural Practices, Cropping Patterns, and Socio-Economic Conditions of Tribal Farmers in Akole Tehsil

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Abstract

In India, cultivation is a factor that contributes to socio-economic development of the tribal and rural populations. Agriculture is the primary source of livelihood in tribal regions and a critical component of the social and economic life of the individuals. Majority of the tribal farmers rely on traditional farming, forest products, and seasonal labour. Nonetheless, farming in these areas has been characterized by a number of threats including; limited irrigation systems, minimal application of modern technology, inadequate infrastructure and low accessibility of markets. This research paper is about agriculture in the tribal region of Akole Tehsil located in the Sahyadri Mountain range and is also a region characterised by hilly terrain, forest cover and heavy monsoon rainfall.

A big percentage of the population in Akole is that of tribal groups like Mahadev Koli, Thakar and Bhil which are primarily agriculturalists and livestock rearing. The agricultural activities in the area are predominantly rain-fed and subsistence-based and small plots of land. Major crops are paddy, jowar, bajra, tur, wheat, vegetables, horticultural crops such as pomegranate, onion as well as tomato. The research design is a secondary research design grounded on government reports, census reports, journals and books where descriptive and analytical research techniques are adopted. The results highlight the importance of the better irrigation, the adoption of modern agricultural practices, crop diversification, soil protection, and the enhanced market access to enhance sustainable agricultural growth and uplift the socio-economic status of tribal farmers.

Keywords: *Tribal agriculture, Akole tehsil, tribal development, rural economy, sustainable agriculture.*

Introduction:

Agriculture was always taken as the staple of the Indian economy and it remains to be the main source of livelihood of a big part of the rural population. A huge percentage of the population in India is directly or indirectly reliant on agriculture and other related services like animal rearing and forestry as well as small enterprises in the countryside. Agriculture is even more significant in tribal areas, since it is the basis of the economic survival, food security, and cultural identity. The tribal communities reside mostly in remote, hilly and forested areas with the opportunities in the industrial and service sectors being minimal and thus the livelihood systems closely tied with the land, forests and the natural resources. In Maharashtra (Khyade, M. S., Kolhe, S. R., and Deshmukh, B. S., 2009) there are various tribal dominated regions in the Western Ghats belt and Satpuda ranges. Akole Tehsil in the former Ahmednagar District (now Ahilyadri mountain range), which is located at the northern side of the range, is one of such regions.

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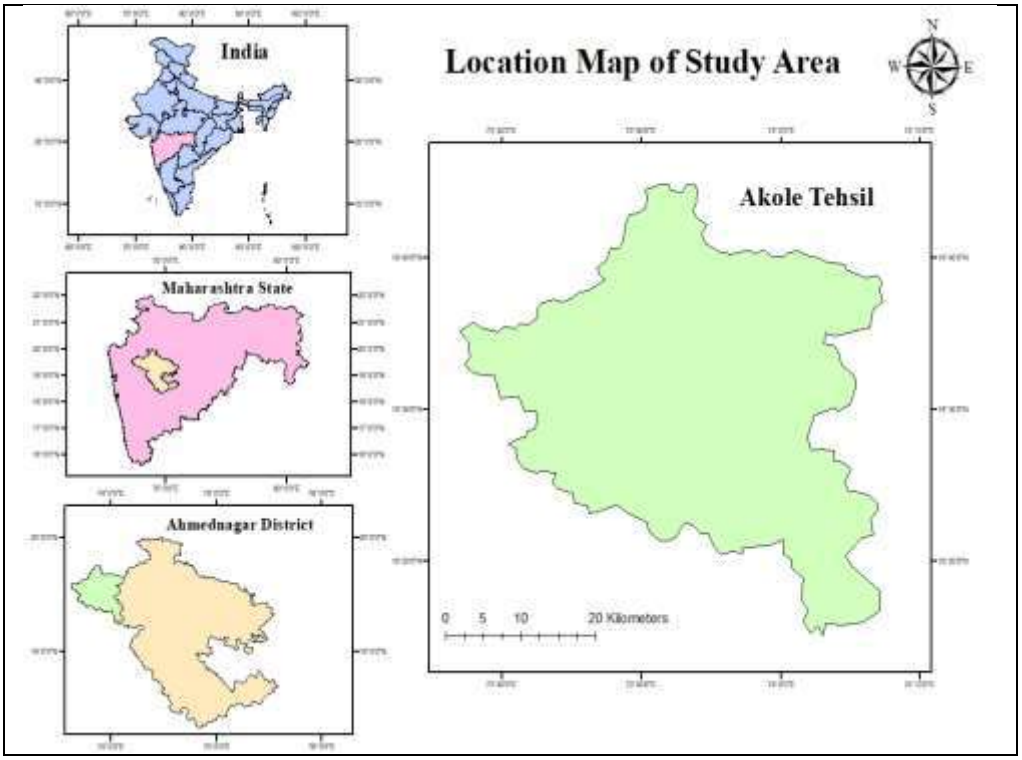
The area is also an input to the rugged terrain, woodland, hill slope, and narrow valley which highly impacts the settlement pattern, farming, and social-economical life of the tribal community. (Government of India 2011) Communities like Mahadev Koli, Thakar and Bhil are the main tribal population of Akole tehsil and they mostly rely on agriculture, forest produce collection, and livestock rearing. Their cropping systems have been associated with a traditional ecological knowledge which is generated over the years and they grow crops which are adapted to the local climatic and soil conditions like millets, paddy, pulses and seasonal vegetables. Nevertheless, the practice of agriculture is mostly small-scale and subsistence-based with the bulk of the products consumed by the households. In terms of geography, Akole tehsil has approximately 1505 square kilometres of land with approximately 65 per cent of land area covered by agriculture and approximately 27 percent by forests. (Uikey, A. A., & Patil, S., 2023) Despite the rather deep rainfall that the region receives thanks to its position in the Western Ghats, the irrigation facilities are still scarce due to the hilly environment as well as the insufficient development of the infrastructure and the fact that agriculture in the region is mostly rain-fed. The agricultural productivity will also be constrained by small and fragmented landholdings, low access to modern agricultural inputs, poverty, low levels of education, and poor market connectivity. Migration of wage labour seasonally is also predominant in the tribal households and influences the stability and growth of the agricultural sector in the area. This was published in Maharashtra State Gazetters - Government of Maharashtra, Ahmednagar District, 1976, P.1.

Study Area

The Akole Tehsil is in the West of Ahilyanagar District 19deg North latitude and 73deg East longitude. It is located almost 140 km to the district headquarters in Ahilyanagar city. The district of Nashik borders Thane and Palghar to the west and Pune District on the south and Sangamner Tehsil on the east respectively. The area is situated on the hilly strip of the Western Ghats (Sahyadri Range). The area is greatly affected by climate, agriculture and patterns of settlement due to this geographical location (Government of Maharashtra 2011).

Location Map of the Study Area



Location map of the study area

1. Physical Features and Terrain

The physical terrain of Akole Tehsil is rugged, uneven, and features mountains and steep slopes, valleys and plateaus, and a lot of trees. It is located in the mountain range of Sahyadri that has a great impact on the climate, vegetation, and the

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settlement patterns. Key geographical formations like Kalsubai Peak, Harishchandragad Fort and Bhandardara Dam are found around this region or in it. Due to the mountainous terrain, there is a limited area of large continuity of agricultural land. (Maharashtra State Gazetters Government of Maharashtra, Ahmednagar District 1976, P.1). Thus, agriculture is done predominantly in valleys and soft slopes where there is better soil and moisture conditions.

2. Climate

The Tehsil of Akole has climate of tropical monsoon which has three seasons; summer, monsoon, and winter. The most significant season regarding the agricultural sector is the monsoon season since most crops rely on rainfall. The region has fairly high rainfall because of the influence of the Western Ghats than the eastern parts of the district. The crops grown under this rain include paddy, millets and pulses (Sharma, R. 2015). Again, there are minimal irrigation systems thus making agriculture highly reliant on the monsoon rains.

3. Rivers and Water Resources

There are several rivers and streams that are born in this area in the Sahyadri hills. Pravara River is one of the largest rivers that flow in Akole Tehsil. It supplies farm and irrigation water to numerous villages and domestic water in most of them. The Bhandardara Reservoir is significant in terms of the storage and irrigation of water. Some of the tribal villages, however, rely primarily on rainfall and seasonal streams to perform their farming. (Tiwari, P. C. 2008).

4. Population and Tribal Communities

Akole Tehsil is both forest-covered and hilly with a large population of tribal people. The Mahadev Koli, Bhil and Thakar tribes are major tribal groups. The living of such communities has always relied on agriculture, livestock farming, and forest produce. They have useful traditional knowledge on crops and forest resources. But most of the villages also have difficult experiences, such as the inability to access education, healthcare, transportation, and markets. **(Ministry of Tribal Affairs. 2014).**

5. Soil

The Akole Tehsil has different types of soil because of the variation in topography and climate. Primary soils include black soil, red soil and laterite soil. The black soil is fertile and good in crops such as the jowar, wheat and pulse. Red soils are found on the upland slopes and they need to be adequately fertilised and watered. High rainfall high areas use laterite soil which requires soil conservation measures to ensure that the soil remains fertile.

Objectives of the Study

1. To examine the cropping scheme in the area.
2. To research the socio-economic status of tribal farmers.
3. To draw significant issues of tribal agriculture.

Research Methodology

The current study is analytical and descriptive in nature and aims at studying the Akole Tehsil agricultural conditions and geographical factors. The research is predominantly founded on the secondary data gathered by using government reports, census information, research periodicals, books and trusted web sources. Descriptive statistical analysis to get an understanding of land use, cropping patterns and socio-economic aspects of the area were done using the information collected. There were also comparative studies conducted on other factors like rainfall, soil conditions and agricultural productivity. This approach will assist in detecting the key issues tribal farmers have and the general agricultural development of the area.

Result and Discussion

Cropping Pattern

The rainfall distribution, the soil types, topography and the availability of the irrigation facilities are some of the major factors that determine the cropping pattern of Akole tehsil. A big portion of the area is in the hilly belt of the Sahyadri ranges, hence the agricultural practices are mostly rain-based, and farmers base their farming operations on the monsoon season. Most of the crops are grown in Kharif season (June-October) when the rainfall is at its peak. There is a smaller percentage of Rabi crop (November-February) in regions where the soil retention is low or scarce irrigation exists. Traditional food habits of tribal communities, which serve as the basis of the cropping pattern, include Major Crops and Agricultural Seasons (Patil, S., Agale, S., and Kauthale, 2019).

Crop	Season	Characteristics
Rice	Kharif	The main crop grown in the valley areas with good rainfall and water retention
Jowar	Kharif	An important cereal crop suitable for dryland farming
Bajra	Kharif	Drought-resistant crop grown in upland areas
Tur	Kharif	Major pulse crop used for household consumption

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Wheat	Rabi	Cultivated in limited irrigated areas during winter
Vegetables	Seasonal	Includes tomato, onion, and leafy vegetables grown for local markets

Source: Government of India (2016), Government of Maharashtra (2011)

1. Rice

One of the crops that are highly grown in Akole tehsil and especially during the Kharif season is rice. Because of the comparatively high rainfall received in the hilly areas of the Sahyadri Mountain Range, Rice farming is largely adapted in valley areas and low-lying areas where it can hold water longer. The conventional means of rice planting such as transplanting of rice seedlings in flooded fields are usually employed by the farmers. Rice, (Deshpande, R. S. 2008) is one of the staple food crops among the locals and is vital in ensuring food security among tribal households.

2. Jowar

Another valuable cereal crop that has been produced in the area is jowar; more so in the upland and dryland regions where soils have limited water. It is primarily planted in the Kharif season and it is very appropriate in semi-arid climatic situations. Jowar has been appreciated to resist drought and the inability of the soil to be fertile (Bhende, M. J. 2013). The grain is also commonly used in making traditional food like bhakri which is a vital meal in the rural diet.

3. Bajra

The Bajra is planted on light soils and has low precipitation. It is a tough crop which is able to grow under fairly poor soils and it consumes less water than most other cereals. Bajra is mainly cultivated in the monsoon season and it is a source of healthy food and animal feed. The crop serves as an important source of food in the tribal populations and prevents food insecurity in rain-fed agricultural systems. (Singh, K., & Sharma, A., 2018).

4. Tur

Tur or pigeon pea is a special pulse crop resident in the area in the Kharif season. It is also prepared together with other crops via intercropping programs, which assist in enhancing soil fertility and chances of crop failure are minimized. Tur is appreciated due to a large amount of protein it contains and is commonly utilized in the cooking of dal, which is one of the main foods in an Indian family. Crop is also useful in terms of maintaining soil fertility by repairing soil nitrogen.

5. Wheat

The Rabi season is the season that is used to grow wheat in regions where there are irrigation facilities or the soil has sufficient water at the end of a period. The bit of land planted with wheat is relatively lower in Akole tehsil as compared to Kharif crops since the irrigation resources are limited. Nevertheless, wheat is a significant crop in some of the fertile valley regions where farmers are capable of supplying enough water to use during winter. (Government of Maharashtra. 2018) The crop is consumed by the household primarily, and it helps to ensure food security of the farming families.

6. Vegetables

Most farmers grow vegetables in small scale especially in regions where irrigation can be done due to the availability of water. Brinjal, chili, cabbage, tomato, and leafy vegetables are some of the common crops that are grown in kitchen gardens or small plots located close to villages. Vegetables are significant in offering nutritious food to the local households, as well as, opportunities to the farmers to generate more revenue by selling the excess products in the local markets. (Gadgil, M., and Guha, R. 1995) Over the recent years vegetable farming has been increasing slowly due to a rise in awareness, government subsidies and accessibility of the markets.

Other Important Crops in Akole Tehsil

1. Sugarcane

Sugarcane is produced on small irrigated lands where water can be produced. It is primarily grown along rivers, wells and reservoirs. It is a cash crop, and this generates more income to farmers.

2. Onion

Onion is a major commercial crop that is grown during the Rabi season. It thrives in fertile and well drained soils under sufficient irrigation. Onions fetch good money in the local markets where they are sold by the farmers.

3. Tomato

Tomato is a fruit crop that is cultivated on irrigation fields on a seasonal basis. It grows rapidly and yields rapid financial results. The tomatoes are sold by the farmers in local markets and towns.

4. Pomegranate

Pomegranate is a plant crop that is advertised by the government. It thrives successfully in semi-arid conditions under irrigation. The crop is very valuable in the market and offers permanent income.

5. Vegetables

Small plots are used to cultivate vegetables such as brinjal, chili, cabbage, cauliflower and leafy vegetables. They are usually grown around the water bodies or in kitchen gardens. They offer food and supplementary cash.

6. Traditional Millets

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Tribal farmers usually cultivate millets like ragi and vari. They are less water demanding and thrive well in rain-fed regions. They are healthy and significant to food security. **(Patil, S., Agale, S., & Kauthale, V., 2019).**

Irrigation Facilities in Akole Tehsil

The level of irrigation is quite significant in enhancing the productivity of agriculture, crop stability, and the income of the farmers. The supply of the irrigation facilities that directly affect the type of crops grown in tribal areas such as Akole tehsil and the general pattern of crops grown. Despite the fact that the region has comparatively good rainfall owing to the fact that the Sahyadri hill region where the village is located, irrigation facilities have not been well established in most of the villages. Consequently, a significant percentage of agricultural land is rain-fed, and farmers usually have to experience uncertainties with inconsistency of rainfall and varying climate conditions. The principal irrigation sources in the area are wells, tube well, rivers, small dams and canals.

1. Wells

One of the most used traditional irrigation sources by farmers in Akole tehsil is the wells. The agricultural fields of many of the farmers have been dug with wells which supply the water to the crops during the dry seasons. In valley regions where there is relatively more groundwater supply, of critical concern is well irrigation. Well water is also extracted with electric pumps or diesel pumps and is normally used to irrigate vegetables, wheat, onion and sugarcane. **(NABARD. 2020)**

2. Tube Wells

Another source of irrigation that is very significant in some of the villages is tube wells. These wells feature roots of ground water sources that are found in deeper levels. The supply of water through tube wells is usually more stable than through traditional wells and particularly in the dry seasons. (Government of India. 2016) With access to tube wells, farmers are able to grow crops during the Rabi season and occasionally to grow commercial crops that need frequent irrigation.

3. Rivers

The area is irrigated with a number of small streams and rivers that originate in Sahyadri hills such as the Pravara River. Agriculture relies on these rivers as a source of natural water. Farmers at villages near river banks occasionally utilize river water, but by pumps or little channels. The ground water in the surrounding of rivers is also recharged by the river water.

4. Small Dams and Reservoirs

Even the small dams and reservoirs built along rivers and streams are significant in the storage of water that is used in agriculture. The Bhandardara Dam is linked to one of the most crucial reservoirs in the area that contains the water of the Pravara River. The existence of such reservoirs assists in provision of water to aid in irrigation, drinking and other developmental needs of adjacent villages. These water sources have a major benefit however, only to those villages that are closer to the dam or reservoir system (Ministry of Tribal Affairs. 2014).

5. Canals

There are also regions that have access to canal irrigation wherein water supplies of reservoirs or dams are channeled via canals. The canal irrigation assists farmers to produce crops in both the Rabi and Kharif seasons. The canal network in the Akole tehsil however is small and not comprehensive that all the villages can be covered because of hilly terrain with sparse settlements.

6. Groundwater as a Major Source

Ground water has been regarded as the most significant and dependable irrigation to most of the farmers in Akole tehsil. The groundwater relied upon by farmers to irrigate their farms is through wells and tube wells. There is however a major concern that during low rainfall years the amount of water in the ground may fall as a result of overuse of the ground water resources in certain regions.

Socio-Economic Condition of Tribal Farmers

Socio-economic status of tribal farmers in Akole Tehsil is largely defined by low economic resources and small-scale farming and lack of access to modern developmental facilities. However, the agricultural industry and forest resources are the major sources of livelihood of most tribal families (Gadgil, M., and Guha, R., 1995) however, the revenues obtained through farming are not always enough to sustain the household. The geographical seclusion, hilly nature, and poor infrastructure, including roads, irrigation, and market infrastructure, are also other factors contributing to the economic hardships of tribal people in the area. Consequently, most families depend on more than one livelihood activity, such as agriculture, animal husbandry, gathering of forests and wage labour.

1. Small Landholdings

The small and scrappy plots of land, which are usually between 1 and 2 hectares or even smaller, are owned and operated by most of the tribal farmers in the region. Because of the growth of the population and the way in which inheritance

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is done, agricultural lands have been subdivided into smaller tracts across generations. Small plots of land restrict the extent of mechanised agriculture and large-scale production of crops. Paddy, millets and pulses are typical examples of traditional crops that farmers mostly grow to be consumed at home.

2. Low Income Levels

The farming system in the tribal regions is more subsistence based and the yield of crops is comparatively low due to shortage of irrigation systems and the traditional mode of farming. Consequently, agricultural earnings are usually insufficient. Families have moderate annual earnings and thus they can hardly afford better seeds, fertilizers or modern farming gadgets. The issue of poverty is a major problem in a lot of the tehsil villages. **(Pingali, P. 2012)**

3. Limited Access to Modern Technology

The next significant feature of the socio-economic situation of tribal farmers is the poor application of the current farming technology. Farmers usually use traditional tools and methods because of the lack of awareness and financial constraints. Modern irrigation systems, better seeds, fertilisers and farm machineries are relatively scarce. The extension services and agricultural training programs have reached in the villages, and the development of its impact is still in progress (Swaminathan, M. S. 2006).

4. Low Literacy Rates

The level of educational attainment between the tribal and urban populations or non-tribal populations in the region are usually less. Low literacy levels impact on the capacity of the farmers to embrace new agricultural technologies, the interpretation of government programs and the attachment to financial services like bank loans or subsidies on agricultural inputs. In Maharashtra (Government of Maharashtra. 2011) Despite the fact that educational opportunities have been enhanced in recent years due to the government programs and tribal welfare schemes, the problems associated with the right of accessing the school and the quality of education have remained to be a challenge in the majority of the remote villages. **(Government of Maharashtra. 2011)**

5. Dependence on Forest Resources

The forests of the Sahyadri Mountain Range are also very important to many tribal households who rely on them as a source of livelihood. Other sources of income and subsistence are forest resources like fuelwood which include honey, medicinal plants, wild fruits and bamboo among other minor forest products. Such resources are specifically valuable at times that agricultural production is minimal or when households are economically disadvantaged.

6. Seasonal Migration for Employment

Tribal families lack employment opportunities and agricultural income in the villages and therefore many of the families migrate seasonally. When the agricultural season is off, family members tend to take up wage labour in towns and cities within close vicinity as Nashik, or Pune. They are usually employed in the construction industry, the brick kiln industry, agricultural labour, or small industry. Although migration gives a short-term source of income, it also comes with social issues which include interruption in schooling of children and poor living standards (Singh, R. B., and Chauhan, J. S., 2011).

Problems of Agriculture in Tribal Areas

There are a number of challenges that are affecting agriculture in the tribal areas of Akole Tehsil, which is influencing productivity, income and general rural development. The roots of these issues are largely geographical reluctance, inadequate infrastructure, traditional farming, and social-economic factors of tribal farmers. ICAR. 2015) In most villages, the agricultural development depends on the hindrances posed by the hilly nature of the Sahyadri Mountain Range and the lack of access to the modern resources.

1. Lack of Irrigation

Lack of proper irrigation facilities is one of the greatest problems encountered by farmers in the area. Much of the farmlands totally rely on monsoon rainfall to grow crops. Though the region has moderate- to high-rainfall in the monsoon period, the lack of proper water storage and irrigation facilities implies that the farmers are not able to make use of the water throughout the year. According to (NABARD. 2020) Production of crops is usually reduced greatly during the seasons of irregular rainfall or drought. The scarce access to wells, canals, and irrigation systems make farmers unable to produce a variety of crops or produce crops with high water consumption.

2. Soil Fertility Problems

The other issue of concern is the reduction of fertility of agricultural soils in most of the areas. Noiseless cultivation that lacks proper management of soils has led to deficiency of micronutrients that lower soil productivity and crop yield. Hilly areas also have a common problem of soil erosion following the heavy rains and steep slopes. (World Bank. 2018) Once fertile topsoil is lost due to erosion, the soil that remains is less fertile. The fact that organic manure and balanced fertilisers are used in small quantities only is also a contributing

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factor to the decreasing soil fertility in certain villages.

3. Traditional Farming Methods

The majority of tribal farmers still use the conventional farming methods and use of primitive farming equipment like wooden ploughs and manual labour. Even though these classical methods have been applied over the decades, they have been found to lead to less productivity of agriculture than the modern ways of farming. There is still low awareness, lack of financial resources, and inability to access agricultural extension services in many villages that hinder the adoption of improved seeds, mechanisation, modern irrigation systems and scientific methods of farming techniques.

4. Market Problems

The tribal farmers also have problems selling their agricultural commodities at reasonable prices. Most of the villages are in very hilly areas that have poor roads and transport infrastructure. Due to these constraints, farmers might be forced to move long distances when accessing the local markets. Otherwise, in particular instances, they have to sell their products to middlemen at reduced prices. Lack of proper storage facilities and structured market systems also contribute to the losses at the end of harvests and less earnings of the farmers.

5. Land Fragmentation

Another significant problem to agricultural efficiency in the area is land fragmentation. Agricultural land has over the years been subdivided among family members leading to poor land holdings, which are small and scarce. The small size of land parcels and the distance between them makes the modern technique of farming and the application of machinery challenging among the farmers (Singh, K., & Sharma, A., 2018). A small landholding also precludes the prospect of mass production of crops as well as decreases the profitability of farms in general.

Government Schemes for Agricultural Development

Trying to enhance agricultural situation and livelihoods of tribal farmers in Akole Tehsil, the Government of India and Government of Maharashtra have introduced a number of development programs and welfare schemes.

1. Integrated Tribal Development Project (ITDP)

ITDP aims at developing tribal communities in general. It assists agriculture by providing better seeds, farm implements, irrigation facilities as well as training farmers. The scheme assists in enhancing the standards of living of tribal farmers.

2. National Rural Livelihood Mission (NRLM)

NRLM will alleviate poverty in rural areas by enhancing livelihood and self-employment. It promotes Self-Help Groups (SHGs) formation to get financial assistance and training. The farmers gain on the agricultural, livestock and small business support.

3. Tribal Sub-Plan (TSP)

TSP makes sure that government money is explicitly used to develop the tribal. The program aids agriculture, irrigation, infrastructure, education, as well as healthcare in the tribal locations. It assists in enhancing better agricultural methods and livelihood.

4. Watershed Development Programs

Watershed programs are aimed at land and water conservation. Check dams, contour bundling, and farm ponds are some of the activities that are used to store rainwater and minimize soil erosion. Such programs enhance water availability to be used in agriculture.

5. Pradhan Mantri Krishi Sinchai Yojana (PMKSY)

PMKSY is planning to increase irrigation infrastructures and supply water to all farms. It propagates effective irrigation techniques such as drip and sprinkler irrigation systems. The program assists farmers in better management of water and raising crop yields.

Suggestions for Improvement

1. Development of Irrigation Infrastructure

Small dams, farm ponds and check dams can be used to improve irrigation by storing rainwater that can be used in agriculture. Sprinkler irrigation and drip techniques that are applied in the modern world enhance water efficiency. The improved irrigation systems allow the farmers to grow crops both in Kharif and Rabi seasons.

2. Promotion of Modern Agricultural Technology

The agricultural productivity can be improved by using better seeds, fertilisers, and advanced farming machinery. Agricultural extension services and demonstrations should guide the farmers. This assists them to embrace scientific methods of farming and increase crop yield.

3. Soil Conservation and Watershed Management

Contour bundling, terracing and afforestation can be conducted to minimize soil erosion in hilly regions. Watershed management assists in the conservation of soil and also enhances water retention. The practices are environmentally friendly and sustainable.

4. Expansion of Horticulture and Agro-Forestry

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Planting of fruits such as mango, pomegranate and guava can boost the income of farmers. Agro-forestry promotes the cultivation of trees together with the crops in order to enhance the fertility of the soil. Crop diversification reduces the reliance on one crop and risk is minimized.

5. Training Programs for Tribal Farmers

The tribal farmers are trained to acquire modern techniques of farming and managing pests. They also create awareness on the health of the soil and effective use of water. This kind of programs enhances agricultural production and capability of the farmers.

6. Better Marketing Facilities and Agricultural Cooperatives

This makes farmers sell their produce at fair prices through improved transportation, markets as well as storage facilities. Farm cooperatives lessen reliance on the middlemen. They also assist farmers to purchase seeds and fertilisers cheaply.

7. Access to Agricultural Credit and Subsidies

The easy access to agricultural loans and government subsidies will enable farmers to invest in more desirable farming practices. The funds may be applied in irrigation gear, seeds, and equipment. This promotes the use of the modern technology and enhances productivity. **(Jadhav, R., & Kale, S., 2016)**

Conclusion

The main means of livelihood among the tribal groups in Akole Tehsil is agricultural activities with most of the rural families relying on farming, livestock production and forest products to sustain themselves. The area is situated on the hilly area of the Sahyadri Mountain Range that largely affects agricultural activities and settlements. Since rainfalls are fairly good and the valley lands are fertile, crops like paddy, millets, pulses and seasonal vegetables have been planted in the region. But agriculture is largely subsistence based and rain fed whereby; majority of farmers grow crops that are mostly consumed at home. The agricultural productivity has been low due to some factors which include hard terrain, ineffective irrigation facilities, soil fertility and the practice of traditional farming methods despite favorable climatic conditions. Socio-economic factors such as low income, small landholdings, poor access to market, and absence of modern agricultural technologies are also limiting the development of agriculture in the area. **(Bhende, M. J. 2013)**

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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Original Article

Organic Farming and Sustainable Agriculture: A Study of Farmers in Maharashtra

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Abstract

The present study titled "Organic Farming and Sustainable Agriculture: A Study of Farmers in Maharashtra" aims to examine the awareness, benefits, and challenges associated with organic farming, and its role in promoting sustainable agriculture. Agriculture continues to play a vital role in the Indian economy, and the need for sustainable practices has become increasingly important due to the adverse effects of chemical-based farming on soil health and the environment. This study is based on both primary and secondary data. The primary data was collected through a field survey method, using a structured questionnaire and personal interviews with farmers to gather first-hand information. The questionnaire was designed to cover various aspects such as socio-economic profile, farming practices, awareness, benefits, challenges, and farmers' suggestions regarding organic farming. Secondary data was collected from government reports, research papers, and other reliable sources to provide a conceptual and theoretical background.

The findings of the study reveal that although farmers have basic awareness about organic farming, its adoption is still limited due to factors such as initial low productivity, lack of resources, and marketing challenges. However, farmers acknowledge the long-term benefits of organic farming, including improved soil fertility, reduced dependence on chemical inputs, and environmental sustainability. The study concludes that organic farming has significant potential to contribute to sustainable agriculture, but its widespread adoption requires increased awareness, proper training, institutional support, and effective policy implementation.

Keywords: *Organic Farming, Sustainable Agriculture, Soil Health, Farmers' Awareness, Agricultural Practices, Maharashtra, Environmental Sustainability*

Introduction:

India is widely recognized as an agrarian economy, where agriculture plays a vital role in the overall development of the country. Out of the total population of approximately 1.4 billion, nearly 46% of the population still depends on agriculture as their primary source of livelihood. This indicates that almost half of the country's population continues to be engaged in agricultural activities. Agriculture not only provides livelihood but also serves as a major source of employment in India. It is estimated that more than 50% of the total employment in the country is generated by the agricultural sector. In addition to this, agriculture contributes significantly to the Gross Domestic Product (GDP) of the nation, highlighting its importance in the economic structure of India. Thus, agriculture remains the backbone of the Indian economy, supporting millions of livelihoods and ensuring food security for the nation.

The primary sector is not limited to agriculture alone, but also includes allied activities such as fisheries, forestry, mining, and agro-based practices. Among these, animal husbandry plays a significant role as a supporting activity to agriculture. In rural areas, farming and livestock rearing are closely interconnected. Farmers often engage in activities such as dairy farming, poultry farming, and sheep/goat rearing as supplementary sources of income. These allied activities contribute to improving the overall economic condition of farmers.

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In a developing country like India, a large portion of the population depends on the primary sector not only for employment but also for their livelihood. Another important feature of the agricultural sector is that it provides raw materials to various industries, thereby supporting the industrial sector as well.

However, despite its importance, agriculture has often been subjected to excessive exploitation. In the pursuit of increasing agricultural production, there has been a growing dependence on chemical fertilizers and pesticides. Although these inputs have helped in increasing crop yields in the short term, their excessive use has led to serious consequences. The fertility of the soil has gradually declined, and the overall health of agricultural land has been adversely affected. Unfortunately, many farmers continue to rely on chemical inputs without fully realizing the long-term damage caused to the soil and the environment. This has become a matter of serious concern, highlighting the need to shift towards more sustainable and environmentally friendly agricultural practices. In order to reduce the damage caused to agriculture and to preserve soil fertility, there is a growing need to adopt more sustainable farming practices. Excessive use of chemical fertilizers should be minimized, or ideally avoided, as it leads to long-term degradation of soil health. Instead, greater emphasis should be placed on the use of organic inputs such as compost, farmyard manure, and other natural fertilizers. These practices not only help in maintaining the fertility of the soil but also contribute to environmentally sustainable agriculture. Therefore, the shift towards organic farming has become essential for ensuring the long-term sustainability of agriculture.

At the outset, it is essential to clearly understand the concept of organic farming, as its proper study and dissemination among farmers can significantly increase its adoption. Organic farming refers to a method of agriculture in which crop production is carried out by minimizing or completely avoiding the use of chemical fertilizers and instead relying primarily on organic inputs such as compost, farmyard manure, and other natural substances. In many cases, farmers tend to use chemical fertilizers excessively, often without proper guidance, in an attempt to increase agricultural productivity. While this may result in short-term gains, it leads to a decline in soil fertility and overall land quality in the long run. Unfortunately, the adverse effects on soil health are not always immediately visible to farmers. In this context, the concept of sustainable agriculture becomes highly relevant. Sustainable agriculture refers to the practice of utilizing natural resources in such a way that they are preserved and remain available for future generations. It emphasizes the responsible use of key agricultural resources such as soil and water, ensuring that agricultural activities do not lead to their depletion or degradation. Thus, organic farming and sustainable agriculture together promote an environmentally friendly and long-term approach to agricultural development.

Research Methodology:

The present study adopts a descriptive and analytical research design to examine the awareness, benefits, and challenges associated with organic farming among farmers in Maharashtra. In order to ensure a comprehensive and systematic analysis, both primary and secondary data sources have been utilized.

Data Collection Sources

Primary Data:

The primary data was collected through a field survey method. A well-structured and standardized questionnaire was designed to obtain first-hand information from the respondents. Personal interviews were conducted with farmers to ensure the accuracy, clarity, and reliability of the collected data.

Secondary Data:

To establish a strong theoretical foundation and contextual understanding, secondary data was collected from various reliable sources such as Government of Maharashtra agricultural reports, National Sample Survey Office (NSSO) data, academic journals, published research papers, and official agricultural department websites.

Structure of the Questionnaire

The questionnaire was systematically divided into several thematic sections to capture a comprehensive understanding of the study:

Section I: Socio-Economic Profile

This section includes basic demographic details of the farmers such as age, education, and family background.

Section II: Farming Practices

This part examines the cropping patterns, types of crops cultivated, and the traditional or

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modern farming techniques adopted by the farmers.

Section III: Awareness of Organic Farming

This section evaluates the level of awareness and knowledge among farmers regarding organic inputs, certification processes, and environmentally friendly practices.

Section IV: Benefits of Organic Farming

It focuses on farmers' perceptions regarding the advantages of organic farming, including improvement in soil health, long-term cost-effectiveness, and health benefits of chemical-free produce.

Section V: Challenges and Problem-Solving

This section identifies the major challenges faced by farmers in adopting organic farming, such as the transition period, pest control issues, and market accessibility, and explores possible solutions to enhance farmer satisfaction.

Section VI: Sustainable Agriculture

This part examines the relationship between organic farming practices and long-term sustainability, particularly in terms of resource conservation and environmental protection.

Section VII: Farmers' Suggestions

The final section collects qualitative feedback and suggestions from farmers regarding the promotion and expansion of organic farming practices.

Sampling and Area of Study

The study is focused on farmers from selected regions of Maharashtra. A sample of farmers was chosen for the field survey to represent different categories of agricultural practices and backgrounds.

Objectives of the Study:

- To study the level of awareness of organic farming among farmers in Maharashtra.
- To examine the extent of adoption of organic farming practices by farmers.
- To analyze the impact of organic farming on soil health and agricultural productivity.
- To identify the major challenges faced by farmers in adopting organic farming.
- To evaluate farmers' perception towards sustainable agriculture.
- To suggest measures to promote organic farming and sustainable agricultural practices.

Conceptual Background and Significance of the Study:

Organic farming is a natural method of agriculture that avoids the use of synthetic fertilizers, chemical pesticides, and genetically modified organisms (GMOs), and instead relies on practices such as crop rotation, animal manure, and biological pest control to maintain soil fertility and produce high-quality food. It forms a crucial component of sustainable agriculture, which emphasizes the long-term conservation of environmental resources for future generations. While organic farming primarily focuses on eco-friendly methods of production, sustainable agriculture aims at achieving a balance between environmental protection, economic viability, and social well-being. The integration of these two approaches helps in maintaining environmental balance by protecting soil, water, and biodiversity, reduces farmers' dependence on costly chemical inputs thereby improving economic sustainability, and ensures the availability of safe and chemical-free food while promoting a healthier and safer environment for both farmers and society.

Agriculture has been practiced since ancient times and continues to be a fundamental occupation for human survival, as it provides the essential food required for life. It is carried out across the world, although the methods of cultivation differ from region to region. In countries like the United States, where land is abundant, extensive farming is widely practiced. In contrast, in a country like India, where the population is high and land availability is limited, intensive farming is more common. In India, agriculture has traditionally been a hereditary occupation, passed down from generation to generation—from great-grandparents to grandparents, parents, and now the present generation. This type of agriculture is commonly referred to as traditional farming. However, over time, agricultural productivity began to decline due to various natural calamities such as droughts, excessive rainfall, and other environmental factors. As a result, the Green Revolution emerged as a major turning point in Indian agriculture. It led to a significant increase in agricultural production through the introduction of high-yielding varieties of seeds, modern irrigation methods, and the extensive use of chemical fertilizers and pesticides. While the Green Revolution successfully addressed the immediate need for food security, it also brought several negative consequences. Farmers increasingly depended on chemical inputs to boost production, which led to a decline in soil fertility, loss of

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biodiversity, and deterioration in the quality of agricultural produce, particularly due to the use of hybrid varieties.

Up to the 1960s, agriculture in India was largely based on traditional and organic practices. However, during the period from 1960 to 1980, modern chemical-based agriculture expanded rapidly. Although it helped in increasing food production, it came at a high cost, including degradation of soil health, destruction of beneficial microorganisms, and growing ecological imbalance. The excessive use of chemicals also contributed to an increase in pest attacks and crop diseases, which can be considered one of the major drawbacks of this phase. In the subsequent period from 1980 to 2000, there was a gradual shift towards integrated farming practices, which combined chemical methods with scientific approaches such as Integrated Pest Management (IPM). This approach aimed to reduce the harmful effects of chemicals while maintaining productivity. As a result, organic farming began to regain importance, and it started to be recognized as a scientifically supported agricultural system. Organic farming emphasizes the use of natural inputs and ecological balance, making it a sustainable alternative for the future of agriculture.

While studying organic farming, an important observation emerges regarding its global position and significance. Organic farming has gained considerable importance worldwide, with several countries actively adopting it on a large scale. It has been observed that countries such as New Zealand, Australia, and Cuba rank among the leading nations in the adoption of organic farming practices. These are followed by European countries, which collectively hold the second position, while countries in Latin America occupy the third position. India, along with some other nations, is placed in the fourth position, which indicates that the country still lags behind many developed and developing nations in the adoption of organic farming. However, India has shown a renewed interest in organic farming since the year 2000, and there has been a gradual increase in its adoption over time. According to available data, approximately 3 million hectares of land in India is reported to be under organic farming. However, a significant portion of this land includes forest areas where organic practices are followed for medicinal plants and natural vegetation. In reality, only about 1 million hectares of land is actively used for organic agricultural practices. Despite this limitation, the data indicates a consistent and encouraging growth in the area under organic farming in India.

Further analysis of organic farming reveals that it is primarily practiced for crops such as fruits, tea, coffee, spices, and various medicinal plants. In India, several states have made notable progress in this field. For instance, in Gujarat, organic cotton is cultivated on approximately 30 to 45 hectares of land. Similarly, states like Odisha and Andhra Pradesh are known for large-scale organic coffee cultivation. In addition, states such as Uttarakhand, Mizoram, Odisha, Tamil Nadu, and Karnataka have formulated specific policies to promote organic farming. As a result of this growing emphasis, the Government of Maharashtra also took initiatives to support organic agriculture by establishing a Regional Biofertilizer Development Centre in Nagpur, which was later renamed as the Regional Centre of Organic Farming. These developments clearly indicate that organic farming has been gradually expanding across different regions of India.

Data Analysis:

The data analysis for the present study is based on the responses collected through a structured questionnaire and personal interviews conducted with farmers during the field survey. The questionnaire served as the primary tool for collecting relevant information, and the responses obtained from the farmers were systematically analyzed according to different sections of the questionnaire. During the field survey, information was gathered by asking a variety of questions to farmers in order to understand their socio-economic background and farming conditions.

Section I: Basic Information of Farmers

The first section of the data analysis focuses on the basic information of the farmers collected during the field survey. This section includes details such as the name, age, educational qualification, and landholding of the respondents. The analysis reveals that the farmers belong to different age groups, primarily ranging between 30 to 55 years. In terms of education, a few farmers were found to be illiterate, while nearly 70% of the farmers had completed primary and secondary education. Only a small number of farmers (around 3–4 respondents) had attained higher education. With regard to landholding, it was observed that most farmers possess small agricultural land. Approximately 80% of the farmers own between 1

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to 2 hectares of land, while the maximum landholding recorded was around 5 to 6 hectares. This clearly indicates that the majority of the respondents fall under the category of small and medium farmers.

Section II: Farming Practices

The second section of the data analysis focuses on the farming practices adopted by the farmers. This section included 3–4 questions aimed at understanding the type of agriculture practiced and the use of organic inputs. The first question was related to the type of farming practiced by the farmers, with two main options provided: organic farming and traditional farming. The analysis revealed that more than 50% of the farmers reported practicing a combination of both organic and traditional methods. Around 30–40% of the farmers stated that they primarily follow traditional farming, while only a small number of farmers (approximately 7–8 respondents) were found to be practicing purely organic farming. This indicates a matter of concern, as it reflects that the importance and adoption of organic farming have not yet fully reached all farmers. Further observations showed that some farmers have been using organic inputs like farmyard manure for many years, even if they are not fully practicing organic farming. In other words, a number of farmers follow partial organic practices, particularly through the use of natural manure obtained from livestock. In terms of cropping patterns, farmers were found to cultivate crops such as sugarcane, cotton, soybean, gram, jowar, bajra, and wheat. When asked about the types of organic fertilizers used, nearly 70–75% of the farmers reported using farmyard manure. Additionally, some farmers also use vermicompost and poultry manure along with traditional organic inputs.

Section III: Awareness about Organic Farming

The primary objective of this section was to assess the level of awareness among farmers regarding organic farming. As observed in the previous section, only about 7–8% of the farmers were practicing purely organic farming, which made it important to understand whether the remaining farmers were aware of this concept. The findings reveal that all farmers possessed at least a basic level of awareness about organic farming. Most of them reported that they had gained this knowledge informally, mainly through interaction with other farmers, rather than through formal training or government initiatives. This indicates a gap between policy efforts and their effective implementation at the grassroots level, despite various government measures aimed at promoting organic farming. Further, when farmers were asked whether organic farming is beneficial for the environment and helps in maintaining soil fertility, the majority responded positively. They acknowledged that organic farming is environmentally friendly and contributes to sustaining soil health. However, when a follow-up question was asked regarding why they do not fully adopt organic farming, many farmers highlighted several challenges. The most common responses included that organic farming involves more effort, is time-consuming, and requires higher initial investment. These perceptions act as significant barriers to the wider adoption of organic farming practices.

Section IV: Benefits of Organic Farming

This section focuses on analyzing the perceived benefits of organic farming among farmers. The primary purpose of including this section was to understand that if farmers become aware of the advantages of organic farming, they may be more inclined to adopt it on a larger scale. During the field survey, farmers were asked whether organic farming helps in improving soil fertility. In response, many farmers agreed that organic farming enhances soil quality and makes the soil more porous and fertile. Farmers who regularly use farmyard manure reported that they have observed an increase in crop productivity over time. Another important question was related to the use of chemical fertilizers and whether their usage has reduced. The responses indicated that farmers who use organic manure tend to rely less on chemical fertilizers. Even when chemical fertilizers are used, they are applied in very limited quantities, mainly during the sowing stage. Some farmers also reported the use of vermicompost as an alternative organic input. Farmers further highlighted that the use of organic fertilizers has not only improved crop yield but has also contributed to maintaining long-term soil health and fertility. However, when asked whether organic produce fetches a better price in the market, the responses were mixed. Some farmers stated that they receive slightly better prices, while others mentioned that due to the lack of consumer awareness about organic products, price advantages are not always consistent.

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Section V: Challenges of Organic Farming

This section focuses on identifying the major challenges faced by farmers in adopting organic farming practices. As observed earlier, nearly 70% of the farmers practice a combination of traditional and organic farming, which indicates that farmers encounter certain initial difficulties while shifting towards organic methods. The analysis reveals that one of the most significant challenges is the lack of adequate knowledge and awareness about organic farming practices. In addition, farmers reported issues such as limited availability of resources, insufficient supply of organic inputs, and a lack of strong motivation or perceived necessity to fully adopt organic farming. Another major concern highlighted by farmers is the initial decline in crop productivity. Many farmers stated that during the early stages of adopting organic farming, yields tend to decrease, which leads to financial losses. Due to such initial setbacks, farmers often become discouraged and reduce their reliance on organic methods. However, it was also observed that many farmers are not fully aware that, although yields may decrease initially, productivity tends to improve significantly in subsequent seasons as soil health is restored. Furthermore, when farmers were asked about the difficulties faced in marketing organic produce, some respondents acknowledged that they do face challenges. They explained that due to lower initial production, organic products are often not available in sufficient quantities to meet market demand. At the same time, a few farmers also mentioned that the government is making efforts to promote organic farming through various schemes and initiatives.

Section VI: Sustainable Agriculture

This section examines the role of organic farming in promoting sustainable agriculture from the perspective of farmers. During the survey, farmers were asked whether they believe that organic farming contributes to sustainable agricultural practices. Only a few farmers were able to respond in detail; however, those who did expressed positive views. They stated that organic farming helps in the controlled and efficient use of natural resources, such as soil and water. According to them, reduced dependence on chemical inputs leads to better conservation of these resources. As a result, natural resources are utilized more responsibly, ensuring that they remain available for future generations, which is a key principle of sustainable agriculture. Additionally, farmers were asked whether they would continue practicing organic farming in the future, and whether those who are not currently using it would consider adopting it. The responses were largely positive, with most farmers expressing their willingness to continue or adopt organic farming practices. They acknowledged that organic farming is beneficial not only for agriculture but also for long-term environmental sustainability.

Section VII: Farmers' Suggestions

The final section of the questionnaire focuses on collecting suggestions from farmers regarding the promotion and adoption of organic farming. This section aims to understand farmers' perspectives and recommendations for improving the use of organic practices. The responses indicate that farmers strongly believe that organic farming helps in maintaining soil health and enhances its long-term productivity. According to them, organic farming is highly beneficial and should be adopted on a wider scale. They emphasized that the use of organic methods helps in preserving soil fertility for a longer period, making agriculture more sustainable. Furthermore, farmers suggested that the government should take more active steps to promote organic farming. They recommended the implementation of various schemes and support programs to encourage farmers to adopt organic practices. In addition, they highlighted the need for awareness campaigns, training programs, and workshops to educate farmers about the benefits and methods of organic farming.

Conclusion:

The present study on "Organic Farming and Sustainable Agriculture: A Study of Farmers in Maharashtra" highlights the growing importance of organic farming as a sustainable alternative to conventional agricultural practices. The findings of the study reveal that although farmers possess a basic level of awareness regarding organic farming, its actual adoption is still limited. A majority of farmers continue to follow a combination of traditional and organic methods, while only a small proportion has fully adopted organic farming. The study clearly indicates that farmers recognize the benefits of organic farming, particularly in terms of improving soil fertility, maintaining soil health, and reducing dependence on chemical fertilizers. Organic practices such as the use of farmyard manure, vermicompost, and other natural inputs

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have shown positive impacts on agricultural productivity in the long run.

However, despite these benefits, several challenges hinder the widespread adoption of organic farming. The major issues identified include lack of proper knowledge, initial decline in crop yields, limited availability of organic inputs, and marketing difficulties. These challenges create hesitation among farmers, especially due to the risk of short-term financial losses. The study also highlights that organic farming plays a crucial role in promoting sustainable agriculture by ensuring the conservation of natural resources like soil and water for future generations. Farmers who are aware of these long-term benefits have expressed a positive attitude towards continuing or adopting organic practices in the future. Furthermore, the suggestions provided by farmers emphasize the need for stronger government support, awareness programs, training, and effective policy implementation to bridge the gap between knowledge and practice. Increasing consumer awareness and improving market access for organic products are also essential for ensuring better price realization for farmers.

In conclusion, while organic farming holds significant potential for achieving sustainable agriculture in Maharashtra, its success largely depends on enhanced awareness, institutional support, and gradual transition strategies that reduce the risks faced by farmers. With proper guidance and support, organic farming can emerge as a viable and sustainable solution for the agricultural sector.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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Original Article

Role of Artificial Intelligence in E-Commerce

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Abstract

The e-commerce sector is changing as a result of artificial intelligence (AI), a game-changing technology. Through intelligent systems, it allows companies to enhance client engagement, optimize supply chain management, and offer customized shopping experiences. Recommendation systems, chatbots, dynamic pricing, fraud detection, and inventory management all make extensive use of artificial intelligence (AI) technologies like machine learning, natural language processing, and predictive analytics. E-commerce businesses can evaluate customer behaviour and increase operational efficiency with the use of these technologies. Widespread acceptance is still hampered by factors including ethical dilemmas, expensive implementation costs, and data protection concerns. The purpose of this study is to investigate the use of AI in e-commerce, as well as its advantages and disadvantages. Secondary data gathered from scholarly articles, reports, and journals forms the basis of the study. The results show that AI greatly improves decision-making, boosts consumer happiness, and makes businesses more competitive in the digital market. The study finds that AI will continue to be crucial in determining how e-commerce develops in the future and suggests using AI technology strategically to optimize company expansion.

Keywords: *Chatbots, machine learning, artificial intelligence, e-commerce, personalization, and predictive analytics.*

Introduction:

E-commerce has emerged as a major mode of business due to the rapid rise of digital technology, which has changed the global retail environment. One of the most important technologies influencing innovation in the e-commerce industry is artificial intelligence (AI). Artificial Intelligence (AI) refers to computer systems that are able to carry out tasks like learning, decision-making, problem-solving, and language comprehension that normally need human intelligence. AI technologies are utilized in the e-commerce sector to evaluate vast amounts of customer data, forecast user preferences, and provide tailored recommendations. Online businesses are becoming more successful and efficient because to AI-powered tools like chatbots, recommendation engines, and automated shipping systems. These solutions assist companies in streamlining supply chain processes, improving client experiences, and optimizing pricing tactics. Prominent e-commerce firms like Amazon and Alibaba have effectively incorporated AI technologies to raise consumer satisfaction and boost productivity. Businesses may use AI to better analyse consumer behaviour patterns and develop tailored marketing strategies, which eventually boosts sales and customer loyalty.

The use of AI in e-commerce has many benefits, but there are drawbacks as well, such as expensive technology costs, ethical dilemmas, and data privacy problems. Examining the use, advantages, and constraints of AI in e-commerce is therefore crucial.

Statement of the Problem

Personalized client experiences, shifting consumer tastes, and fierce competition are just a few of the issues facing the e-commerce sector. Large amounts of customer data are frequently difficult for traditional systems to properly evaluate.

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Even though AI can improve customer service and operational efficiency, many firms still find it difficult to employ because of the complexity of the technology, the expense, and worries about algorithmic bias and data protection.

As a result, it is vital to examine how AI technologies affect the growth and profitability of e-commerce companies.

Objectives

- To investigate the idea of artificial intelligence in online shopping.
- To examine how AI is used in online retail companies.
- To assess how AI may enhance customer satisfaction and operational effectiveness.
- To determine the difficulties in implementing AI in e-commerce.
- To offer suggestions for the successful implementation of AI technologies.

Scope

The scope of this study is limited to the role and application of artificial intelligence in the e-commerce sector. The research focuses on how AI technologies such as machine learning, chatbots, recommendation systems, and predictive analytics influence business operations and customer experiences. The study mainly relies on secondary data from journals, research papers, and industry reports

Limitations of the Study

1. The study is grounded substantially on secondary data sources.
2. The exploration doesn't include primary check data from consumers or businesses.
3. Rapid technological changes in AI may limit the long- term connection of the findings.
4. The study focuses on general trends rather than specific company- position analysis.

Data Collection

The study is grounded on secondary data collected from exploration journals, academic publications books, Assiduity reports, Online databases and websites. Secondary data provides precious perceptivity into the operation of AI in e-commerce and helps in understanding assiduity trends and technological developments

Research Methodology

This exploration adopts a descriptive exploration design to dissect the part of artificial intelligence in-e commerce. The study is grounded on a methodical review of being literature and reports on AI technologies used in online retail. The exploration methodology includes:

1. Identification of applicable literature related to AI and e-commerce.
2. Collection of data from academic journals and exploration papers.
3. Analysis of colourful operations of AI technologies in e-commerce.
4. Interpretation of findings to understand the impact of AI on business operations and client satisfaction.

Statistical Tools Used

The study uses introductory statistical tools similar as Chance analysis Mean values, Relative analysis descriptive statistics

Literature Review

A review of literature provides an understanding of previous studies conducted in the area of Artificial Intelligence and e-commerce.

- **Levent T. Khrais (2020)** examined the impact of Artificial Intelligence on consumer demand in e-commerce. The study found that AI technologies such as recommendation systems and predictive analytics significantly influence consumer purchasing decisions and enhance customer satisfaction.
- **Amit Parashar, Shikha Parashar, and Manoj Vyas (2025)** analyzed how AI is transforming the e-commerce industry. Their study highlighted that machine learning algorithms improve marketing strategies and help businesses understand consumer behaviour more effectively.
- **Meenakshi Singh and Sukhvinder Kang (2023)** investigated the role of AI in enhancing operational efficiency in online retail businesses. Their findings suggested that AI applications such as chatbots, automated logistics systems, and fraud detection tools improve productivity and reduce operational costs.
- **Priyanka Dixit (2024)** studied the relationship between artificial intelligence and competitive advantage in e-commerce. The research concluded that companies adopting AI technologies achieve better customer engagement and higher sales growth compared to traditional systems.

The literature indicates that AI has a significant positive impact on the development of e-commerce platforms and customer experience.

Conceptual Framework

The conceptual framework explains the relationship between Artificial Intelligence technologies and e-commerce performance.

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- **Independent Variable:** Artificial Intelligence Technologies, Machine Learning, Chatbots, Recommendation Systems, Predictive Analytics, Dynamic Pricing.
- **Dependent Variable:** E-Commerce Business Performance, Customer Satisfaction, Sales Growth, Operational Efficiency, Customer Retention.
- **Conceptual Relationship:** AI Technologies → Better Data Analysis → Tailored Services → Enhanced Customer Experience → Higher Sales & Business Performance

Future Research Scope Studies

Future Research studies can explore:

- Consumer trust in AI-driven e-commerce platforms.
- Ethical issues related to AI decision-making.
- AI adoption in small and medium-sized e-commerce businesses.
- The role of AI in cross-border digital commerce.
- The role of AI is cross border digital commerce.

Implications of the Study

The study highlights the importance of AI technologies in transforming the e-commerce sector. Businesses that integrate AI tools can better understand consumer preferences, optimize pricing strategies, and enhance customer engagement. The study also emphasizes the need for companies to address challenges related to data privacy and ethical use of AI.

Applications of Artificial Intelligence in E-Commerce

Artificial Intelligence is widely used in various aspects of e-commerce operations.

1. Product Recommendation Systems Recommendation systems analyse customer browsing history and purchase behaviour to suggest relevant products.

2. Chatbots and Virtual Assistants AI-powered chatbots provide instant customer support and help resolve queries efficiently.

3. Fraud Detection Machine learning algorithms analyze transaction patterns to detect suspicious activities and prevent fraud.

4. Inventory Management AI helps businesses forecast product demand and maintain optimal inventory levels.

5. Dynamic Pricing AI algorithms adjust product prices based on demand, competition, and market trends.

Result and Discussion

The analysis shows that Artificial Intelligence significantly enhances the performance of e-commerce businesses. AI technologies help companies understand customer behaviour and provide personalized shopping experiences. Recommendation systems boost sales by making clients aware of pertinent products. Chatbots enhance customer service by giving prompt answers to questions. AI also improves supply chain management by predicting demand patterns and optimizing logistics operations. Overall, the adoption of AI technologies leads to increased customer satisfaction, improved operational efficiency, and higher profitability for e-commerce companies.

Conclusion

Artificial Intelligence has become a key driver of innovation and growth in the e-commerce industry. AI technologies enable businesses to analyse customer data, provide personalized services, and improve operational efficiency. The study highlights that AI applications such as recommendation systems, chatbots, predictive analytics, and automated logistics systems significantly enhance the performance of e-commerce businesses. However, organizations must address challenges related to data privacy, cybersecurity, and high implementation costs to ensure successful adoption of AI technologies. The future of e-commerce will be increasingly driven by Artificial Intelligence, and businesses that effectively integrate AI into their operations will gain a competitive advantage in the digital marketplace.

Recommendations

- E-commerce companies should invest in AI technologies to improve customer experience.
- Businesses should implement strong data privacy and security measures.
- Organizations should train employees in AI-related skills.
- Governments should promote AI research and development through supportive policies.
- Businesses should adopt ethical AI practices to avoid bias and discrimination.

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Original Article

A Study of Investment Awareness of Working Women in Nashik Tahsil Maharashtra

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Abstract

Financial awareness is becoming important in achievement of financial inclusion in the economy. Investment awareness and knowledge is important not only for investors but also for the all-women's in the country. Awareness and knowledge about various investment avenues is important in various stage of the life of working women's. This study aims to focuses on awareness and knowledge, investment structure and problems faced by the working women's while taking investment decisions. The survey is conducted through primary and secondary data by using interviews of working women's and simple random sampling techniques with the sample size of 45 respondents in Nashik tahsil. The data are analyzed by using the percentage analysis test. The research is totally related with the working women's it includes government employees, private employees, businessman and professional in Nashik tahsil. This research study shows that the majority of the working women's have knowledge and awareness about the various investment avenues. Most of the working women prefer to invest their money in gold, real estate and public provident fund. There is huge percentage of working women's have knowledge about the mutual funds and share market but they are not preferring to invest their money in mutual funds and share markets because of they think that the investment in mutual funds and share market is very risky. This research paper is also focused on the problems faced by working women's while taking an investment decisions and it can be concluded that the huge percentage of working women's are depends on husband and family members while taking the investment decision.

Keywords: *Awareness, Knowledge, Lifestyle, Working women's, Investment, Avenues*

Introduction:

In ancient times, women were not even allowed to get an education. Her only role was to take care of the house. The world of women is limited to their families and their children. But then people gradually began to recognize the importance of education for women and today there are many highly educated women in our country. It is literally a sign of progress of our country. Most of the women seem to be working successfully in all these fields, e.g. government sector, semi-government sector, private sector, etc., and of course, while doing so they have not forgotten the role of a housemaid. In both places, home and job, they are doing very well. They know how to manage the balance of work and life. Nowadays, it is found that more and more women in the workplace who are financially independent. No doubt, that today's women are more successful. They are getting a good salary, but what about their investment strategy? Do they financially knowing enough to invest on their own? If so, what are their investment and savings strategy? What is their view on investment and savings? What is the approach of women to take risks while investing and saving? These questions need to be answered in order to paint a picture of the role of Indian working women when making investment decisions. Financial investment is the purchase of financial securities such as stocks, bonds or mortgages. As a working woman, it is very important to shape her financial life or financial investment.

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Today's working women have more earning potential and more influence on their financial decisions than ever before. Today's working women represent almost half of the workers and most businesses are owned or managed by women. Although most women make or control decisions in all areas, working women are aware of saving but having less investment strategies. It is now more important for women to focus on financial investment than ever before. Throughout her life, as a woman, she faces different financial challenges than her male counterparts. If women want to control their financial future, they must recognize the differences and strive to empower themselves. Making money is half the equation for achieving financial freedom. It is equally important for women to work effectively to make their money. In addition, the situation is often different for women, and the more they know about the basics and their options, the better their financial investment choices will be.

Use of term 'Investment':

Here, investment is considered as investment of income that is intended to achieve an objective. Additional income or value addition is an investment. The essential quality of an investment is that it involves 'waiting' for a reward. The today's consumption includes the promise of income that has been saved or kept away in the hope that it will have some benefits in the future. Financial experts and economists have classified investments. Therefore, according to financial experts, investment is the distribution of income. Assets that are expected to yield some benefits or positive returns. Asset investment in a given period ranges from a safe investment to a risk. This type of investment is also called 'financial investment'.

Importance Of Investment for Women:

1. Generally, the life expectancy of a woman is more than a man, so that it is important for women to have enough investment to sustain lifelong lifestyle.
2. It is observed that in some metro cities in India the women became career oriented and try to live independently.
3. It is often observed that women having conservative approach while taking investment decisions. If they trained themselves well about the ways of investing and the returns, they may take important and bold decisions to invest.
4. It is noticed that, in case of working spouses the ratio of divorce is more due to working status, working conditions expectancy, working hours etc. by considering these things the working women not only financially independent but also having moderate investment policy for future.

Review Of Literature:

1) The National Council of Applied Economic Research (NCAER) conducted a survey of households (1964), entitled "Attitude Towards and Motivations for Savings". The survey covered a sample of 4650 households spread over India. It provides an insight into the attitude towards and motivations for savings of individuals. One of the important finding was that the investment in securities was preferred by the high income households.
2) MM Shankar and M.E. Vijayalakshmin (2007), an article on "Studies on Motivational Factors of Women Entrepreneurs in Chennai" states that 71% of respondents in the sample of 47respondents attracted women entrepreneurs who were motivated to start a business. Factors like this. 53 per cent of women entrepreneurs were affected by shocking factors such as inadequate family income, dissatisfaction with paid jobs, difficulty in finding jobs and flexible work schedules due to family responsibilities.
3) Mr. Mahdi Salehi and Habib Valizader (2007), in their article titled "Entrepreneurship Some Evidence from Corporate Sector" suggested that in a competitive and globalization environment, the best way for long term survival is through creativity and innovation in corporate sector. Entrepreneurs create and develop new products and services and generate employment opportunities as well as improve the living standard of people. The authors stated that the manager plays a focal point in the development, facilitation and oversight of the entire entrepreneurial process within an organization. The power of corporate entrepreneurship can develop entrepreneurial initiative from all directions which include management directions from the top, middle or lower management decisions.
4) Dr. V. Manickvawasagam, et al., (2007), in his article "Women Entrepreneurs: An Analysis" states that women entrepreneurs, self-sector, resource system and many factors are key to success. Support systems help them succeed in their work. In addition, the education, training, knowledge, abilities and qualities of the entrepreneurs affect their efficiency. Motivational patterns, family background are also closely related to success. Resource systems, technical and marketing support, managerial consulting and financial support also determine the success of an enterprise.

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5) According to study by S. Hema (2007), in her Study on Investment Behavior of women Investors in Palani" analyzed the varied investment avenues out there to women investors. Among the varied avenues they like Saving Bank Deposits. The most important reason for choose this investment is safety measures. Next to bank deposits, life assurance schemes and gold square measure the opposite investment avenues. Although some respondents have an interest in invest in shares but, they have not aware towards invest in shares. Similar is that the case as concerning mutual funds.
6) Sandra J Huston (2010), the author talks about measuring financial literacy. Author mentions that measuring financial literacy is important to understand the impact of education as well as roadblocks. It helps in highlighting the today's limitations and helps researchers in coming up with standardized, commonly accepted financial literacy instruments.

Statement Of the Problem:

Saving is an important indicator of economic growth. In today's economic climate, creating awareness about savings is inevitable. Saving is a special habit that embodies women in particular. Even in the past, when women were not earning actively, they had a habit of saving to cover contingent liabilities. At that time women were not aware of the various shops of investment. Things have been changed completely over time. Today's women who are employed in many places have a diverse knowledge of investing through their education and as a result they invest in a variety of investments such as shares, debentures, insurance, mutual funds and bank deposits. An aspiring woman has many investment ideas in her mind to make an investment decision. Although there are various investment options available, most of them still rely on the banking system for savings either, they are not aware of the other avenues of investment available in the market or they consider that investment as a risk.

In this study, researcher will try to understand women's awareness of various investment and investment options, investment structure of working women's, the difficulties they face while taking investment decision.

Significance Of the Study:

The review available from the literature shows that a number of research studies have been conducted to identify male awareness, strategy and comprehension levels around the world. The strategies, behaviors, and perceptions of working women investors are very low and their investment potential should not have been considered by previous researchers. Very few researchers have focused on women, and this has been a neglected area of research, especially in India. Today's working women in particular have started playing a decisive role in the economic sector. Companies are more interested in understanding the way of working women are attracting to invest in financial investment. New tools and packages can be created for those who can meet the needs of working women. Through this study, the researcher seeks to create awareness among working women about financial investment and find the right way to attract working women to financial investment.

Objectives Of the Study:

- To study the awareness of working women towards investment.
- To know the investment structure of working women.
- To identify the problems faced by the working women while making the investment.

Hypothesis:

- H_1: There is significant relationship between investment awareness among working women.
- H_1: There is significant relationship between problems faced by working women while making the investment decision

Research Methodologies:

Source of data: The research basically depends upon primary and secondary data.

1. **Primary Data:** The research is empirical research based on the survey method. Primary data will be collected with the help of interviews.
2. **Secondary Data:** The secondary data regarding the theoretical aspects of investments, investment awareness, and problems of women in investmentis to be collected from books, journals, newspapers and from various educational websites.

Sample size:

The research took a simple size of 45 respondents of working women from Nashik Tahsil. Samples are selected with the help of simple random sampling techniques to collect the data from the respondent.

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Table No 1:

Sr. no.	Working Women	Selected Samples
1.	Government Employees	15
2.	Private Employees	15
3.	Business and Professionals	15
TOTAL SELECTED SAMPLES		**45**

Table no 1 show that the 45 working women from Nashik tahsil are considered forthe research study. Out of 45 working women 15 are government employees, 15 private sector employees and 15 working women are businessman and professionals are selected as sample for the study.

Data Analysis and Interpretation:

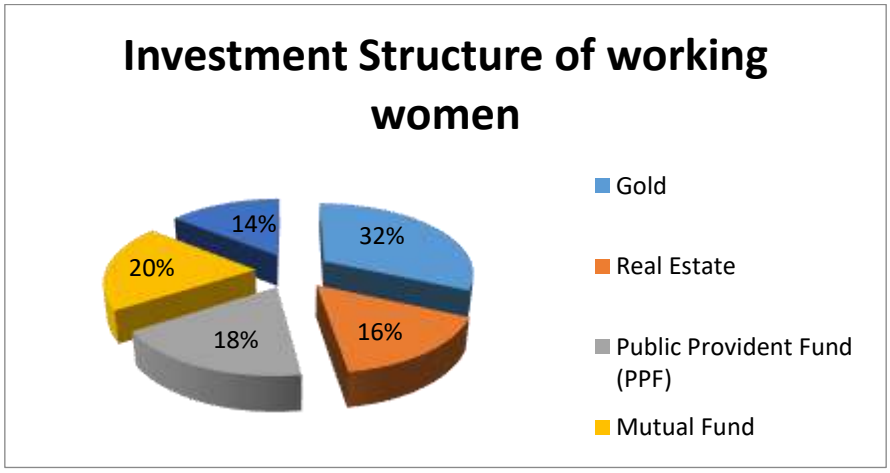
A survey is conducted considering 45 working women as sample size. The researcher takes an interview of 45 working women in Nashik tahsil in Maharashtra regarding awareness and knowledge of investment.

Table no. 2: Awareness of working women about the various investment avenues:

Working women	High (%)	Moderate (%)	Low (%)	Total (%)
Government Employees	75	15	10	100
Private Sector Employees	82	12	06	100
Businessman's and Professionals	92	05	03	100

The above table no 2 shows that the women from Nashik tahsil have a good knowledge about the various investment avenues. The table shows that the awareness of working women's in government sector are 75% i.e. highly aware about the various investment avenues, 15% women's have a moderate knowledge about the investment avenues and 10% working women's have low knowledge about the investment avenues. Knowledge of private sector working women is better than the government sector working women's. 82% Private sector working women's have high knowledge about the various investment avenues, 12% private sector working women have moderate knowledge and 6% private sector working women's have low knowledge about the various investment options. Were as businessman's and professional women's have excellent knowledge about investment avenues as compared to government sector and private sector working women's. 92% i.e. highly businessman and professional women's are aware about various investment avenues, 5% businessman and professional women's have moderate knowledge about the various investment avenues and 3% have low knowledge about the various investment avenues. So it is proved that the working women's have knowledge and aware about the various investment options or avenues.

Char no.1:



The chart no 1 show that the investment structure of government sector, private sector, businessman and professional working women in Nashik tahsil. The researcher says that the majority of the working women's save their money, but not in financial investment options. The researcher comes to know that the 14% working women are not interested in any of these investment avenues. 32% working

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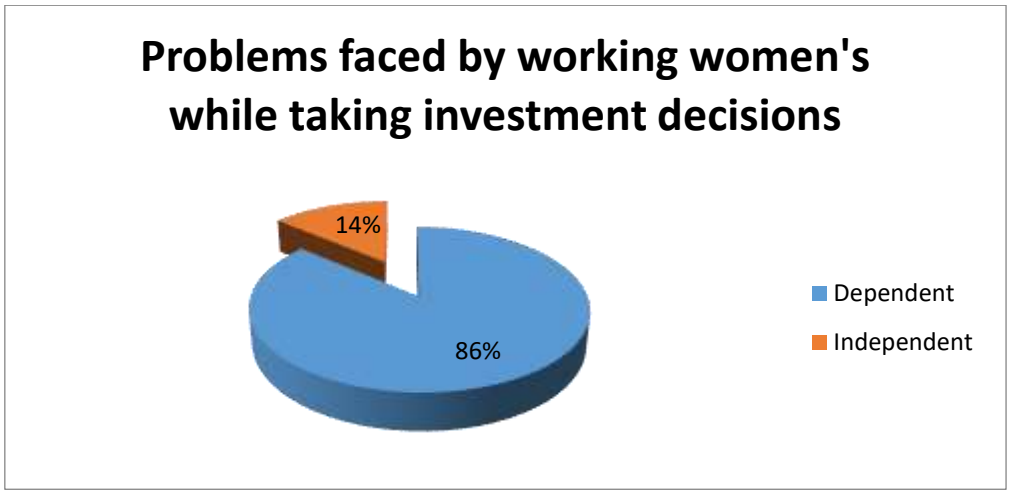
women are like to invest their money in gold. 16% working women are interested to invest their money in real estate. The above chart also shows that the very few working women's are interested to invest their money in public provident fund and mutual fund the reason behind this is due to the lack of knowledge, awareness and the most important reason is safety due to the above reasons the working women's are not investing their money in public provident fund and mutual fund.

Chart no. 2



The above pie chart no 2 shows that 86% government, private, businessman and professional working women are dependent on their husband and family members while taking investment decisions. Remaining 14% working women of government, private, businessman and professional are taking their own investment decision. The reasons for not taking the investment decision by their own are male and family dominance in some areas.

Findings, Suggestions and Conclusion:

This study shows that the working women's have knowledge and aware about the various investment options. They mostly prefer to invest in gold, real estate and public provident they are not investing their money in the mutual fund because they consider that investment is risky. The present study also analyzed that most of the working women are depends on their husband and family members while taking investment decisions. According to the survey study the researcher can say that majority of the working women's have basic and moderate knowledge and awareness about the various investments available in the market. The researcher suggested that the working women's have knowledge and awareness about the mutual fund as well as the share market but they are thinking that the investment in mutual funds and share market is very risky for motivating the working women's to invests in mutual funds and share market it is needed to organized a conference, workshops on mutual funds and share markets. The husband and family members of the working women's has given an freedom to working women's to take their investment decision by their own. This research is helpful to the investment firms to target the working women's to motivate the working women's to invest their money in various investment avenues.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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Original Article

Evolution of the Indian Education System: From Ancient Traditions to NEP 2020

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Abstract

The Indian education system has witnessed a remarkable evolution over the centuries, shaped by the nation's socio-cultural, political, and economic developments. This research paper examines the historical progression of education in India, tracing its journey from the ancient Gurukula system of the Vedic period to the contemporary framework under the National Education Policy (NEP) 2020. Key historical phases, including the Vedic, Buddhist, Medieval, Colonial, and Post-Independence periods, are analyzed, highlighting pedagogical methods, curriculum, and accessibility. The study also evaluates major policy interventions, such as the National Policy on Education (1968, 1986) and NEP 2020, to understand their impact on curriculum design, quality, accessibility, and skill-based learning. Using a descriptive and analytical methodology, including historical and comparative analysis, the research explores how Indian education has transitioned from exclusive, rote-based learning to inclusive, flexible, and competency-oriented frameworks.

The findings indicate a progressive emphasis on holistic development, critical thinking, vocational skills, and global competitiveness. NEP 2020 represents a transformative milestone, introducing multidisciplinary learning, technology integration, and flexible curricular structures aligned with cognitive development. Overall, the Indian education system has evolved to prioritize equity, inclusivity, and excellence, preparing learners for the challenges of the 21st century (Government of India, 2020; UNESCO, 2022).

Keywords: *Indian education system, Gurukula, NEP 2020, historical evolution, policy analysis, inclusive education, skill development*

Introduction:

Education in India has a long and illustrious history, deeply rooted in its cultural, spiritual, and philosophical traditions. The evolution of the Indian education system mirrors broader transformations in society, governance, and the economy, reflecting changing priorities and knowledge needs over time. In ancient India, education was primarily holistic and spiritual, focusing on character building, moral development, and intellectual growth, with the Gurukula system serving as the foundational model. Knowledge was transmitted orally, and curricula emphasized the study of the Vedas, philosophy, mathematics, and ethics (Sharma, 2019).

During the Buddhist period, education became more structured and inclusive, with institutions like Nalanda and Takshashila attracting students from across Asia. The curriculum broadened to include philosophy, medicine, logic, and literature, while Pali and Prakrit were widely used as mediums of instruction (Singh, 2021). In the Medieval period, Islamic education influenced Indian learning through madrasas and maktabs, integrating religious studies with mathematics, literature, and philosophy. The Colonial period further transformed education by introducing Western knowledge, English as the medium of instruction, and formal universities, primarily to meet administrative and governance needs (Macaulay, 1835).

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After independence, the Indian government focused on universalizing education and promoting social equality through policies such as the National Policy on Education (1968, 1986), establishing programs to increase access, literacy, and quality of learning (Government of India, 1968, 1986; Ministry of Education, 2020). The National Education Policy (NEP) 2020 represents a new era in Indian education, emphasizing flexibility, skill-based learning, multidisciplinary curricula, technology integration, and global competitiveness (Government of India, 2020; UNESCO, 2022).

Objectives

The primary objective of this study is to examine the evolution of the Indian education system across historical periods and analyze the impact of various policy interventions on access, quality, and pedagogy. Specific objectives include:

1. To trace the historical development of education in India, highlighting the Vedic, Buddhist, Medieval, Colonial, and Post-Independence periods.
2. To identify the key features, curriculum, and pedagogical approaches of each historical phase.
3. To analyze major policy frameworks, including NPE 1968, NPE 1986, and NEP 2020, and their influence on inclusivity, skill development, and flexibility.
4. To compare and evaluate changes in accessibility, curriculum, and learning outcomes across different periods.
5. To provide insights into the role of educational reforms in preparing students for contemporary social, economic, and global challenges.

Methodology

This research adopts a descriptive and analytical approach, relying primarily on secondary sources such as policy documents, official reports, scholarly articles, and historical texts. The study focuses on systematically examining historical developments, policies, and their outcomes.

Methods of analysis include:

- **Historical Analysis:** Examining the evolution of education across periods to identify trends, continuities, and changes in curriculum, pedagogy, and access.
- **Comparative Study:** Comparing educational features and outcomes across periods to understand the shift from exclusive and rote-based learning to inclusive, skill-oriented frameworks.
- **Policy Analysis:** Reviewing key policies such as NPE 1968, NPE 1986, and NEP 2020 to evaluate their impact on curriculum, pedagogy, access, and quality.

This approach allows for a comprehensive understanding of the trajectory of Indian education, connecting historical practices with contemporary reforms and identifying key patterns and lessons (Creswell, 2014; Government of India, 2020).

Historical Analysis of Indian Education

1. Ancient Indian Education System (Vedic Period: 1500–500 BCE)

Education was based on the Gurukula system, where students lived with teachers and received holistic instruction. The curriculum emphasized Vedas, philosophy, and mathematics, with Sanskrit as the medium of instruction. Teaching was primarily oral, relying on memorization. Access was limited, and the system emphasized moral and spiritual values but lacked inclusivity (Sharma, 2019).

2. Buddhist Period (500 BCE–1200 CE)

The Buddhist period introduced structured institutions like Nalanda and Takshashila, which attracted students from across Asia. Education became more inclusive, covering philosophy, medicine, literature, and logic, with Pali and Prakrit as mediums of instruction. The period promoted critical thinking, debate, and intellectual exchange (Singh, 2021).

3. Medieval Period (1200–1757 CE)

Islamic influence shaped education through madrasas and maktabs, integrating religious studies with mathematics, literature, and philosophy. Education remained formal and structured, with access largely restricted to Muslim communities. This period contributed to the integration of diverse knowledge systems (Kumar, 2020).

4. Colonial Period (1757–1947 CE)

British policies, including Macaulay's Minute (1835) and Wood's Despatch (1854), introduced Western education and English as the medium of instruction. Universities were established, and curricula emphasized administrative, scientific, and literary knowledge. Access expanded, but inequalities persisted based on region, class, and gender (Macaulay, 1835).

5. Post-Independence Period (1947–Present)

Post-independence policies, such as NPE 1968 and NPE 1986, emphasized universal access, social equality, and expansion of education. Programs like Sarva Shiksha Abhiyan and the Mid-Day Meal Scheme helped increase enrollment and reduce disparities. Curricula incorporated science, technology, vocational training, and value-based

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education (Government of India, 1968, 1986; Ministry of Education, 2020).

6. National Education Policy (NEP 2020)

NEP 2020 introduces the 5+3+3+4 structure, emphasizing multidisciplinary, skill-based, and flexible learning. The policy promotes technology integration, experiential learning, and global competitiveness. It seeks to prepare learners for the 21st century while fostering creativity, critical thinking, and lifelong learning (Government of India, 2020; UNESCO, 2022).

Comparative Analysis

A comparative study of Indian education shows a clear shift from restricted access and rote-based learning to inclusive, skill-oriented, and flexible frameworks. The Vedic period emphasized spiritual and moral education with limited access, whereas the Buddhist period introduced structured institutions with broader curricula and inclusivity. The Medieval period integrated Islamic knowledge, and the Colonial period prioritized Western administrative and scientific knowledge. Post-independence policies focused on universal access, social equality, and modernization of curricula, culminating in NEP 2020, which emphasizes flexibility, multidisciplinary learning, and global competence (Government of India, 2020; UNESCO, 2022).

Results and Discussion

The findings indicate that India's education system has progressively evolved to meet changing societal needs:

- Education shifted from exclusive to inclusive, accommodating diverse learners.
- Policies such as NPE 1968, NPE 1986, and NEP 2020 improved access, quality, and equity.
- NEP 2020 emphasizes skill development, multidisciplinary learning, and flexibility, preparing students for global challenges.

Overall, the system has transitioned from rote-based learning to competency-oriented education, reflecting a balance between traditional knowledge and modern skills (Government of India, 2020; UNESCO, 2022).

Conclusion

The Indian education system has evolved significantly from the Gurukula system to NEP 2020, reflecting societal, cultural, and economic changes. Policies after independence laid the foundation for universal access and social equity, while NEP 2020 represents a transformative step toward holistic, multidisciplinary, and skill-oriented education. Effective implementation of these policies is crucial to achieving educational excellence, global competitiveness, and lifelong learning. India's journey demonstrates a continuous effort to integrate tradition with modernity, equity with quality, and knowledge acquisition with skill development, paving the way for an inclusive and globally relevant education system (Government of India, 2020; UNESCO, 2022).

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First and foremost, I am deeply thankful to my project guide/mentor for their invaluable guidance, constant encouragement, and insightful suggestions throughout the course of this study. Their support helped me understand the historical development and modern transformation of the Indian education system.

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Original Article

A Study of Higher Education Problems and Solutions in India: Viksit Bharat @2047

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Abstract

Higher education is central to nation-building, productivity growth, and social mobility. India stands at a demographic crossroads with one of the world's largest youth populations, offering a historic opportunity to transform into a knowledge-driven economy by 2047 under the vision of 'Viksit Bharat'. Despite rapid expansion in the number of institutions and enrolments, the higher education ecosystem continues to face deep structural challenges—uneven quality, faculty shortages, limited research intensity, weak industry linkages, inequitable access, and governance inefficiencies. This paper provides a comprehensive, conference-level analysis of the problems affecting higher education in India and proposes a multi-dimensional reform roadmap aligned with the National Education Policy (NEP) 2020 and long-term development goals.

Using secondary data from government reports, policy documents, global indices, and academic literature, the study evaluates systemic constraints and identifies actionable solutions across financing, governance, curriculum, digital transformation, research and innovation, and inclusion. The paper argues that India's transition to a developed nation by 2047 requires a paradigm shift from input-centric expansion to outcome-driven excellence, with a focus on employability, research productivity, and global competitiveness. It concludes that coordinated reforms, sustained public investment, and stakeholder collaboration can enable India to build a resilient, inclusive, and world-class higher education system.

Keywords: *Higher Education, Viksit Bharat 2047, NEP 2020, Gross Enrolment Ratio, Skill Gap, Digital Learning, Research Ecosystem, Employability, India*

Introduction:

Higher education plays a transformative role in economic development by generating skilled human capital, fostering innovation, and strengthening democratic institutions. India has emerged as one of the largest higher education systems globally, with over 1,100 universities and more than 40,000 colleges. The Gross Enrolment Ratio (GER) in higher education has increased steadily, reflecting improved access. However, expansion has not always translated into quality, equity, or relevance.

The vision of 'Viksit Bharat @2047' seeks to position India as a developed economy characterized by high per capita income, technological leadership, and inclusive growth. Achieving this vision depends heavily on the ability of the higher education system to produce globally competitive graduates, generate cutting-edge research, and support industrial transformation.

The National Education Policy (NEP) 2020 provides a comprehensive framework for reform, emphasizing multidisciplinary education, flexibility, digital integration, and institutional autonomy. However, effective implementation remains a challenge due to systemic constraints. This paper critically examines these issues and presents a roadmap for aligning higher education with national aspirations.

Objectives of the Study

- To examine the structural challenges in India's higher education system.

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- To assess the impact of these challenges on employability and economic growth.
- To analyze policy frameworks such as NEP 2020.
- To propose strategic reforms for improving quality, access, and innovation.
- To align higher education development with the Viksit Bharat @2047 vision.

Research Methodology

This study is based on secondary data collected from:

- Ministry of Education reports
- All India Survey on Higher Education (AISHE)
- UGC publications
- World Bank and UNESCO reports
- Peer-reviewed journals

A descriptive and analytical approach has been used to identify key issues and propose evidence-based solutions.

Current Status of Higher Education in India

India's higher education system has witnessed rapid expansion in recent decades. The GER has improved significantly, and there has been growth in private sector participation. Digital initiatives such as SWAYAM, e-PG Pathshala, and National Digital Library have expanded access to learning resources.

However, international rankings reveal that only a limited number of Indian institutions feature among the world's top universities. Research output, though increasing, lacks global impact. Additionally, regional disparities persist, with rural and backward regions lagging behind urban centres.

Major Problems in Higher Education in India

1. Lack of Quality Education

Quality remains uneven across institutions. Many colleges suffer from outdated pedagogy, insufficient faculty training, and limited academic rigor. Accreditation mechanisms exist but are not uniformly enforced.

2. Faculty Shortage and Capacity Issues

A significant number of teaching positions remain vacant. Existing faculty often face heavy workloads, limiting their ability to engage in research and innovation.

3. Inadequate Infrastructure

Infrastructure gaps—especially in state universities and rural colleges—affect learning outcomes. Laboratories, libraries, and digital connectivity are often insufficient.

4. Skill Gap and Employability

Employers frequently report that graduates lack critical thinking, communication, and practical skills. This mismatch leads to high levels of educated unemployment.

5. Limited Research and Innovation

India's research expenditure as a percentage of GDP remains low compared to developed nations. Collaboration between academia and industry is weak.

6. Inequity in Access

Socio-economic disparities limit access for marginalized groups. Gender gaps and regional inequalities continue to affect participation.

7. Outdated Curriculum

Curricula in many institutions are not aligned with emerging technologies and industry requirements, reducing relevance.

8. Governance and Regulatory Challenges

Over-regulation and fragmented governance structures hinder institutional autonomy and innovation.

9. Brain Drain

A large number of talented students pursue higher education abroad, leading to loss of intellectual capital.

Solutions and Reform Strategies for Viksit Bharat @2047

1. Effective Implementation of NEP 2020

NEP 2020 proposes multidisciplinary universities, flexible curricula, and academic credit banks. Strong monitoring and funding are required for implementation.

2. Enhancing Quality and Accreditation

Strengthening NAAC and NBA accreditation processes can ensure accountability and continuous improvement.

3. Faculty Development

Regular training, better compensation, and research incentives can attract and retain talent in academia.

6.4 Investment in Infrastructure

Public and private investment should focus on modern classrooms, laboratories, and digital infrastructure.

5. Industry-Academia Linkages

Internships, apprenticeships, and collaborative research can bridge the gap between education and employment.

6. Promoting Research and Innovation

Increasing R&D funding, establishing innovation hubs, and supporting startups can enhance research output.

7. Digital Transformation

Integration of AI, online platforms, and blended learning models can improve accessibility and quality.

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8. Inclusive Education Policies

Scholarships, reservation policies, and targeted programs can improve participation of disadvantaged groups.

9. Internationalization

Collaborations with foreign universities and student exchange programs can enhance global exposure.

Role of Technology in Higher Education

Technology is a key enabler for transforming higher education. Digital platforms can democratize access, personalize learning, and improve efficiency. Artificial Intelligence, Big Data, and Virtual Reality can revolutionize teaching and research.

Policy Implications

Policymakers must focus on:

- Increasing education spending to at least 6% of GDP
- Simplifying regulatory frameworks
- Encouraging private sector participation
- Strengthening data-driven decision-making

Conclusion

The transformation of India's higher education system is not merely an educational priority but a national imperative for achieving the vision of Viksit Bharat @2047. As India moves towards becoming a developed economy, the role of higher education must evolve from being a system focused on degree attainment to one that fosters innovation, critical thinking, entrepreneurship, and global competitiveness. The challenges identified in this study—ranging from quality concerns and infrastructure gaps to skill mismatches and inequitable access—highlight the structural limitations that need urgent and sustained attention.

One of the most critical insights from this analysis is that expansion alone cannot ensure progress. While India has made commendable strides in increasing the number of institutions and enrolments, the emphasis must now shift toward enhancing learning outcomes and ensuring that graduates are equipped with relevant, future-ready skills. The persistent gap between academic knowledge and industry requirements continues to hinder employability, underscoring the need for stronger collaboration between academia and industry. Integrating internships, vocational training, and real-world problem-solving into curricula can significantly improve job readiness.

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I would like to express my sincere gratitude to all those who have supported and guided me in the successful completion of my project titled "A Study of Higher Education Problems and Solutions in India: Viksit Bharat @2047."

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Original Article

An Analytical Study of APMC Market Digitalisation for Farmers in Nashik District

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Abstract

Agriculture is a vital part of India's economy, and having efficient marketing systems is key to helping farmers earn more money. the Agricultural Produce Market Committee (APMC) has been the main system for regulating agricultural markets, but it has had some problems like lack of transparency, unfair pricing, and too much control by middlemen. In recent years, digital tools like e-NAM (National Agriculture Market), online bidding, and electronic payments have been introduced to make APMC markets more efficient and transparent. this study looks at how digitalisation has affected APMC markets for farmers in Nashik District. It checks how aware farmers are of digital tools, how much they use them, and what benefits they get. It also looks at the problems they face when adopting these digital tools. The study also checks whether digitalisation has helped farmers get better prices, reduce exploitation, and access better markets. The results aim to help improve digital infrastructure and policy support for better agricultural marketing.

Keywords: *agricultural marketing, E-Nam, APMC's, Nashik District, digitalisation, farmers.*

Introduction:

Agriculture is the foundation of India's economy and supports the livelihood of many people. In Maharashtra, Nashik District is known for producing a lot of agricultural goods, especially onions, grapes, and vegetables. The Agricultural Produce Market Committee (APMC) helps regulate the buying and selling of agricultural products, ensuring fair trade and protecting farmers from unfair treatment. however, traditional APMC markets have faced issues such as lack of transparency, delayed payments, and too much involvement of middlemen.

To fix these problems, the Government of India has launched digital initiatives like e-NAM, digital payment systems, and online trading platforms. These efforts aim to create a single national market, help farmers get better prices, and ensure honest dealings.

In Nashik District, where farming is a major part of the economy, using digital tools in APMC markets could greatly help farmers make more money and improve market efficiency. but the success of these efforts depends on several factors like farmers' knowledge of digital tools, availability of good infrastructure, awareness, and ease of access. This study looks at how well digitalisation is working in APMC markets and its effect on farmers in Nashik District.

Objective

- To study function of APMC markets in Nashik District.
- To study Awareness farmers into the digital initiatives that have been introduced in these markets, like e-NAM, online trading, and using digital payments.
- To evaluate the impact of APMC digitalisation on farmers' income and price realization.
- To Study challenges faced by farmers in using digital systems in APMC market.
- To suggest measures for improving the effectiveness of digitalisation in APMC markets.

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Functioning of APMC Markets in Nashik District

Agricultural Produce Market Committees, or APMCs, are important for managing how agricultural products are sold in India.in Nashik District, which is famous for growing onions, grapes, and other vegetables, APMC markets serve as a main place where farmers sell their crops. The key roles of APMC markets in Nashik are as follows:

1. Trading System - they create a fair and clear system for selling agricultural goods through open auctions, which helps farmers get good prices for their products.

2. Elimination of Middlemen Exploitation - they work to stop middlemen from taking advantage of farmers by offering a structured and organized way to sell produce.

3. Provision of Infrastructure - they offer essential facilities like storage spaces, grading areas, weighing stations, and transportation options, which help keep the quality of the products high.

4. Price Discovery Mechanism - They help figure out market prices through competitive bidding, ensuring prices are based on what the market can bear.

5. Market Information - They provide daily updates on prices and the amount of produce arriving, which allows farmers to make better choices about when and where to sell.

6. Revenue Collection - They collect fees and commissions from the market, which are used to improve and maintain the market facilities.

Awareness of Farmers About Digital Initiatives in APMC Markets

1. e-NAM, or the National Agriculture Market - an online platform that links APMC markets throughout India. It enables farmers to sell their agricultural products to buyers outside their local areas, helping them get better prices for their goods.

2. Online Trading Systems: Certain APMCs in Nashik have introduced online bidding systems, which help cut down on physical crowds and make the buying process more transparent.

3. Digital Payment Systems: Transactions are now done through UPI, bank transfers, and mobile wallets, making payments quicker and more secure, and reducing the need for cash.

Impact of APMC Digitalisation on Farmers' Income and Price Realization

The process of digitizing APMC markets has brought major changes to how agricultural marketing works. Programs like e-NAM, online bidding, and digital payment systems have made transactions more efficient and transparent. In Nashik District, where agricultural trade is very active, these digital changes have had both positive and mixed effects on farmers' incomes.

Impact on Farmers' Income:

1. Better Market Access: Digital platforms such as e-NAM let farmers connect with more buyers than just local markets. **t**his increase in competition usually means farmers can get better prices for their crops.

2. Reduction in Intermediaries: Digitization helps cut down on middlemen, enabling farmers to sell directly to traders or buyers. this allows farmers to keep a bigger portion of the final price.

3.Faster Payments: Digital payment systems ensure that farmers get their money quickly and securely straight into their bank accounts, which improves their cash flow and financial security.

4. Transparency in Transactions: Online trading systems help prevent unfair practices and manipulation, making sure farmers get fair value for their goods

Price Realization:

1. Improved Price Discovery: e-NAM offers instant price updates from various markets, allowing farmers to make smarter choices when selling their produce.

2. Competitive Bidding: Online auctions create a competitive environment, which often results in better prices for farmers than traditional selling methods.

3. Quality-Based Pricing: By using digital grading and setting standards, farmers can get fair prices that reflect the actual quality of their crops.

4. Reduction in Price Fluctuations: Having access to a nationwide market helps keep prices more stable to some degree.

Challenges Faced by Farmers in Using Digital Systems in APMC Markets

1. **Low Digital Literacy:** Many farmers, especially older ones, don't have the skills needed to use smartphones, computers, or online services.

2. **Lack of Awareness**: Farmers often don't know much about the benefits and how to use digital platforms like e-NAM.

3. **Poor Internet Connectivity**: Rural areas in Nashik still have internet problems, which makes it hard to access online services.

4. Dependence on Middlemen: Farmers keep relying on commission agents to sell their crops, which stops them from using digital systems directly.

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5. Technical Issues: Issues like website errors, slow responses, and no technical help make farmers lose confidence.

6. Trust Issues: Some farmers are worried about digital payments and fear fraud or delays in getting money.

7. Language Barriers: Most digital platforms aren't available in local languages, making them hard to use.

Improving the effectiveness of digitalisation in APMC markets.

Digitalisation in APMC markets has the potential to bring big changes to how agricultural products are marketed by making the process more transparent, efficient, and beneficial for farmers. However, to fully benefit from this change, several important steps need to be taken, especially in places like Nashik.

1.Improving Farmers' Understanding of Digital Tools - The government and APMC authorities should conduct regular training sessions, workshops, and awareness programs to teach farmers how to use digital tools such as e-NAM, online trading, and digital payment methods. Extra attention should be given to small farmers and older farmers who may not be very familiar with technology.

2. Strengthening Digital Infrastructure - Good internet, reliable electricity, and access to digital devices are important for digitalisation to work. **t**he government should invest in improving digital facilities in rural areas, including Wi-Fi in APMC yards and villages.

3. Creating Easy-to-Use Digital Platforms - Digital systems should be simple and easy for farmers to use. Platforms like e-NAM should be available in local languages such as Marathi in Nashik, along with clear instructions so farmers don't face difficulty in using them.

4. Support Systems - APMC markets should have help desks or support centers where farmers can get help with using digital tools. trained staff should be available to assist with technical problems right away.

5.Getting Farmers to Participate Directly - Efforts should be made to reduce farmers' reliance on middlemen by encouraging direct registration and participation in digital markets.

Incentives such as lower market fees or bonuses for using digital payment methods can help motivate farmers.

6. Ensuring Safe and Timely Digital Payments - To build trust, digital payment systems must be secure, clear, and fast. **t**he government should ensure there are proper ways to deal with payment issues or fraud.

7.Integrating with Other Agricultural Services - Digital APMC platforms should be linked with other services like crop advice, weather data, storage options, and transportation support.

This will create a complete support system for farmers.

8. Checking and Improving the System - APMC digital efforts should be regularly reviewed to see how well they are working. Farmers' feedback should be gathered and used to make the system better continuously.

9. Working with Private Sector - Partnerships with private technology companies can help develop better, faster, and more innovative digital solutions for APMC markets.

Conclusion

The study finds that APMC markets in Nashik District are very important for selling agricultural products and supporting farmers. The use of digital tools like e-NAM, online trading, and digital payments has made the market process more transparent, efficient, and helped farmers get better prices. Farmers are starting to learn about these tools, but they are not widely used yet because of issues like lack of digital knowledge, poor internet and technology facilities, and farmers still relying on middlemen to sell their goods.

Digital tools have helped farmers by making it easier to reach buyers, get money quickly, and find out better prices. but there is still a long way to go to fully use the benefits of digitalization. To make it work better, farmers need more training, better technology and internet, simpler and easier-to-use platforms, and strong government support. If these things are properly put in place, digital APMC systems can greatly increase farmers' income and improve the overall agricultural marketing system in Nashik District.

Acknowledgment

I would like to express my sincere gratitude to all those who have supported and guided me in the successful completion of my project titled "An Analytical Study of APMC Market Digitalisation for Farmers in Nashik District."

First and foremost, I am deeply thankful to my project guide/mentor for their invaluable guidance, constant encouragement, and insightful suggestions throughout the course of this study. Their support helped me understand the role of digitalisation in improving agricultural marketing systems and farmers' access to market information.

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Original Article

Role of Small-Scale Industries in Employment Generation and Regional Economic Development in Ahilyanagar District, Maharashtra

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Abstract

In this paper, the author analyzes how small-scale industries contribute to employment and economic development of a region, Ahilyanagar district of Maharashtra using only secondary data. The paper integrates district industrial-profile statistics, Census data, district domestic product estimates, and official rainfall records with Udyam-registration figures to estimate the structure, growth and economic importance of the small-scale industrial base in the district (Census of India, 2011; Directorate of Economics and Statistics, 2023; Development Commissioner MSME, 2013; District Industries Centre Ahilyanagar, 2026; Ministry of MSME, 2021). The discussion reveals that the role of small-scale industries in the district has long existed as a labour-absorbing industry between agriculture and the non-farm sector, particularly food processing, machinery, fabricated metals, non-metallic mineral products, chemicals, printing, transport repair and other service-oriented activities (Development Commissioner MSME, 2013). District level evidence shows that in 2011-12 the district recorded 4, 510 registered MSME units and 56, 609 number of jobs in the industrial profile and subsequently the Udyam data of July 2021 records 29,941 registered MSMEs in the district, with most of them micro enterprises (Development Commissioner MSME, 2013; Ministry of MSME, 2021). It is termed in the paper that the developmental significance of such units is not merely in direct employment but also in the spatial dispersion of non-farm employment, backward connection to agricultural activities, the formation of local markets, and the incremental fortification of the district industrial economy (Directorate of Economics and Statistics, 2023; Uma and Anbuselvi, 2023). Simultaneously, the research points to long-term infrastructure, financial, technological, productivity, market accessibility, and climate-sensitive dependability on agro-industrial. The paper concludes that small-scale industries are the key to the balanced regional development at Ahilyanagar and suggests the cluster support, greater credit and digitalization, skill development, better logistics, and sector-specific agro-processing and engineering activities upgrading (Development Commissioner MSME, 2013; Ministry of MSME, 2025).

Keywords: *small-scale industries, MSME, the creation of employment, regional development, Ahilyanagar district, Maharashtra, secondary data.*

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Introduction:

In the Indian economy, small-scale industries are strategically placed since they are relatively low in capital and broader in the scope of the employment they generate, proximity to local resources, spreading of entrepreneurship, and decentralizing the location of industry (Kumari, 2021; Uma & Anbuselvi, 2023; Ministry of MSME, 2025). Small industries development is particularly significant in the districts where agriculture is still the leading source of the poor population, but it is not able to offer stable year-round employment opportunities and over-exposes them to over-reliance on seasonal agriculture (Development Commissioner MSME, 2013; Directorate of Economics and Statistics, 2023).

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The situation in Ahilyanagar district is precisely that due to the fact that it is among the largest districts in terms of area in Maharashtra, a large part of its population is residing in rural areas, there is a high degree of rainfall variability, and both agro-industrial belts, which are irrigated, and some drylands, with weaker agrarian resilience thresholds exist (Census of India, 2011; Development Commissioner MSME, 2013; Ahilyanagar District Administration, 202

The industrial economy of the district has increased historically in interaction with co-operative sugar factories, dairy, engineering activities, agro-processing and market towns like Ahilyanagar, Sangamner, Shrirampur, Kopargaon, Rahuri and other taluka centres (Development Commissioner MSME, 2013). Nevertheless, the larger developmental contribution of small-scale industries in the district is not confined to industrial production. They offer wage employment; the self-employment; subcontracting; repair services; the local supply chain; and urban-rural market connections that influence the overall rural economy (Uma and Anbuselvi, 2023; Ministry of MSME, 2025). This is why it is significant to analyse their contribution on the district level in terms of regional development in a practical geographical context.

It is against this background that the current study explores the role of small-scale industries in creation of employment and regional economic development in Ahilyanagar district basing on the official secondary data. The rainfall graph and a short discussion of the location are also included in the paper due to the definition of climatic variability and the influence of the variability on the agricultural performance, agro-based industry raw-material supply, and the broader non-farm substitution of the district economy (Ahilyanagar District Administration, 2026a; Development Commissioner MSME, 2013).

Review of Literature

The literature on Indian small-scale and MSME development has always been consistent that such ventures play a critical role related to labour absorption, entrepreneurial diffusion, and decentralized industrialization, particularly in the areas where large-scale industry is scarce (Kumari, 2021; Uma and Anbuselvi, 2023).

According to Kumari (2021), small-scale industries have been maintained in the centre stage in India due to their ability to encourage production with comparatively lower capital intensity and create jobs both in rural and urban regions.Uma and Anbuselvi (2023) argue that MSMEs serve as a key source of employment in India and spur inclusive growth, as it results in fewer skilled and semi-skilled workers.

The recent annual reporting of the Ministry of MSME also highlights that the contribution of small industries to development is most pronounced when they are integrated into local production system, agro-processing chains, engineering clusters, and service networks and not isolated (Development Commissioner MSME, 2013; Ministry of MSME, 2025).At the regional level, the literature implies that small industries make the biggest contribution to development when they are part of the local production systems, agro-processing chains, engineering clusters, and networks of service providers (Development Commissioner MSME, 20

The observations apply to Ahilyanagar since the district is a mix of drought-prone areas, agrarian variety, manufacturing locales, and a growing population of micro-enterprises registered, all of which render it an appropriate area to conduct a district-level analysis (Ahilyanagar District Administration, 2026a; Ministry of MSME, 2021).

Objectives and Hypotheses

The Ahilyanagar district which was then the Ahmednagar district is situated in the western Maharashtra and straddles between the upper Godavari basin and the Bhima basin (Development Commissioner MSME, 2013). The industrial profile of the district has an area of 16.67 lakh hectares, and it has a population of 4,543,159 in the Census 2011 with a literacy level of 69.38 per cent and majority of rural settlement (Census of India, 2011; Development Commissioner MSME, 2013). Climate According to the district administration, the climate is usually hot, dry, and drought-prone, with the rainfall distributed unevenly with a relatively high rainfall in the western talukas including Akole and Sangamner compared to most of the eastern and south-eastern regions (Ahilyanagar District Administration, 2026a). This agro-climatic imbalance is topical since it influences the agricultural raw materials, migration of labour and geography of agro-based industries.

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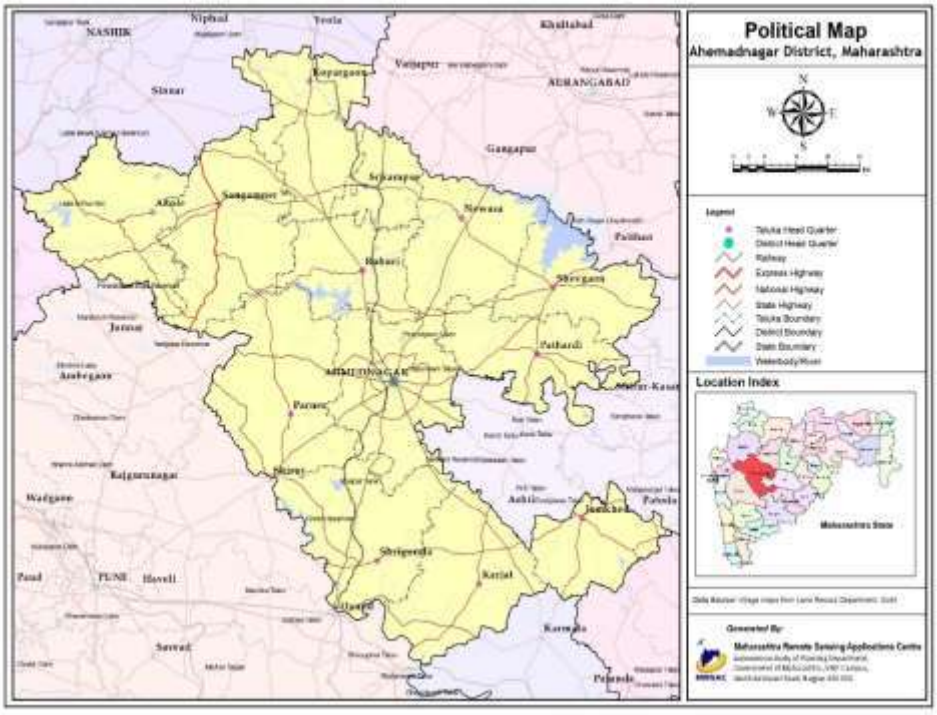

Figure 1. Study area map of Ahilyanagar district (schematic, prepared by the author; adapted from MRSAC district political map and official district location information).

Figurative source note: The district locator and boundary sketch were based on the Maharashtra Remote Sensing Applications Centre political map of the district and the official pages of the district location of Ahilyanagar district administration (Ahilyanagar District Administration, 2026b; MRSAC, n.d.).

Data Sources and Methodology

The entire research is founded on secondary data. The primary sources involved are Census 2011 population statistics of Ahmadnagar district; the Brief industrial profile of Ahmednagar District by the Development Commissioner (MSME); district rainfall statistics published by the Ahilyanagar district administration; district domestic product estimates of Maharashtra published by the directorate of economics and statistics; and district-wise Udyam registration statistics published by the ministry of MSME (Census of India, 2011; Development Commissioner MSME, 2013; Directorate of Economics and statistics, 20

The paper has a descriptive and analytical approach methodologically. The figures at the district level are arranged in the table format, development trends are explained through mere comparisons, and the role of industry is explained in terms of employment, industrial outlay, and overall development of the region (Uma & Anbuselvi, 2023). The rainfall chart that is presented in the paper is merely a locational-context variable and not a causal model of industrial development directly. This is suitable as the industrial geography of the district is still closely related to the agriculture, agro-processing, and drought-sensitive rural demand (Ahilyanagar District Administration, 2026a; Development Commissioner MSME, 2013).

One of the shortcomings of the research is that the accessible district-level data are based on varying periods of time and reporting systems. Based on this, it is necessary to understand the results as a multi-year district profile but not as an annual econometric indicator (Directorate of Economics and Statistics, 2023).

Table 1. Basic socio-economic and industrial profile of Ahilyanagar district

Indicator	**Value**	**Source / year**
Population	4,543,159	Census 2011
Literacy rate	69.38%	Census 2011
Geographical area	16.67 lakh hectares	District industrial profile
Registered MSME units	4,510	District industrial profile, 2011-12

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Employment in registered MSMEs	56,609	District industrial profile, 2011-12
Turnover of MSMEs	Rs. 4,214,329,573	District industrial profile, 2011-12
Export from MSMEs	Rs. 22,645,000	District industrial profile, 2011-12
Udyam-registered MSMEs	29,941	Ministry of MSME, 31 July 2021
Udyam distribution	Micro 29,212; Small 676; Medium 53	Ministry of MSME, 31 July 2021
GDDP at constant prices	Rs. 10,169 crores	2011-12

Source: compiled from Census of India (2011), Development Commissioner MSME (2013), Directorate of Economics and Statistics (2023), and Ministry of MSME (2021).

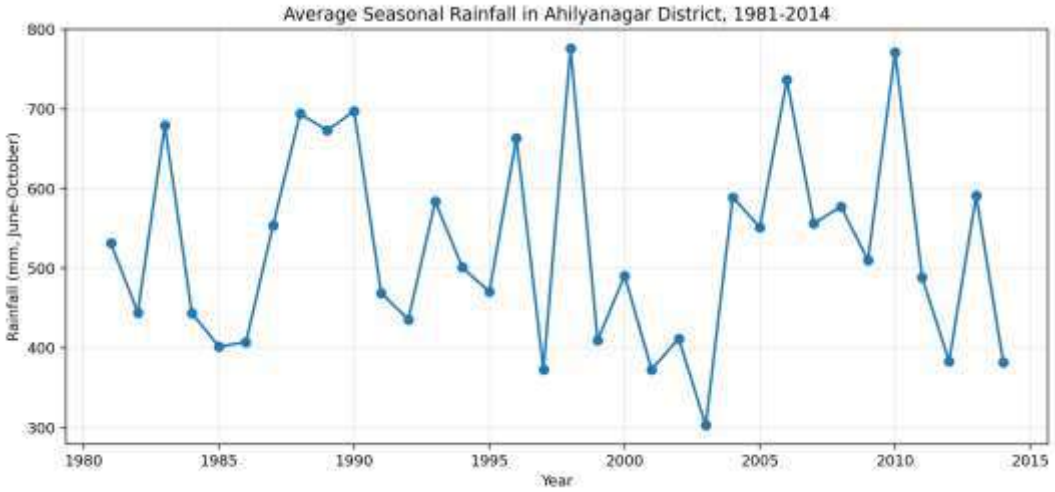

Figure 2. Average seasonal rainfall in Ahilyanagar district, 1981-2014.

Figure note: The source of the figure is official district rainfall tables, 1981-2014. The values of 1990-1999 district averages were calculated by taking the published annual district totals and dividing by the reported number of talukas in the table (Ahilyanagar District Administration, 2026a).

Results and Discussion

1. Growth and structure of small-scale industries

In the district industrial profile, the district had already established a strong base of small-enterprises, with 4,510 registered units of MSMEs in Ahilyanagar in 2011-12, of which 56,609 individuals were reported to have been employed, and the total investment in the profile table recorded was 45,871 lakhs, which implies that the district had already established a significant base of small-enterprises by the early 2010s (Development Commissioner MSME, 2013). It is also indicated in the same source that the industrial structure was dominated by the micro units as small units constituted a very small yet still economically important layer whereas medium units were non-existent. This trend indicates a district economy in which the formation of employment and enterprises relies on numerous small establishments as opposed to several large factories (Development Commissioner MSME, 2013). This conclusion is further supported by the data on the Udyam registration as at 31 July 2021. The formal registration system is overtaken by the preponderance of micro-enterprises, and this shift toward more formal enterprise environment is observable in the numbers of 29,941 registered MSMEs in the district, 29,212 of which were micro units, with only 53 small and 676 medium and large units (Ministry of MSME, 2021).The transition to a more formal enterprise environment should not be interpreted as a set of one-to-one effects, given that registration systems vary, but it does clearly show an expanding and formalizing enterprise ecosystem within the district (Development Commissioner MSME, 2013; Ministry of MSME, 2021).

2. Industrial composition and employment character

The district industrial profile further shows that food products and beverages had 481 enterprises and 4,902 reported jobs, machinery and equipment had 472 enterprises and 6,842 jobs and fabricated metal products had 369 enterprises and 7,512 jobs as major components of the small-enterprise structure (Development Commissioner MSME, 2013). Other non-metallic mineral products also contributed to the 334 enterprises and 7,512 jobs, which means that the construction-related and engineering-related industrial actions play an important role in the district economy (Development Commissioner MSME, 2013).

The importance of this composition on the development of the region is that agro-processing is associated with workshop-based manufacture and

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service-related repair. Geographically, such a structure diffuses the industrial jobs in market towns, roads, and peri-urban clusters instead of having all the jobs concentrated in one metropolitan node (Development Commissioner MSME, 2013; Uma and Anbuselvi, 2023). Small-scale industries therefore have a direct and indirect employment effect. Indirectly, through units of workers, owner-operators, units promote transport, trade, packaging, retail, maintenance, supply of raw materials and local business services (Uma & Anbuselvi, 2023; Ministry of MSME, 2025).

3. Temporal expansion of registered units

The table of trend in DIC depicts that there was a consistent increase in registered units since 2380 after the adjustment of deregistration in 2001-02 to 4510 in 2011-12, whereas reported employment also increased between 29869 to 56609 in the same expansive period (Development Commissioner MSME, 2013). This tendency indicates that the district industrialization did not stand still. Instead, the small-scale industry was slowly gaining increasing role as a labour-absorbing activity in the 2000s. This growth is noteworthy since the district was still heavily agrarian during the same period, and some previous occupational statistics indicate that farming and agricultural labour were still a major labor force (Development Commissioner MSME, 2013). Developmentally, this implies that the small-scale industries were a complimentary sector which did not necessarily replace agriculture, just expanded the economic base of the district. This kind of diversification is one of the main aspects of balanced regional development in semi-arid districts (Directorate of Economics and Statistics, 2023).

4. Link with district economy and regional development

6.4 \related with the district economy and regional development.

The data of 2011-12 District domestic products shows that when the city is taken to a constant price, the gross district domestic product of Ahilyanagar is of 10,169 crore and the industrial component is 9,965 crores in the secondary-sector table, which indicates that non-primary activity in the district economy is a significant part (Directorate of Economics and Statistics, 2023). In as much as district domestic product aggregates are made of several scales of enterprise, they offer a convenient macro-level background to the industrial profile. The fact that both the high district output, and the general prevalence of micro-enterprise, have been conducive to the growth of regional development in Ahilyanagar hints at the idea that both the organized and the dispersed industrial activity have facilitated the process (Directorate of Economics and Statistics, 2023; Development Commissioner MSME, 2013).

The contribution of small-scale industries to regional-development can be conceptualized in at least five ways: first, in terms of employment generation; second, in terms of incomes diversification beyond agriculture; third, in terms of strengthening local markets and services functions; fourth, in terms of creating backward and forward linkages with farming, construction, and transport; and fifth, in terms of supporting smaller urban centres and taluka headquarters in terms of their presence in the economy (Development Commissioner MSME, 2013; Kumari, 2021; Uma and An Agro-processing and engineering facilities might be more suitably located in areas that are more agricultural and better connected, whereas micro-enterprises, repair work, and local services might be the alternative livelihood systems in drought-prone areas (Ahilyanagar District Administration, 2026; Development Commissioner MSME, 2013).

5. Rainfall variability as locational context

The rainfall graph shows that the Ahilyanagar district has had significant inter-annual variability, and seasonal averages are ranging between approximately 303 mm in 2003 to greater than 770 mm in 2010 according to the official series used here (Ahilyanagar District Administration, 2026a).The variability is significant to small-scale industries due to the fact that a high proportion of the enterprise base in the district is related to agriculture, food processing, rural demand, and transportation of farm related products. The years of poor rainfall can decrease the income of crops, market demand, and flow of raw-material, and the years of good rainfall may enhance the local purchasing power and agro-industrial throughput (Ahilyanagar District Administration, 2026a; Development Commissioner MSME, 2013). Rainfall therefore does not dictate the growth of industries in a mechanical way, but it creates the environment of development of the district. In this determination, the industrial geography of Ahilyanagar can be perceived concerning its economic system as well as its climatic uncertainty (Ahilyanagar District Administration, 2026a).

6. Major constraints

Even the district industrial profile reports about generalized problems related to industrial development, and the general literature on MSMEs reports that there are obstacles to the development, like limited access to credit, technology shortages, infrastructure bottlenecks, marketing constraints, and quality-certification challenges (Development Commissioner MSME, 2013; Ministry of MSME,

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2025). In the case of Ahilyanagar, these are compounded by the issue of spatial unevenness. The potential of industrial development is not as one district-wide since the supports and requirements of transport, irrigation, town-based demands, and ecosystems of entrepreneurs are sharply different in every taluka (Development Commissioner MSME, 2013; Ahilyanagar District Administration, 2026a). A structural challenge of scale is also an issue that microenterprises are encountering. According to the 2021 Udyam distribution, micro units predominantly constitute the industrial base of the district, which is good to business and employment decentralization but can also reflect a low productivity level, poor technology adoption, and susceptibility to market shocks unless the support systems are reinforced (Ministry of MSME, 2021; Ministry of MSME, 2025).

Policy Suggestions

1. The agro-processing, machinery, fabricated metal products and building construction-material activities should be consolidated in the cluster development as these areas already demonstrate the presence of the district level and opportunities of employment (Development Commissioner MSME, 2013).
2. Micro units should be further provided with district-level credit similarity, digital bookkeeping, market connection, and quality certification services to ensure that more businesses can grow to become sustainable small units (Ministry of MSME, 2025).
3. These industrial promotions should have spatial differentiation. Agro-industry and engineering have higher values and can be supported by irrigated and market-connecting belts, drier talukas are in need of heavier support of repair service, rural manufacturing, and enterprise incubation (Ahilyanagar District Administration, 2026a; Development Commissioner MSME, 2013).
4. The local industrial composition should be combined with skill development, in particular food processing, working with machines, fabrication, electricity repairs, packaging, and maintenance work (Ministry of MSME, 2025).
5. Small-scale industries should explicitly be seen as an instrument of balanced development and not just a residual or informal industry since their impact on employment and town-based growth is significant in a cumulative manner (Uma & Anbuselvi, 2023).

Conclusion

This research validates that small-scale industries have significantly contributed to the creation of employment and economic growth of the region in Ahilyanagar district. According to official data on the industrial activities of the district, a significant number of registered units and jobs are observed at the end of 2011-12, but subsequent Udyam data indicates the further growth and formalized visibility of the enterprise structure in the district, which is dominated by micro units (Development Commissioner MSME, 2013; Ministry of MSME, 2021). Agronomic, engineering, mineral, chemical, printing, and repair-oriented industries are seen to be a mix of industrial makeup of the district which contribute to the diversification of the economy outside the field of agriculture (Development Commissioner MSME, 2013). Employment, entrepreneurship, local market creation, and strengthening of secondary and tertiary operations in taluka centres and transport corridors contribute to the enhancement of the regional development in the district (Directorate of Economics and Statistics, 2023; Uma and Anbuselvi, 2023). Due to the climatic inequality and being also drought prone, the policy support of small industries must be territorially responsive and must be concentrated on infrastructure, credit, skill formation, digitalization and cluster-based upgrading. Small-scale industries are not a peripheral element to the development of a district such as Ahilyanagar; they are one of the primary mechanisms with the help of which the creation of a more stable and balanced regional economy is possible.

Acknowledgment

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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Original Article

E-Commerce and Digital Transformation: An Analysis of Business Development and Difficulties

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Abstract

The mutually beneficial relationship between digital transformation and e-commerce has become a crucial element of business advancement in today's evolving commercial landscape. The internet has facilitated e-commerce, enabling the buying and selling of products and services across geographical boundaries and reshaping traditional business models. Digital transformation, which involves incorporating digital technologies into all areas of business operations, serves as a strategic approach to the digital era. This study thoroughly explores the interconnected areas of digital transformation and e-commerce, highlighting evolving trends, persistent challenges, and substantial impacts. By examining consumer behavior within the context of digital transformation, we emphasize the shift toward personalized interactions and omni-channel experiences. We illustrate fective transformation examples and their outcomes through industry case studies.

E-commerce and digital transformation have changed how modern businesses operate. As e-commerce has grown, using technology smartly in digital transformation has changed the way companies work. This research helps us understand how much e-commerce and digital transformation have affected businesses and society. It also gives guidance to important people on how to use technology well in a fast-changing business world. Our study shows the benefits of digital transformation, like doing things faster, reaching more customers, and providing better service. We also offer useful tips for businesses as they face these changes

Keywords: *consumer experiences, digital transformation, e-commerce, and modern commerce*

Introduction:

The electronic buying and selling of products and services over the internet, known as e-commerce, has become a major component of modern business. Its unmatched accessibility and ease have transformed consumer habits, business practices, and global markets. However, the growth of e-commerce is closely tied to the broader concept of digital transformation. Digital transformation refers to the integration of digital technologies into various aspects of business operations and strategy, leading to significant changes in how companies operate and deliver value. It involves adopting new technologies, streamlining processes, and rethinking traditional approaches. In today's business landscape, the topics of e-commerce and digital transformation are of great importance. As digital technologies continue to shape the market, businesses must adapt or face obsolescence. E-commerce has fundamentally altered how goods and services are exchanged across borders, while digital transformation has reshaped internal operations.

It has enabled greater consumer engagement, data-informed decision-making, and streamlined processes. Understanding the connection between e-commerce and digital transformation is essential for maintaining competitiveness, fostering innovation, and meeting evolving customer expectations as businesses transition from traditional to digital commerce. In today's business landscape, the subjects of e-commerce and digital transformation are of great significance. Businesses must navigate an environment where traditional models are rapidly evolving due to the widespread influence of technology across all aspects of commerce.

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The digital revolution has enabled e-commerce, disrupted traditional retail models and transformed how products are bought, sold, and utilized. Digital technologies integrated into operations and customer engagement have reshaped business strategies, competitive dynamics, and market behaviors. In today's globalized world, e-commerce effortlessly connects businesses with customers across geographical boundaries. As the world moves swiftly towards a more digital future, understanding how digital transformation fuels e-commerce growth is crucial to maintaining innovation, staying relevant, and achieving long-term success in an increasingly interconnected and technology-driven corporate environment. The study concludes by highlighting future research directions and potential areas for exploration in the rapidly evolving fields of digital transformation and e-commerce. The presented framework offers a comprehensive analysis of the interactions between these two dynamic areas, enhancing understanding of their significance and impacts.

Objective:

- The purpose of this study is to thoroughly examine the complex relationship between digital transformation and e-commerce.
- This study seeks to identify emerging trends in e-commerce, the challenges they bring, and their wider impact on businesses and society.
- Furthermore, the study aims to offer practical guidance and valuable insights for companies operating in this rapidly changing environment**.**

Transformation Trends in Digital Business and E-Commerce

E-commerce has grown rapidly because of digital transformation, which means using new technologies in how businesses operate. This change is changing the way companies work, connect with customers, and provide value. One big trend is mobile commerce, or m-commerce, because more people are using smartphones and apps to look for and buy things. Because of this, businesses are making websites and apps that are friendly for mobile devices to make shopping easier and more enjoyable for customers.

Another important trend is the use of Artificial Intelligence (AI) and machine learning. These tools help companies understand customer behavior, offer personalized suggestions, and improve customer service using chatbots and virtual assistants. Personalization has become very important for keeping customers happy and increasing sales.

Digital payment systems are also a major development in e-commerce. Payment methods like UPI, mobile wallets, and online banking have made shopping faster, safer, and more convenient. This shift toward cashless transactions is helping online shopping grow, especially in developing countries. Social media is changing how businesses promote and sell their products. Platforms like Instagram and Facebook are now used not just for advertising but also for direct sales, allowing businesses to reach more people and interact with customers more effectively. Omnichannel retailing is becoming more important.

Companies are combining online and in-store shopping to give a smoother experience. Customers can look at products online and buy them in-store, or do the opposite, making shopping more flexible and convenient. Cloud computing has helped speed up digital transformation. Cloud technology allows businesses to store a lot of data, work more efficiently, and scale their services based on demand without needing expensive physical infrastructure.

Big data and analytics are important for understanding what customers want and what trends are happening in the market. Companies use these insights to make smart decisions, adjust their pricing, and improve their products. Another new trend is better logistics and delivery systems. Options like same-day or next-day delivery have become standard, helping companies stay competitive and satisfy customers. As online shopping grows, so does the need for strong cybersecurity and data protection. Companies are spending more on secure systems to keep customer information safe and build trust. Finally, voice and visual search technologies are changing how people find products. Voice assistants and image-based search tools make shopping easier and improve the overall experience.

Function of Emerging Digital Technologies

Emerging technologies are crucial in transforming the e-commerce sector by enhancing operational efficiency, enriching customer experience, and promoting innovation. These advancements help businesses adapt to the rapidly evolving digital environment and sustain their position in the global market. Artificial Intelligence (AI) is a major driver in this transformation.AI allows businesses to analyze vast customer data, gain insights into consumer behavior, and provide personalized recommendations through chatbots. This leads to better-informed decisions and improved customer satisfaction.

Big Data and Analytics are also vital as they enable organizations to collect, process, and interpret large volumes of data. By leveraging these insights, companies can identify market trends,

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anticipate customer demand, and refine pricing strategies. This data-centric approach enhances operational efficiency and enhances profitability.

Cloud Computing is another key technology that enables businesses to store and manage data over the internet instead of relying on physical infrastructure. It offers flexibility, scalability, and cost benefits, allowing even small enterprises to participate in e-commerce effectively. Blockchain is increasingly recognized as a trustworthy method for transaction processing.

It ensures transparency, reduces the risk of fraud, and builds customer trust through a secure, decentralized system that is tamper-proof. The Internet of Things (IoT) is playing a growing role in e-commerce. IoT devices assist with inventory management, supply chain tracking, and real-time monitoring of goods, thereby improving operational effectiveness.

Augmented Reality (AR) and Virtual Reality (VR) are enhancing the online shopping experience by allowing customers to visualize products before making a purchase. For instance, customers can virtually try on clothes or see how furniture would fit in their home.

Automation and Robotics are reshaping warehouse and logistics operations. Automated systems expedite order processing, minimize errors, and ensure faster, more reliable deliveries. In addition, Digital Payment Technologies such as UPI, mobile wallets, and contactless payments have simplified and secured online transactions. These technologies enhance the convenience and safety of e-commerce.

Problems and Difficulties

Even though e-commerce is growing quickly and more businesses are moving online, they still face many problems that can stop them from doing well and staying around for the long term. These problems come from different areas such as technology, how the company is run, money, and social factors. One big problem is keeping online information safe and private. As more people shop online, businesses are more likely to face hacking, data leaks, and fake activities. It's very important to protect customer details, and if they don't, customers might lose trust and there could be legal issues.

Another big challenge is the cost of getting new technology. Using advanced tools like AI, cloud systems, and automation needs a lot of money. This can be especially tough for small and medium-sized companies, which might not have the resources to match bigger companies in terms of tech.

Not having enough digital skills is also a big issue. Both workers and business owners might not know how to use digital tools properly. This lack of knowledge can slow down the process of becoming more digital. In some places, especially in areas that are still developing, there are not enough resources. Poor internet, not enough digital devices, and weak delivery systems can make it harder to grow online businesses. Some businesses also resist changing. They might not want to use new technology because they're worried about risks or don't understand how it works. This can stop them from improving and growing.

Logistics and supply chain problems also affect how well e-commerce works. Things like late deliveries, expensive shipping, and trouble with inventory can make customers unhappy and lower business results. There are also legal and rule issues. Since different countries have different laws about online shopping, taxes, and data protection, it's hard for businesses to operate smoothly around the world. Lastly, keeping customers happy and trustworthy is very important. Things like product quality, return options, and the chance of online fraud can all make customers less likely to buy online.

E-commerce and digital transformation have driven substantial growth and innovation in the business sector. However, these advancements come with several challenges that can disrupt operational efficiency and long-term business viability. One major issue is the concern over security and privacy. As online transactions become more prevalent, so do the risks of cyberattacks, hacking, and data breaches. This leads to customer reluctance in sharing personal and financial details, which can erode trust in e-commerce platforms.

Another significant challenge is the high cost of implementing advanced technologies such as artificial intelligence, cloud computing, and automation. These require significant financial investment, making it difficult for small businesses to keep up, thus widening the gap between large and small enterprises. Technical problems and system failures are also common. Website crashes, payment errors, and software malfunctions can harm the customer experience and lead to lost sales. Therefore, maintaining a dependable and efficient digital infrastructure is crucial. A lack of digital skills and awareness among both employees and consumers presents another obstacle. Many individuals are not well-versed in digital tools and platforms, which hinders the adoption and growth of e-commerce.

In addition, logistics and delivery issues can negatively affect customer satisfaction. Delays, high shipping costs, and inventory management

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difficulties can lower the efficiency of e-commerce operations. Regulatory and legal challenges also create obstacles. Varying rules on taxation, consumer protection, and data privacy across countries complicate cross-border business operations.

Influence on Consumer Behaviour

E-commerce and digital transformation have had a big impact on how customers behave, changing the way they look for, evaluate, and buy products. As digital technology has improved, customers have become more informed, confident, and careful in their choices. One clear change is the growing love for online shopping. Customers now find it easy to look through and buy things from home, which saves them time and effort. This trend has reduced their dependence on physical stores. Another big change is the ability of customers to make better-informed decisions. With easy access to product details, reviews, and price comparisons online, they can make smarter and more thoughtful choices.

Personalization has also played a big role in changing customer behavior. E-commerce platforms use data and AI to suggest products based on individual preferences and past purchases. This customized approach makes the shopping experience better, increasing satisfaction and loyalty. Social media has become a major influence on how customers make decisions. People are often influenced by online ads, influencer promotions, and feedback from others on platforms like Instagram and Facebook. The idea that others approve of a product is a big factor in their buying decisions Digital transformation has also raised customer expectations about speed and convenience. Now, customers expect fast delivery, easy-to-use websites, and simple payment options. Features like same-day delivery and one-click purchasing have set new standards.

The use of cashless and digital payment methods has also changed customer habits. People now prefer fast and secure options such as UPI, mobile wallets, and credit or debit cards, which has led to less use of physical money. Another key development is the rise of multi-channel shopping.

Customers interact with businesses through different platforms, including websites, apps, and physical stores, and they expect a smooth and consistent experience across all these channels. Despite these positive changes, there are also worries about trust and security. Customers are cautious about sharing their personal information online and tend to choose platforms that offer strong data protection and reliable services. Digital transformation has changed how customers buy things and also how they think about shopping, compare prices, and interact with brands. One big change is that more people are buying things on a whim. They are more likely to make sudden purchases because of eye-catching online ads, short-term sales, and offers that push them to decide quickly.

Another major change is that customers are more aware of prices and often check different websites before buying. This makes them more careful with their money and less loyal to one brand unless they feel they're getting something extra. The ability to shop anytime has also influenced customer behavior. Unlike stores that are only open at certain times, online shops are available 24/7. This constant access has led to more shopping happening throughout the day. Also, customer reviews and ratings play a big role in buying decisions. Many people look at what others have said about a product before making a purchase. Good reviews help build trust and make people more likely to buy, while bad reviews can stop someone from buying.

Impact on Business Operations

E-commerce and the move towards digital transformation have really changed how businesses work, making them more efficient, flexible, and effective overall. Using digital technologies in business processes has helped companies make their operations smoother, reduce costs, and boost productivity. One of the biggest changes is the automation of business tasks. Tools like artificial intelligence, machine learning, and robotics help with everyday activities such as processing orders, managing stock, and handling customer service. This cuts down on errors and makes the whole process more efficient.

Another key change is the improvement in how supply chains are managed. Digital tools let businesses track goods in real time, predict customer demand more accurately, and control inventory better. This helps avoid delays, cut costs, and make sure products reach customers on time. Making decisions based on data is also a big change. Companies now use big data and analytics to understand market trends, customer preferences, and how well their business is doing. This leads to smarter, more strategic decisions.

Cloud computing has also changed how businesses operate by offering more flexibility and the ability to adjust operations as needed. Companies can store and access data from anywhere, work together more easily, and grow without having to buy a lot of physical equipment. E-commerce has also helped businesses expand globally. Companies can now reach customers all

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over the world without needing a physical store, which opens up more market opportunities and increases potential revenue.

Another important change is better customer service. Digital platforms allow for faster communication, 24/7 support through chatbots, and more efficient handling of customer questions, which leads to higher satisfaction. However, there are also some challenges. Cybersecurity threats, the need for regular system updates, and the requirement for ongoing maintenance are all issues businesses must deal with. Companies need to invest in secure systems and hire skilled workers to manage these problems effectively.

Future Scope and Research Opportunities

E-commerce and digital transformation are fields that are always evolving, offering many new opportunities for research and development. As technology advances quickly, both researchers and companies need to explore new areas to stay up-to-date with the latest trends and improve the systems they use. One major area to watch is the increasing use of Artificial Intelligence (AI) and automation.

Future studies can focus on how AI can help personalize customer experiences, improve customer service, and support better decision-making. It's also important to research how AI is used in an ethical way and what impact it has on jobs. Another big area is the growing use of blockchain technology in e-commerce. Researchers can study how blockchain can make online transactions more transparent and secure, and how it can be used to manage supply chains more efficiently.

The development of Augmented Reality (AR) and Virtual Reality (VR) is opening up new ways to enhance the online shopping experience. Future research could look into how these technologies affect customer satisfaction and buying habits. Sustainability is becoming a bigger concern in e-commerce. Researchers might focus on eco-friendly packaging, ways to reduce carbon footprints in delivery, and promoting sustainable business practices. The growth of cross-border e-commerce is also opening up new research topics.
Studies could examine the challenges of international trade laws, taxes, and differences in how people from different cultures shop online. Cybersecurity and data privacy are also important areas. As more people use digital services, there's a need for better security measures. Future research could explore new ways to protect user information and prevent cyber-attacks. The impact of 5G and faster internet connections is another promising area. Research could look at how better internet speeds improve user experience, enable real-time transactions, and support the growth of mobile commerce.

Finally, making e-commerce accessible to everyone is an important topic. Research could focus on how to ensure that online shopping platforms are usable by people in rural areas, older adults, another key area of study is data ethics and consumer privacy. As companies collect more personal information, there's a bigger need to find a good balance between providing tailored services and keeping people's privacy safe. Researchers can look into the ethical rules and new policies that come up in this field.

Digital tools are becoming more important for rural areas and small businesses, especially in countries like India. Studies can look at how online platforms help small businesses grow and support local economies.AI-generated content and chatbots are playing a bigger role in marketing and customer support. Future research might compare how well these technologies work against traditional human methods. Fintech is also growing quickly in e-commerce. New services like Buy Now Pay Later (BNPL) and digital loans are changing how people spend money. Researchers can examine the financial risks linked to these trends and how they influence consumer behavior those with low digital skills**.**

Methodology

This research paper uses a descriptive and analytical approach to study the relationship between e-commerce and digital transformation. It also looks into the current trends, challenges, and wider effects of these developments. The study uses secondary data, which is collected from various sources like academic articles, journals, books, websites, and government reports. These sources provide accurate and relevant information that supports the analysis. The research follows a qualitative method, which means the data is carefully examined and interpreted to find patterns, changes, and the impact of e-commerce. This method helps in gaining a deep understanding of the topic by using existing information and conducting detailed analysis.

In short, e-commerce and digital transformation have really changed how businesses work these days. By using modern digital tools, companies can run their operations more easily, and the way customers interact with brands, shop, and choose products has also changed. The quick growth of mobile shopping, online payments, artificial intelligence, and data analysis has created new opportunities for businesses to grow and come up with new ideas.

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The research shows that new technologies are important for making business processes more efficient, offering better personalized experiences, and improving customer satisfaction. However, businesses also face several challenges, like the risk of cyberattacks, the cost of setting up digital systems, a lack of skilled workers in digital fields, and limitations in current infrastructure. Overcoming these issues is crucial for long-term success in the digital world. Additionally, digital transformation has greatly influenced how customers behave.

Today's consumers are more informed, value convenience, and depend a lot on technology. They now expect faster service, secure payment options, and customized experiences, which has made competition among businesses even tougher.

The study also highlights that the future of e-commerce relies on continuous innovation, adopting new technologies, and focusing on customer-centric strategies. Areas like artificial intelligence, blockchain, augmented and virtual reality, and sustainable practices offer exciting opportunities for growth and further exploration. Overall, companies that effectively adopt digital transformation and remain adaptable to market changes are more likely to succeed in the global business environment.

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Original Article

Classroom to Startup: Role of Universities in Research and Innovation in India

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Abstract

In the contemporary knowledge-based economy, universities are no longer confined to the traditional roles of teaching and knowledge dissemination. Higher education institutions have increasingly become centers of innovation, research, and entrepreneurship. In India, the rapid expansion of the startup ecosystem has highlighted the importance of universities in nurturing innovative ideas and transforming them into viable business ventures. Universities provide an environment where students and researchers can develop creative solutions to societal and technological challenges through research activities, innovation laboratories, and incubation centers. The present research paper examines the role of universities in promoting startups, research, and innovation in India. It explores how higher education institutions facilitate entrepreneurial development through research support, incubation infrastructure, industry collaboration, and entrepreneurship education. Universities contribute significantly to the development of startup culture by encouraging students to convert academic knowledge and research outputs into innovative products and services. The study is based on descriptive research methodology and uses secondary data collected from government reports, academic journals, policy documents, and institutional publications. The analysis focuses on the development of university incubation centers, research initiatives, and government policies such as Startup India, Atal Innovation Mission, and National Education Policy 2020 that promote entrepreneurship in higher education institutions. The findings indicate that universities play a crucial role in building the startup ecosystem by providing mentorship, funding support, and innovation infrastructure. However, challenges such as limited research funding, inadequate industry collaboration, and lack of entrepreneurial training remain significant barriers. The study concludes that strengthening university-industry partnerships, increasing research funding, and integrating entrepreneurship education into university curricula can significantly enhance innovation-driven startup development in India. Universities have the potential to become powerful engines of economic growth, employment generation, and technological advancement.

Keywords: *Higher Education, Innovation, Startups, Entrepreneurship, Research, Incubation Centres*

Introduction:

Higher education institutions play a vital role in the intellectual, social, and economic development of a country. Traditionally, universities have been regarded as centers of learning where knowledge is generated and disseminated through teaching and research. However, the role of universities has evolved significantly in the modern knowledge-based economy. Today, universities are expected to contribute not only to education but also to innovation, entrepreneurship, and economic development. In recent years, India has emerged as one of the largest startup ecosystems in the world. According to government statistics, thousands of startups are registered every year in sectors such as technology, healthcare, education, and manufacturing.

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Government initiatives such as Startup India, Digital India, make in India, and Atal Innovation Mission have played a crucial role in promoting entrepreneurship across the country.

Universities have become important institutions in supporting startup development. They provide intellectual resources, research infrastructure, and mentorship that help students transform innovative ideas into successful startups. Incubation centres established in universities provide technical guidance, business support, and networking opportunities to young entrepreneurs.

The transformation from classroom learning to startup creation represents a significant shift in the traditional education model. Universities now emphasize experiential learning, innovation labs, and entrepreneurship development programs that encourage students to apply theoretical knowledge to real-world challenges. This approach enhances students' creativity, problem-solving ability, and entrepreneurial skills. Research activities are also essential for innovation. Universities generate new knowledge through research projects that can lead to technological advancements. When these innovations are commercialized through startups, they contribute significantly to economic growth and job creation.

Despite these developments, several challenges remain in the Indian higher education system. Limited research funding, inadequate infrastructure, and weak collaboration between academia and industry restrict the potential of universities to fully support startup development. Therefore, it is important to examine the role of universities in promoting startups, research, and innovation in India.

Review of Literature

Several researchers have studied the relationship between higher education, innovation, and entrepreneurship.

- **Agarwal (2009)** emphasized that higher education institutions play a crucial role in the development of knowledge economies by promoting research and innovation.
- **Altbach (2015)** highlighted that universities across the world are increasingly contributing to economic development by supporting technological innovation and entrepreneurial activities.
- **Gupta (2016)** examined the role of innovation and entrepreneurship programs in Indian universities and found that such initiatives significantly improve students' entrepreneurial capabilities.
- **Jain (2019)** studied university incubation centres in India and concluded that incubation support is essential for transforming innovative ideas into startups.
- **Tilak (2012)** emphasized that higher education contributes to economic development through research, human capital formation, and technological innovation.
- **Sharma (2020)** pointed out that entrepreneurship education in universities helps students develop business skills and encourages them to start their own ventures.
- **Patil (2019)** observed that universities with strong research infrastructure and industry collaboration tend to produce more successful startups.

Overall, previous studies indicate that universities play a critical role in promoting innovation and entrepreneurship. However, the effectiveness of these initiatives depends on institutional support, research funding, and collaboration with industries.

Problems of the Study

1. Lack of effective linkage between classroom learning and startup development.
2. Limited research infrastructure in several universities.
3. Insufficient financial support for startup incubation.
4. Weak collaboration between universities and industries.
5. Lack of entrepreneurship education in traditional academic curricula.

Objectives of the Study

1. To examine the role of universities in promoting startup development in India.
2. To analyze the contribution of higher education institutions to research and innovation.
3. To study the growth of incubation centres in universities.
4. To identify challenges faced by universities in developing startup ecosystems.
5. To suggest measures for strengthening innovation and entrepreneurship in higher education.

Scope of the Study

The present study focuses on the role of universities in promoting startups, research, and innovation in India. It covers university initiatives such as incubation centres, innovation laboratories, entrepreneurship development programs, and research collaborations that contribute to startup development.

Limitations of the Study

1. The study is mainly based on secondary data.
2. Limited statistical data on university startups is available.

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3. The study focuses primarily on Indian higher education institutions.

Data Collection

The research is based on secondary data, collected from:

1. Government reports
2. Research journals
3. Academic books
4. University websites
5. Startup ecosystem reports

Research Methodology

The study adopts descriptive research design. Secondary data was collected from various academic sources and analyzed using descriptive statistical methods. The methodology includes literature review, data interpretation, and comparative analysis.

Statistical Tools Used

The following statistical tools were used:

1. Percentage analysis
2. Comparative analysis
3. Descriptive statistics

Data Analysis and Interpretation

Table 1: Growth of Startups in India

Year	Number of Startups
2016	4500
2018	7200
2020	12000
2022	16000
2023	18000

The data indicates significant growth in startup activity in India during the last decade.

Table 2: University Incubation Centers

Year	Incubation Centers
2016	50
2018	95
2020	160
2022	240
2023	275

The growth of incubation centers indicates increasing emphasis on entrepreneurship in universities.

Results and Discussion

The analysis shows that universities are increasingly becoming centers of innovation and entrepreneurship. Incubation centres established in universities provide infrastructure, mentorship, and funding support for student startups.

Research activities in universities contribute significantly to innovation. When research outcomes are commercialized through startups, they generate employment opportunities and technological advancement. However, universities face challenges such as limited research funding and weak industry collaboration. Addressing these challenges is essential for strengthening the startup ecosystem in higher education institutions.

Conclusion

Universities play a crucial role in transforming academic knowledge into innovative startups. By promoting research, innovation, and entrepreneurship, higher education institutions contribute to economic development and technological advancement.

Recommendations

1. Universities should establish more incubation centres.
2. Entrepreneurship education should be integrated into university curricula.
3. Government should increase research funding.
4. Strong university-industry collaboration should be promoted.
5. Universities should encourage commercialization of research.

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I would like to express my sincere gratitude to all those who have supported and guided me in the successful completion of my project titled "Classroom to Startup: Role of Universities in Research and Innovation in India."

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Conflicts of interest

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Original Article

Impact of Digital Agriculture on Crop Productivity: A Statistical Analysis of Maharashtra Farmers

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Abstract

This study examines the relationship between digital agriculture practices and crop productivity among farmers in selected districts of Western Maharashtra, namely Pune, Satara, Sangli, Kolhapur, and Solapur. The analysis is based on primary data collected from 125 farmers using a structured interview schedule. A stratified sampling approach was adopted to ensure representation of both digitally engaged and non-digital farmers across different agro-economic conditions.

The study constructs a digital adoption index by incorporating variables such as use of mobile-based advisory services, internet access, and exposure to precision farming tools. Crop productivity is measured in terms of yield per hectare for major crops cultivated in the region. Comparative and statistical methods, including mean analysis and t-test, are employed to assess differences between the two groups.

The findings indicate that farmers with higher levels of digital engagement tend to achieve better crop productivity; however, the extent of improvement varies across districts and is influenced by factors such as irrigation access, farm size, and input use. In several cases, digital usage remains limited to basic communication tools, which restricts its potential impact on productivity. The results suggest that while digital agriculture has the capacity to enhance farm outcomes, its effectiveness depends on the depth of adoption rather than mere access to technology.

The study highlights the need for targeted interventions focusing on digital literacy, affordable access to advanced tools, and region-specific advisory systems. Without addressing these structural constraints, the benefits of digital agriculture are likely to remain uneven and concentrated among a smaller section of farmers.

Keywords: *Digital Agriculture, Crop Productivity, Digital Adoption Index, Precision Farming, ICT in Agriculture, Western Maharashtra, Farmer Survey, Yield Analysis, Stratified Sampling, Smallholder Farmers, Irrigation Influence, Agricultural Efficiency, Rural Technology Adoption, Farm Output Variation, Statistical Analysis*

Introduction:

Agriculture in Maharashtra continues to operate under conditions of uncertainty driven by irregular rainfall, rising input costs, and fragmented landholdings. In such a context, improving crop productivity is not merely a function of increasing inputs but of enhancing decision-making at the farm level. Over the last decade, digital technologies have begun to enter the agricultural landscape, offering tools that claim to support farmers with timely information, resource optimization, and better market access. However, the actual extent to which these technologies translate into measurable improvements in productivity remains uneven and insufficiently examined at the field level.

This study focuses on five districts of Western Maharashtra—Pune, Satara, Sangli, Kolhapur, and Solapur—which together present a diverse agricultural profile. While districts like Pune and Kolhapur exhibit relatively higher irrigation coverage and technological exposure, regions such as Solapur face frequent water stress and variability in crop outcomes.

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Similarly, Sangli and Satara represent mixed farming systems where both traditional practices and modern inputs coexist. This variation provides an appropriate setting to examine whether digital agriculture has a consistent or context-dependent impact on crop productivity.

The growing presence of mobile-based advisory services, internet-enabled weather information, and early-stage precision technologies has created a perception that digital agriculture can address long-standing inefficiencies in farming. Yet, in practice, adoption often remains partial, with many farmers limiting their use of digital tools to basic communication rather than integrating them into production decisions. This gap between access and effective use raises an important empirical question: does digital engagement at the farm level lead to a tangible increase in crop productivity, or does it remain superficial without significant economic outcomes?

To address this, the present study is based on primary data collected from 125 farmers across the selected districts using a structured interview approach. By distinguishing between varying levels of digital engagement and comparing corresponding yield outcomes, the study attempts to move beyond broad claims and provide evidence grounded in actual farming conditions. The analysis takes into account not only digital factors but also other influencing variables such as irrigation, landholding size, and input use, which often interact with technology adoption.

Rather than assuming uniform benefits, this study approaches digital agriculture as a variable process shaped by regional conditions and farmer capacity. The objective is not only to measure its impact on productivity but also to identify the limits within which it operates in the selected districts of Maharashtra.

Literature Review

The growing discourse on digital agriculture has largely focused on its potential to improve farm-level efficiency and productivity through better information flow and resource management. Early studies on information and communication technologies (ICTs) in agriculture highlighted that timely access to weather forecasts, market prices, and agronomic advice can reduce uncertainty in farming decisions. However, these studies also pointed out that access to information does not automatically translate into improved outcomes unless farmers are able to interpret and apply it effectively.

Subsequent research examining mobile-based advisory services in developing regions has shown mixed results. While some studies report noticeable improvements in yield and input efficiency, others argue that the impact remains limited due to low intensity of usage. In many cases, farmers tend to use digital platforms primarily for communication rather than for making critical production decisions. This creates a gap between the availability of digital tools and their effective utilization in agriculture.

Research on precision agriculture and advanced technologies such as sensors, drones, and artificial intelligence suggests a stronger positive relationship with crop productivity. These technologies enable site-specific input application, reduce wastage, and improve crop health monitoring. Empirical findings from pilot projects indicate that such interventions can lead to higher yields and better resource efficiency. However, most of these studies are conducted under controlled conditions or with institutional support, raising concerns about their scalability among small and marginal farmers.

In the Indian context, several studies have emphasized the role of structural factors such as landholding size, irrigation access, and farmer education in shaping the outcomes of digital adoption. It has been observed that larger and better-resourced farmers are more likely to benefit from digital agriculture, while smallholders often face constraints related to cost, awareness, and digital literacy. This uneven adoption pattern results in differential productivity gains, thereby limiting the overall impact at the aggregate level.

Region-specific studies in Maharashtra further highlight the diversity in agricultural practices and technological uptake. Research conducted in irrigated belts has shown relatively higher adoption of modern tools and better yield outcomes, whereas drought-prone regions continue to rely on traditional methods with limited digital integration. This suggests that the effectiveness of digital agriculture is closely linked to local agro-economic conditions rather than being uniformly applicable across regions.

Despite the expanding body of literature, a key limitation remains the lack of micro-level empirical analysis that directly compares digitally engaged and non-digital farmers within the same regional setting. Many studies rely either on macro-level data or on pilot interventions, which do not fully capture the variation in real-world farming conditions. Moreover, the distinction between superficial and intensive digital usage is often overlooked, leading to overestimation of its impact.

In this context, the present study attempts to address these gaps by focusing on district-level evidence from Western Maharashtra, specifically Pune, Satara, Sangli, Kolhapur, and Solapur. By

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using primary data and differentiating farmers based on their level of digital engagement, the study aims to provide a more grounded understanding of how digital agriculture influences crop productivity under varying field conditions.

Research Methodology

Research Design

The study follows a quantitative and cross-sectional design using primary data to examine the impact of digital agriculture on crop productivity across selected districts of Western Maharashtra.

Study Area

The study covers five districts: Pune, Satara, Sangli, Kolhapur, and Solapur. These districts are selected to represent variation in irrigation, cropping patterns, and levels of digital adoption.

Sampling Design

A multi-stage stratified random sampling method is used.
Stage 1: Districts are selected purposively based on agricultural diversity.
Stage 2: Two talukas are selected from each district to capture variation in digital adoption.
Stage 3: One village is selected from each taluka using random sampling.
Stage 4: Farmers are selected using stratified random sampling and divided into digital and non-digital groups.

Sample Size

N = 125
Ni = 25 (for each district)
Where:
N = Total sample size
Ni = Sample per district
Data Collection
Primary data is collected using a structured interview schedule including socio-economic, digital usage, and productivity variables.

Measurement of Variables

(1) Digital Adoption Index (DAI)

Empirical Results and Discussion

DAI = (X1 + X2 + X3 + X4) / 4
Where:
X1 = Mobile usage
X2 = Internet access
X3 = Digital advisory use
X4 = Technology awareness
(2) Crop Productivity
Productivity = Total Output (quintal) / Total Land Area (hectare)

Statistical Tools

(1) Mean
Mean = Sum of X / n
(2) Independent Sample t-test
T = (X1 – X2) / √[(S1^2 / n1) + (S2^2 / n2)]
Where:
X1 = Mean productivity of digital farmers
X2 = Mean productivity of non-digital farmers
$S1^2$ = Variance of digital farmers
$S2^2$ = Variance of non-digital farmers
N1 = Sample size of digital farmers
N2 = Sample size of non-digital farmers
(3) Correlation Analysis
R = covariance(X,Y) / (standard deviation of X × standard deviation of Y)
(4) Multiple Linear Regression Model
Y = b0 + b1(DAI) + b2(L) + b3(I) + b4€ + e
Where:
Y = Crop productivity
DAI = Digital Adoption Index
L = Landholding size
I = Irrigation
E = Education
E = Error term

Hypothesis Testing

H0: b1 = 0
H1: b1 ≠ 0
Decision Rule:
If p-value < 0.05 → Reject H0

Limitations

- Sample size limited to 125 farmers
- Self-reported data bias possible
- Digital adoption measured through indicators

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Table 1: Comparison of Digital and Non-Digital Farmers

Table 1: Comparison of Digital and Non-Digital Farmers

Group	Farmers (n)	Mean Yield (quintal/hectare)	Std. Deviation	
Digital Farmers	62	28.5	4.2	4.2
Non-Digital	63	24.3	3.8	3.8
Total	125	—	—	—

Digital farmers show a higher average yield of 28.5 quintals per hectare compared to 24.3 quintals for non-digital farmers. Further analysis is required to confirm if this difference is statistically significant.

Explanation:

The comparison between digital and non-digital farmers indicates that digital farmers achieve a higher average yield (28.5 quintals per hectare) compared to non-digital farmers (24.3 quintals per hectare). The observed difference of 4.2 quintals per hectare suggests a positive association between digital adoption and crop productivity. However, this difference alone does not confirm statistical significance and requires further validation through statistical testing.

Table 2: District-wise Sample Distribution and Productivity

Table 2: District-wise Sample Distribution and Productivity

District	Digital Farmers	Non-Digital Farmers	Avg Yield (quintal/ha)
Pune	13	12	30.2
Satara	12	13	27.5
Sangli	13	12	28.1
Kolhapur	12	13	29.0
Solapur	12	13	23.5

Pune and Kolhapur show higher productivity, while Solapur records the lowest yield among the districts.

Explanation:

The district-wise analysis highlights variations in productivity across the selected regions. Pune and Kolhapur districts show relatively higher yields, which may be attributed to better irrigation facilities and higher levels of technological exposure. In contrast, Solapur records the lowest productivity due to water scarcity and climatic constraints. Satara and Sangli exhibit moderate productivity levels. This indicates that the impact of digital agriculture is influenced by regional conditions.

Table 3: Results of Independent Sample t-test

T-Test Calculation

Formula:	$t = \frac{X_1 - X_2}{\sqrt{S_1^2 / n_1}} \int (S_1^2 / n_1 + S_2^2)$
Results:	
t-Value:	5.86
p-Value:	< 0.01
Significance:	*Significant (Reject H_0)

Explanation:

The results of the independent sample t-test show that the calculated t-value is 5.86, and the p-value is less than 0.05. This indicates that the difference in productivity between digital and non-digital farmers is statistically significant. Therefore, the null hypothesis is rejected, confirming that

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digital agriculture has a measurable and positive impact on crop productivity.

Final Analysis

The overall findings suggest that digital agriculture contributes to higher crop productivity; however, its impact is not uniform across regions. While districts with better infrastructure and irrigation facilities show stronger benefits, resource-constrained areas experience limited gains. This indicates that digital adoption alone is not sufficient and must be supported by complementary factors such as infrastructure, awareness, and access to resources.

Discussion

The analysis of field data indicates that digital agriculture is linked with improved crop productivity, but the relationship is not uniform across all farmers or regions. Farmers who actively engage with digital tools tend to report better yields, suggesting that access to timely and relevant information can support more informed decision-making at the farm level. However, this improvement is not consistent in every case, as the benefits depend on local conditions and the manner in which technology is used.

The district-level variation observed in the study reinforces this point. In areas such as Pune and Kolhapur, where irrigation facilities and agricultural infrastructure are relatively developed, digital tools appear to complement existing farming practices effectively. Farmers in these regions are better positioned to act on digital advisories, which contributes to higher productivity. On the other hand, in districts like Solapur, where farming is more dependent on uncertain rainfall, the role of digital agriculture is comparatively limited. This suggests that technology alone cannot overcome structural constraints such as water scarcity.

Another key finding is related to the depth of digital usage. While many farmers report access to mobile phones or basic digital services, only a smaller proportion use these tools for production-related decisions. In several cases, digital engagement remains confined to communication rather than active farm management. As a result, the potential benefits of digital agriculture are not fully realized. This highlights the importance of not just access, but meaningful and consistent use of digital tools.

The statistical results support the presence of a significant difference in productivity between digital and non-digital farmers. At the same time, other factors such as land size, irrigation access, and education continue to influence outcomes. Therefore, digital agriculture should be understood as one of several contributing factors rather than the sole driver of productivity.

Conclusion

The study finds that digital agriculture has a positive but uneven influence on crop productivity. Farmers who make active and informed use of digital tools tend to perform better, yet the extent of this advantage varies across regions and farming conditions. The results indicate that technology can support productivity improvements, but it does not operate independently of other factors.

In regions with better infrastructure and resource availability, digital tools are more effectively integrated into farming practices. In contrast, in areas facing structural limitations, their impact remains restricted. This suggests that digital agriculture functions best when it is combined with adequate physical and institutional support. It should be treated as a complementary input rather than a complete solution.

Policy Suggestions

1. Focus on Functional Digital Literacy

Training programs should move beyond basic awareness and focus on how farmers can use digital tools in actual farming decisions such as crop selection, pest control, and input management.

2. Improve Access for Small Farmers

Efforts should be made to ensure that small and marginal farmers are not excluded due to cost barriers. Shared models and targeted support can help improve inclusiveness.

3. Link Technology with Ground Support

Digital platforms should work in coordination with local extension services so that farmers can verify and apply the information effectively.

4. Develop Localized Advisory Systems

Information provided through digital tools should reflect local conditions such as soil type, rainfall patterns, and crop choices to increase relevance.

5. Strengthen Supporting Infrastructure

Investment in irrigation, storage, and rural connectivity is necessary to ensure that the benefits of digital agriculture can be realized in practice.

6. Promote Collective Adoption Models

Farmer groups and producer organizations can enable shared use of advanced technologies, reducing individual costs and improving adoption.

Final Line

Digital agriculture improves outcomes only when farmers are able to use it effectively

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within a supportive local environment; without that, its impact remains limited.

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Conflicts of interest

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Original Article

Emerging Trends in Research Methodology in Higher Education

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Abstract

The most important aspect of higher education is research technique. Given its enormous importance, new trends are being developed to improve the calibre of research technique since it has a big influence on higher education. As a result, research methodology is given more attention. The integration of mixed techniques, the use of big data analytics, artificial intelligence, the development of reproducibility and open science, and the acceptance of participatory and ethnographic approaches can all influence the direction of research methodology in the future. In higher education, innovative research approaches, settings, and technology are crucial.

The current study aims to address the emerging trends in research methodology in higher education systems, particularly the modernization of erudition, new educational frameworks, and didactic techniques. Additionally, it highlights a number of important aspects of higher education, including scientific advancement, digital higher education, and experimental research. The awareness of moral considerations and their impact on society are current topics in academic research. Research presents a number of issues, including text imitation, transdisciplinary research, data confidentiality, study veracity, and social implications of developing technologies like biotechnology and artificial intelligence. Index Terms: Higher education, innovations, technical advancements, research technique, research integrity, and emerging trends.

Keywords: *Research Methodology, Higher Education, Emerging Trends, Mixed Methods Research, Digital Research Tools, Interdisciplinary Research, Big Data Analytics, Artificial Intelligence in Research, Participatory Research, Educational Research Innovation.*

Introduction:

Research is the process of repeatedly looking for things that already exist. It is done in order to discover the truth. Research methods and the rationale behind them are referred to as "research methodology." In actuality, research methodology is the result of context and original content. Technological advancements, digital higher education, and empirical research in higher education have enhanced the contemporary research environment. Technological advancement, digital higher education, and empirical study in higher education make up academic research.

a. Technological advancements: automation, augmented reality, virtual worlds, mobile technologies, etc.

b. Digital Higher Education: e-learning, game-based learning, social media in the classroom, innovative educational paradigms, and educational technology.

c. Empirical Research in Higher Education: Digital Learning, Digital Technologies, New Approaches, Views on New Learning Processes, and New Assessment Techniques

Goals and Objectives:

The current study has the following goals and objectives.

- To describe scholarly research
- To emphasize the relationship between research integrity and technique
- To look into new developments in higher education research methods

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- To support concepts like digital learning, technology advancements, and empirical research in higher education

Research Methodology:

The investigator has used qualitative methods and closely examined the texts pertaining to the academic research's central theme. This aids in identifying new developments in higher education research technique. Several topic features of the research can be better understood or interpreted by reading a text. Additionally, it facilitates the generation of textual and numerical evidence from texts on a wide scale, allowing for the visualization and extensive presentation of full information on academic research and its integration with technology advancement to readers. In order to have greater understanding, the researcher has interpreted the research documents.

Literature Review:

This important feature examines the opinions of previous researchers on the purported subject. The researcher has depicted the new developments in higher education research methods here. When needed, he has provided proof of the facts. The bibliographical section projects this literary review.

Discussions on New Developments in Higher Education Research Methodology:

1. Online Research Methods:

With the aid of online resources, researchers seek for information and gather data via online focus groups, experiments, questionnaires, and interviews. Online research techniques include surveys, focus groups, polls, and data analysis. These techniques can be applied to psychological research, market research, etc. Online surveys gather information from respondents using technologies like Google Forms. Tools are used in online surveys to get information from respondents. Online chat rooms are used in online focus groups to help small groups of people have conversations. Video calls are used in online interviews and group discussions. Social media sites like Facebook are used by online discussion forums to promote conversation. Examining information from the internet

2. Research Development:

Research and development are a process that entails examining, updating, and exploring in order to produce new goods, procedures, or technologies. It's a useful tool for companies to promote and develop their goods and services. Many academic institutions, including colleges and universities, are providing research development support to students and research scholars in order to foster a culture of research and to advance research excellence. The following methods can be used to advance the research. Fundamental research is speculative and inquisitive. It seeks to identify novel principles or facts. Applied research creates new uses for existing knowledge by utilizing the findings of basic research. Business, healthcare, and education are just a few of the industries that use it. Using real-world presentation and analysis, experimental development creates new goods, procedures, or services.

3. Mixed approaches and Interdisciplinary Approaches:

To examine the scholarly research, researchers are combining quantitative (quantifiers) and qualitative approaches (descriptive data). Observations, interviews, document analysis, and participant product analysis are all methods used to gather qualitative data. Numerical data is a component of quantitative data, which uses statistics to identify correlations between variables.

The term "mixed method"

Describes a research strategy in which both qualitative (evocative) and quantitative (arithmetical) data are gathered and examined in the same study. Its main goal is to combine many kinds of data into one study. A mixed method is used for data assortment. Researchers gather both qualitative (such as observations and interviews) and quantitative (such as surveys and statistics) data. The core of mixed methods is data integration. The data is analysed and assimilated using a variety of techniques, frequently with the goal of providing a greater understanding of the topic being studied. Priority is devoted to comparing qualitative and quantitative methods. A popular mixed methods approach that strengthens the validity of the results by comparing findings from quantitative and qualitative data.

Multidisciplinary Approaches:

It entails presenting familiarity and perspectives from several speculative areas to thoroughly examine a subject, frequently incorporating methods from every field to attain a more in-depth analysis. To address a research subject, they integrate information from several academic fields. Collaboration across disciplines is crucial. To discuss a research subject, scholars from many speculative fields collaborate. The integration of knowledge is prioritized. The main goal is to combine knowledge from other fields to create a more comprehensive understanding of a complex problem. The researchers embrace methodological flexibility and create a variety of research methodologies based on the particular requirements of the study, utilizing a variety of

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disciplines. They incorporate intricate research questions. Researchers can employ a mixed methods approach while utilizing intuitions from multiple disciplines through an interdisciplinary lens when examining complex phenomena that require both quantitative and qualitative data. Qualitative data can be utilized to clarify patterns found in quantitative data, and vice versa, enhancing the inclusive rationality of the research findings. Legal conclusions are also feasible. Holistic viewpoints are considered. Researchers can develop a broader grasp of the topic being studied by incorporating perspectives from several disciplines.

Participatory and Action-Oriented Research: This refers to a research methodology in which individuals who are unwaveringly impacted by a problem actively participate in every step of the research process, from identifying the problem to devising explanations, gathering data, examining findings, and causing fluctuations. The main goal is not only to acquire knowledge but also to use accomplishments to discuss the issue within the community. This method places a strong emphasis on the participants as co-researchers, supporting their viewpoints and discoveries all along the way. The main goal is to actively work toward constructive social change in the community under study rather than merely recognizing a challenge. Community members who actively participate in research gain control over the process and a wisdom of intervention, which can lead to hopeful empowerment. Researchers and participants collaborate to formulate study questions, choose appropriate techniques, and interpret findings. While observing the community's practices and undercurrents, researchers actively engage with them. To identify important issues and community assets, graphic representations are made.

Digital Tools and Platforms: Digital tools and platforms are online programs, software, and websites that allow users to carry out a variety of tasks digitally, such as project management, marketing, data analysis, communication, collaboration, and content production. HubSpot, Google Trends, Google Analytics, Google Ads, Canva, Trello, Hootsuite, Mailchimp, and others are examples of digital tools. Content production, project planning, email marketing, website analytics, social media management, SEO optimization, and data visualization are just a few of the tasks that these technologies can be utilized for. Users can access the majority of digital tools from any location with an internet connection by using web browsers or mobile apposite communicate data across disparate apps and update workflows, many digital technologies can be connected with other platforms.

Reflexivity and Self-Cognizance: Reflexivity is the dynamic process of self-examination in which a person critically evaluates their own beliefs, expectations, and performances, essentially becoming aware of how their own perception may influence their behaviour and explanations. Understanding one's own ideas, feelings, and passions—both rational and cataleptic—is a component of self-cognizance. One important tool for fostering and developing self-awareness is reflexivity. Reflexivity is a practice that actively fosters self-awareness by pushing people to critically examine their own prejudices and viewpoints. Reflexivity in research contexts refers to a researcher's awareness of how their personal experiences, values, and behaviours may affect the study process, data interpretation, and conclusions. One of the reflexivity modules is self-reflection. It goes beyond reflecting on one's behaviour. It entails asking why by social and individual settings. People can make more informed statements and understandings by acknowledging their own predispositions. Increased self-awareness promotes better communication and a deeper comprehension of other people's viewpoints. By identifying opportunities for growth, self-reflection on a regular basis helps streamline personal development.

Creativity and Innovation:

These are crucial skills that can help people become more diligent and sensible. The process of coming up with new ideas is called creativity. It is the capacity to generate fresh concepts, possibilities, and visions. The process of putting those ideas into practice is called innovation. It is the process of bringing fresh, useful goods or services to the market. Disruptive innovation can have a big influence on the market by making a good or service more accessible or affordable. Practicing your imagination, scheduling time for creative thought, asking insightful questions about things that already exist, exchanging ideas with others, and learning how to pitch ideas are all ways to increase your creativity and innovation. Innovation and creativity may make people more competitive and productive. solve issues, think creatively, and motivate others.

Lifelong Learning and Collaboration:

This is the idea of always learning and growing throughout one's life while actively interacting with others to exchange concepts, experiences, and acquaintances. As a result, everyone contributes to improving the learning

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process. By collaborating with others to achieve common objectives, we can look for fresh proof and abilities. When people work together to learn, they can impact each other's abilities, fill in knowledge gaps, and accomplish a variety of perceptions, which makes learning comfortable for all participants. Lifelong learning can be facilitated by cooperation in a variety of contexts, such as accredited educational programs, online communities, specialized networks, or inadvertent community communications. Collaboration promotes active participation, in which people actively participate in the learning process by discussing, challenging, and offering their particular awareness. Environments for group education often entail tackling complex issues together, promoting critical thinking, creativity, and sophisticated solutions. taking part in online forums where people exchange knowledge and insights about a range of topics. participating in workshops with coworkers to exchange best practices and learn new abilities. combining seasoned experts with novices to provide direction and support for relentless learning. working cooperatively on team initiatives to accomplish a shared objective, promoting learning via practical experience. Lifelong learning enables people to stay up to date and adjust to new problems and technology in today's quickly changing environment. Working together with different viewpoints might inspire fresh concepts and result in original solutions. Ongoing education and networking can improve employment prospects and develop specialized skills. By encouraging communication, coordinated knowledge involvement can replace personal development. leadership and coordination abilities

Strategic Intuition:

This method involves blending logical concepts to produce creative thoughts. ideas and philosophy. It is predicated on collected experience, knowledge, and emotions as well as logical reasoning, creative discoveries, and pattern recognition.

Correlation Theory:

This theory examines the relationship between two or more variables. It can be expressed as a number known as the correlation coefficient and is used to indicate the strength of the relationship between neutral variables. This association could positive, unfavourable, or neutral.

Convolution Theory:

To make their research strategy more varied and current, researchers are utilizing cutting-edge abilities and novel research techniques. good, negative, or neutral. are used to develop relationships and communication. Social media, video conferencing, and artificial intelligence are all utilized in Make use of technology.

Critical Race Theory:

Scholars devote their work to creating critical race theory methods for quantitative techniques. CRT examines how race, civilization, the law, and the media are related. It also looks at how racism is ingrained in laws. Race is a universal and communal construct. Racial disparities in social, economic, and political spheres are created and maintained by laws and institutions. There are connections between several types of disparities, including those based on race, class, masculinity, and disability.

Conclusion:

The researcher has made an effort to draw attention to current or developing trends in higher education. Online research techniques, research development, mixed methods and interdisciplinary approaches, action-oriented and participatory research, digital tools and platforms, reflexivity and self-awareness, creativity and innovation, lifelong learning and teamwork, strategic intuition, correlation theory, convolution theory, critical race theory, and leverage technology are a few examples. The quality of scholarly research will be improved by the successful application of these trends.

The researcher has attempted to examine the current and emerging trends in research methodology within the field of higher education. These trends include the adoption of online research methods, the development of advanced research designs, and the use of mixed-method and interdisciplinary approaches. In addition, action-oriented and participatory research methods are increasingly being used to address real-world educational issues. The growing use of digital tools and platforms has significantly transformed the research process. Furthermore, technologies such as big data analytics, artificial intelligence, cloud computing, and learning analytics are playing an important role in enhancing the efficiency and accuracy of educational research. Researchers are also expected to develop essential competencies such as reflexivity, self-awareness, creativity, innovation, lifelong learning, teamwork, and strategic intuition. The study also incorporates theoretical perspectives such as correlation theory, convolution theory, and critical race theory to better understand complex educational phenomena. Moreover, the increasing availability of open-access resources, international collaborative research, ethical research practices, and technology-driven data collection techniques are contributing to the

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advancement of research in higher education. The effective integration of these modern trends and technological innovations can significantly enhance the quality, reliability, and overall impact of scholarly research in the field of higher education.

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I would like to express my sincere gratitude to all those who have supported and guided me in the successful completion of my project titled "Emerging Trends in Research Methodology in Higher Education."
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Original Article

Assessment Of Land Use and Land Cover Dynamics in The Dev River Watershed, Parner Tehsil, Maharashtra, Using Geospatial Techniques

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Abstract

The present paper attempts land use and land cover change detection of the Dev River watershed using Geospatial techniques. Remote sensing is a powerful tool for the collection of spatial data, and Geographical Information Systems (GIS) are powerful tools for the management and analysis of data required for any land development activity (Garg, 1991). Change detection analysis was carried out by using satellite imageries of 2013 and 2026. In the present paper, land use and land cover classes included change detection agricultural area, vegetation, built-up, water bodies and barren land. LANDSAT ™, a satellite image of the Dev River watershed, which is the duration from 2013-2026.

The study area is located at a latitudinal extent between 18°56'58"N and 19°6'53"N and a longitudinal extent between 74°15'4"E and 74°24'42"E. The Dev River originates at 913 metres above mean sea level (MSL) near Vadagaon Darya village. The Dev is a major left-bank tributary of the Kukadi River. The total length of the Dev River watershed is 26.3432 km. From its origin to the confluence of the Kukadi River. The total area of the basin is 110.0245 sq. km.

Keywords: *Change Detection, Land Use Land Cover, Remote Sensing, Gis, Dev River Watershed*

Introduction:

Remote sensing data have been the most important data source for the environmental change studies, and a large collection of remote sensing images has made it possible to analyse spatial-temporal patterns of environmental elements and the impact of human activities. Remote sensing has been widely reported on as a methodology of remote sensing change detection and monitoring. (Singh, A., 1989)

Over the past few decades, land use/land cover mapping and change detection techniques have been developed and deployed all over the world (Mucher et al. 2000; Mengistu & Salami 2007; Sahebjalal & Dashtekian 2013; Agaton et al. 2016; Mishra et al. 2020;). Land use and land cover mapping is an essential component wherein other parameters are integrated on the requirement basis to derive various development indexes for land and water resources. Land use refers to man's activities and the varied uses which are carried on overland, and land cover refers to natural vegetation, water bodies, rock/soil, artificial and others noticed on the land (NRSA 1989).

Aim & Objective: To analyse and evaluate changes in land use and land cover patterns in the Dev River Watershed.

Data and Research Methodology:

Spatial-Temporal LULC Change (2013–2026):-This study was conducted to analyze the Spatio-temporal dynamics of (LULC) over a 13-year period (2013-2026) and comparative analysis for 13 years.

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Data Acquisition and Pre-processing:

The foundation of this temporal analysis was the acquisition of cloud-free satellite imagery corresponding to the study years.

- **Satellite Data:** Multi-temporal satellite images were acquired for the years 2013-2026. . Based on the available LULC map legends, the following sensors were likely used:
- **Landsat 8/9 OLI/TIRS:** For the 2013 and 2026 datasets.
- **Imagery Date:** Images from the winter/early spring season were selected to maintain phonological consistency and minimize seasonal variability in spectral responses of vegetation and agriculture.
- **Preprocessing:** All raw images were pre-processed. This included radiometric calibration to convert Digital Numbers (DN) to Top of Atmosphere (TOA) reflectance.
- **Atmospheric Correction:** Standard methods (e.g., Dark Object Subtraction or QUAC) were applied to derive surface reflectance, ensuring that the spectral signatures of features were comparable across the different years.
- **Geometric Correction and Subsetting:** All images were co-registered to a common geographic coordinate system. Using the administrative boundary of Dev River watershed, each scene was clipped (subsetted) to ensure a consistent study area extent of 110.0245 sq. km across all analysis periods, as confirmed by the total area in the provided tables.

Classification System and Scheme:

A uniform classification scheme was adopted to ensure comparability between different years. Based on the legends in the LULC maps and the Word document, five main classes were identified:

1. **Built-up Land:** Settlement, industries etc.
2. **Vegetation/ forest:** Dense Forest, deciduous forest, and mixed woodland.
3. **Agriculture:** Cropland, fallow agricultural land, and plantations.
4. **Water body:** Rivers, reservoirs, and tanks.
5. **Barren Land:** Exposed rock, open areas with little or no vegetation, and scrubland.

Supervised Classification (Maximum Likelihood):

- Using the refined training samples derived from the unsupervised phase, the **Maximum Likelihood Classifier (MLC)** was used to each respective year's image. This process generated the preliminary LULC maps for 2013 and 2026.

Post-Classification and Accuracy Assessment:

- **Filtering and Smoothing:** To remove the "salt-and-pepper" effect inherent in pixel-based classifications, a **majority filter** was applied. This replaced isolated pixels with the dominant class of their neighbors, creating more homogenous and cartographically pleasing land cover patches.
- **Accuracy Assessment:** For each classified year (2013-2026), an accuracy assessment was conducted.

The original FCC images (provided in the files).

- **LULC 2026 Dataset:** The LULC map for 2026 was generated using the same methodological framework, likely using recent satellite data (e.g., **Landsat 8/9 OLI/TIRS**) to allow for the projection and comparative analysis of trends up to 2026.

Area Calculation and Change Detection: -Area Statistics: The number of pixels for each LULC class was computed and converted into square kilometers. The total area for the Dev River watershed was consistently calculated as 110.0245 sq. km, validating the spatial integrity of the analysis across all time stamps.

This allowed for the calculation of:

- Net change in area for each class.
- Percentage of change relative to the total geographical area.
- Gains and losses between specific land cover types.

Spatial Data Source:

Sr. No	Data Types	Years	Data of Production
1	Landsat Image	2013	04/05/2013
2	Landsat Image	2026	17/02/2026

Source: (WWW.GLCF)

Study area:

The study area includes the plateau region of the central part of the Deccan Plateau in Parner tehsil. The study area is located at a latitudinal extent between 18°56'58"N and 19°6'53"N and a longitudinal extent between 74°15'4"E and 74°24'42"E. The Dev River originates at 913 meters above mean sea level (MSL) near Vadagaon Darya village. The Dev is a major left-bank tributary of the Kukadi River. The total length of the Dev River watershed is 26.3432 km. From its origin to the confluence of the Kukadi River. The total area of the basin is 110.0245 sq. km.

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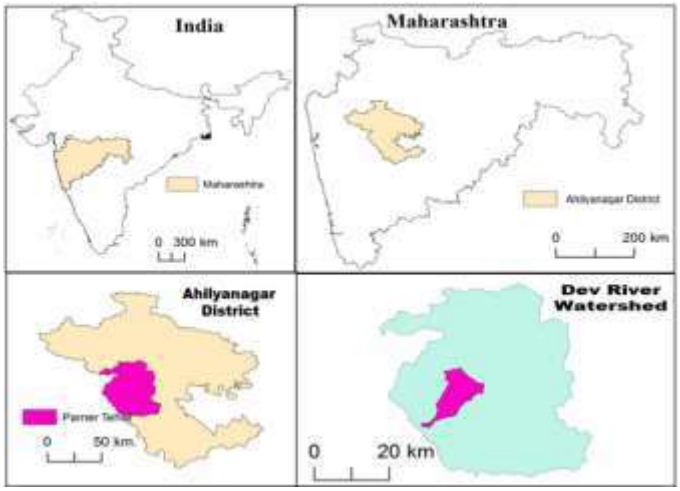

Fig.No.01-Location Map

Results and Discussions: In the present area, (2013 and 2026) with the help of satellite imagery of different years was classified and compared for the LULC change detection analysis.

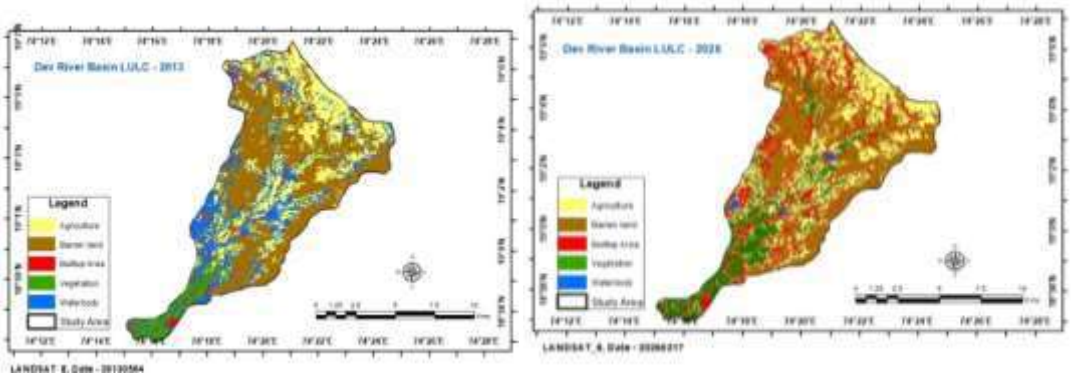

Fig.No.02

LULC distribution in Dev River watershed.

Image	2013		2026	
LULC Classes	Area (km²)	Area %	Area (km²)	Area %
Agriculture	29.33	26.37	34.09	30.99
Barren land	46.87	42.61	32.94	29.95
Built-up Area	4.59	3.90	9.43	8.57
Vegetation	8.49	7.72	15.27	13.88
Water body	20.71	18.83	18.26	16.60
TOTAL	110.0245	100	110.0245	100

LULC changes as observed between 2013 and 2026 in Dev River watershed.

Sr. No	LULC Classes.	Rate of Change From 2013 To 2026		
		Area %(2013)	Area % (2026)	Rate of Change In %
1	**Agriculture**	26.37	30.99	4.63
2	**Barren land**	42.61	29.95	-12.67
3	**Built-up Area**	3.90	8.57	4.67
4	**Vegetation**	7.72	13.88	6.16
5	**Water body**	18.83	16.60	-2.23

Land Use and Land Cover Change Detection in the Dev River Watershed from 2013 to 2026:

- **Vegetation Cover** –In study area 2013, vegetation covered 7.72 per cent of the total area covered by the Dev River watershed study region, and in 2026, 13.88 per cent of the area was under vegetation cover. The vegetation cover decreased from 2013 to 2026, a period of

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13 years. In the percent watershed the vegetation cover is increasing, the positive changes of vegetation cover from 2013 to 2026.

- **Built-up Area –**In the year 2013, the built-up area is covered by 3.90 percent of the total area under the built-up area. In 2026, about 8.57 per cent of the total built-up area of the Dev River watershed. In the present study area, the built-up area increased by 4.67 per cent in 13 years, from 2013 to 2026.
- **Agricultural Land –**Agricultural land occupies a sizeable area. Sugarcane, vegetables are the major crops in the Dev River watershed. In the year 2013, agricultural area was covered by 26.37 per cent of the total area under these categories. In the year 2026, agricultural land area occupies 30.99 per cent of the total area under these categories, and the area increased by 4.63 per cent in the 13 years.
- **Barren Land –**From 2013 to 2026, these 13 years are continuous decreases in barren land. In the years 2013 to 2026, barren land change -12.67 per cent of the total area of the Dev River watershed under these categories. The negative changes of barren land from 2013 to 2026.
- **Water Bodies –**Water bodies included lakes, ponds, tanks, rivers, and streams. 18.83 per cent of the total area is covered by water bodies in 2013, and 16.60 per cent of the total area is covered by the water bodies in 2026. The water bodies' area of the Dev River watershed decreased from 2013 to 2026 by only -2.23 per cent.

Conclusion:

The present study analyses land use and land cover (LULC) changes in the Dev River watershed using Landsat satellite imagery for the period 2013–2026. The results indicate changes in vegetation, built-up area, agricultural land, barren land, and water bodies. Vegetation cover increased from 7.13% i to 13.88%. Built-up areas also expanded significantly from 3.90% to 8.57%, mainly due to human activities. Positive change in agricultural area in 13 years in 4.63%. In contrast, barren land showed a continuous decrease as land was converted for agriculture, settlement and Vegetation. Water bodies slightly declined from 18.83% in 2013 to 16.60% in 2026.

Acknowledgment

I would like to express my sincere gratitude to all those who have supported and guided me in the successful completion of my project titled "Assessment of Land Use and Land Cover Dynamics in the Dev River Watershed, Parner Tehsil, Maharashtra, Using Geospatial Techniques."

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Nil.

Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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Original Article

A Geographical Analysis of Scheduled Caste Population Distribution in Ahilyanagar District

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Abstract

This study examines the distribution of Scheduled Caste population in Ahilyanagar District (formerly known as Ahmednagar) of Maharashtra. Scheduled Castes plays an important role in India's social structure and their spatial distribution. It reflects historical, economic and social conditions. The study is mainly based on secondary sources. It focuses on the total Scheduled Caste population, its percentage in total population, rural and urban pattern, sex composition, and regional variation within the district. For the comparison 1991, 2001 & 2011 census data is used. The paper also explains the tehsil-wise and spatial characteristics of Scheduled Caste population distribution and highlights the need for area-specific development planning. The study finds that Scheduled Caste population is not evenly distributed across Ahilyanagar District. Some parts of the district show higher concentration due to historical settlement patterns, agricultural employment, and urban growth, while other parts have comparatively lower concentration. The study concludes that understanding Scheduled Caste population distribution is essential for social justice, balanced regional development and effective implementation of welfare schemes.

Keywords: *Scheduled Caste, population distribution, Ahmednagar District, Census data, social geography, regional analysis*

Introduction:

Population geography studies the spatial distribution, composition, and characteristics of population of an area. Among the different social groups in India, Scheduled Castes occupy a significant place because of their importance in development planning. The Constitution of India provides special safeguards and welfare measures for Scheduled Castes. Therefore, the study of Scheduled Caste population distribution is important for understanding social structure, regional disparity, and the need for equitable development.

Ahilyanagar District is one of the important districts of Maharashtra. It has a large geographical area with diversified physical conditions, an agricultural base, growing urban centers and considerable social diversity. The distribution of Scheduled Caste population in the district is unevenly distributed in the district. In some tehsils and towns, their concentration is relatively high, while in others it is moderate or low. Such uneven distribution is influenced by various factors like agricultural opportunities, settlement history, urban employment, industrial growth, and social conditions.

Census data of an area provides an authentic and reliable basis for analyzing the Scheduled Caste population. It gives information on total population, sex-wise population and rural-urban composition. Hence, the present study attempts to examine the Scheduled Caste population distribution in Ahilyanagar District from a geographical point of view.

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Need and Significance of the Study

The study of Scheduled Caste population distribution is important for several reasons.

- It helps in understanding the social composition of the district.
- It shows regional imbalance in the concentration of disadvantaged communities.
- It is useful for development planning in sectors such as education, housing, employment, health, and social welfare.
- It assists in identifying areas where government schemes and welfare programs should be strengthened.
- It contributes to population geography and social geography by explaining the spatial pattern of caste distribution.

Ahilyanagar District has both rural and urban areas, drought-prone zones, agriculturally developed regions and expanding towns. Therefore, it is a suitable area for examining the regional pattern of Scheduled Caste population.

Review of Literature

Many studies in population geography and social geography have used Census data to understand social groups and demographic patterns of an area. Census based studies have examined population growth, sex ratio, work participation, rural-urban distribution and social composition. Research on Scheduled Castes generally shows that their distribution is shaped by historical settlement patterns, land relations, occupational structure, and urbanization. Studies also indicate that Scheduled Castes are often concentrated in agricultural labor areas, village peripheries and selected urban localities. Regional studies in Maharashtra have shown that social and economic development strongly influences the condition and distribution of Scheduled Castes. The present study adds to this field by focusing specifically on Ahilyanagar District.

Objectives of the Study

The main objectives of this research paper are:

1. To study the total Scheduled Caste population in Ahilyanagar District.
2. To examine the spatial distribution of Scheduled Caste population in the district.
3. To analyze the rural and urban distribution pattern of Scheduled Caste population.
4. To study the sex composition of Scheduled Caste population.
5. To identify areas of high, medium, and low concentration of Scheduled Caste population.
6. To suggest measures for balanced social development.

Hypotheses

The following hypotheses are proposed for the study:

1. Scheduled Caste population is unevenly distributed in Ahilyanagar District.
2. Rural areas of the district contain a larger share of Scheduled Caste population than urban areas.
3. The proportion of Scheduled Caste population differs from one tehsil to another.

Study Area

Ahilyanagar District is a part of Maharashtra state and located in the western part of it. It is one of the largest districts of the state in terms of area. Area acquired by district is 17048 Sq. Km. The district is known for plateaus, river valleys, drought-prone tracts and agricultural land. The district is drained by Godavari, Pravara, Mula and Sina rivers. Agriculture is the dominant occupation within the district; although trade, transport, education, services and industries are also important in urban centers.

The Ahilyanagar district includes 14 tehsils such as Nagar, Rahuri, Shrirampur, Sangamner, Kopargaon, Newasa, Shevgaon, Pathardi, Karjat, Jamkhed, Parner, Akole, Rahata and Shrigonda. There is mixed rural-urban characteristics within the district. Sugar factories, market centers, religious places, educational institutions and road networks have influenced population and its distribution. Because of such geographical and socio-economic diversity, Ahilyanagar District is suitable for studying Scheduled Caste population distribution. The total population of the district is 4543159. The total Schedule Caste population is 573698; in that 291521 are male and 282177 are females. As per the 2011 census overall literacy rate of the district is about 87.57%; while male and female literacy rate is 92.05% and 82.87% respectively within the district.

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Data Sources and Methodology

1. Sources of Data

The present study is mainly based on secondary data. Census of India, District Census Handbook, Ahilyanagar, Primary Census Abstract, Village Directory and Town Directory, Government statistical reports, Books, journals and research articles related to population geography and social geography are the important sources. The 1991, 2001 & 2011 District Census Handbooks for Ahilyanagar is the official district-level Census source for village and town-wise primary census abstracts.

2. Methodology

The study follows a descriptive and analytical method. Relevant Census data on Scheduled Caste population has been collected and organized for the district. The data can be analyzed at district, tehsil, rural, and urban levels. For interpretation, simple statistical methods are used, such as percentage, ratio, and comparative analysis are used. The spatial pattern is explained through geographical reasoning.

3. Techniques Used

Techniques such as Percentage method, Comparative analysis, Rural-urban comparison, Sex composition analysis are used.

Formula Used

Percentage of Scheduled Caste Population

$$\text{SC Percentage} = \frac{Total\ Schedule\ Caste\ Population}{Total\ Population} \times 100$$

Sex Ratio of Scheduled Caste Population

$$\text{Sex Ratio} = \frac{Female\ Schedule\ Caste\ Population}{Male\ Schedule\ Caste\ Population} \times 1000$$

Literacy Rate

$$\text{Literacy Rate} = \frac{Literate\ Population}{Population\ aged\ 7\ and\ above} \times 100$$

Profile of Scheduled Caste Population in Ahmednagar District

According to the 2011 Census, Ahilyanagar District had a total population of about 4543159; accounted 4.04% of the Maharashtra state population. The population of Scheduled Castes is 573698; accounted for roughly 12.63% of the district population. This indicates that Scheduled Castes form an important part of the district's demographic structure. Their distribution is linked with long-established rural settlements, agricultural labor demand, and the growth of towns such as Nagar, Shrirampur, Sangamner and Kopargaon. The presence of irrigation-based agriculture and sugar industry in some parts has also influenced their concentration.

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Table:1 Tehsil-wise Distribution of Schedule Caste Population (%)

Sr. No.	Tehsil	1991 (%)			2001 (%)			2011 (%)		
		Total	Male	Female	Total	Male	Female	Total	Male	Female
1	Akola	4.25	4.27	4.24	4.21	4.15	4.27	4.56	4.54	4.58
2	Jamkhed	13.19	13.22	13.14	11.97	11.77	12.19	12.99	12.78	13.21
3	Karjat	14.13	14.12	14.14	13.53	13.40	13.66	14.40	14.08	14.75
4	Kopargaon	14.12	13.81	14.47	12.74	12.61	12.89	13.36	13.19	13.53
5	Nagar	13.12	13.01	13.23	13.05	12.68	13.45	14.18	13.93	14.45
6	Newasa	14.15	14.18	14.12	14.01	13.87	14.15	14.72	14.52	14.92
7	Parner	6.93	7.03	6.83	6.72	6.75	6.69	6.97	6.84	7.11
8	Pathardi	11.97	13.82	10.04	9.55	9.45	9.64	9.88	9.74	10.04
9	Rahata	0.00	0.00	0.00	16.02	15.77	16.28	17.14	16.86	17.42
10	Rahuri	13.72	13.69	13.74	13.39	13.41	13.37	13.51	13.37	13.66
11	Sangamner	8.21	8.20	8.21	8.08	8.03	8.12	8.36	8.26	8.47
12	Shevgaon	14.33	14.28	14.39	13.75	13.72	13.78	14.72	14.49	14.96
13	Shrigonda	12.01	12.10	11.92	12.34	12.33	12.35	12.72	12.54	12.92
14	Shrirampur	18.75	19.66	17.78	18.99	18.80	19.19	19.29	18.93	19.67
Total		**12.41**	**12.60**	**12.21**	**12.00**	**11.88**	**12.11**	**12.63**	**12.44**	**12.82**

(**Source:** Census of India-1991, 2001 & 2011)

Distribution of Scheduled Caste Population

1. General Distribution Pattern

The Scheduled Caste population in Ahilyanagar District is unevenly spread. It shows regional variation across tehsils and settlements. Generally, higher concentration is found in agriculturally developed plains, irrigation zones, and urban-industrial centers where employment opportunities are better. Moderate concentration may be observed in mixed agricultural regions, while low concentration may occur in hilly, tribal-dominated, or less accessible areas.

The distribution pattern reflects historical occupation, land ownership pattern, dependency on agricultural labor, migration toward towns, and access to social and economic facilities. In villages, Scheduled Caste population is often associated with service occupations and labor work. In towns, they are engaged in industrial work, transport, trade support activities, municipal employment, domestic services, and informal occupations.

Table-1 indicates the tehsil-wise distribution of Scheduled Caste population in Ahilyanagar District for the years **1991, 2001 and 2011**. The table presents the percentage of Scheduled Caste population in total, male, and female categories. It helps to understand temporal changes and regional variation in the distribution of Scheduled Caste population in the district.

In **1991**, the total proportion of Scheduled Caste population in Ahilyanagar District was **12.41%**. The male Scheduled Caste population was **12.60%**, while the female Scheduled Caste population was **12.21%**. This indicates that the male percentage was slightly higher than the female percentage at the district level. In **2001**, the district total Scheduled Caste population declined slightly to **12.00 percent**. The male percentage was **11.88 percent**, while the female percentage was **12.11 percent**. This shows a small decrease in the overall share of Scheduled Caste population compared to 1991. In **2011**, the total Scheduled Caste population in the district increased to **12.63 percent**. The male percentage rose to **12.44 percent**, and the female percentage increased to **12.82 percent**. This indicates that the Scheduled Caste share in the district population improved during the decade 2001–2011.

2. Tehsil-wise Pattern

At the tehsil level, there is considerable variation in Scheduled Caste population distribution. Tehsils with better irrigation, sugar industry, transport connectivity, and urbanization generally tend to show higher Scheduled Caste concentration. Areas near major roads, industrial units, and market centers often have more diverse employment opportunities, which attract and retain Scheduled Caste population. On the other hand, tehsils with tribal concentration, rugged terrain, or weaker economic development may show lower Scheduled Caste proportion. For analysis, tehsils can be classified into three categories:

High concentration areas

These are tehsils where the percentage of Scheduled Caste population is above the district average. Such areas usually have dense rural settlements, labor demand, or urban centers. **Shrirampur** tehsil recorded the highest percentage of Scheduled Caste population throughout the study period. It was **18.76%** in 1991, **18.99%** in 2001, and increased further to **19.29%** in 2011. This shows that Shrirampur had the strongest concentration of Scheduled Caste population within the district.

Rahata presents a special case. It shows **0.00 percent** in 1991 because it was not a separate tehsil at that time. In 2001, its Scheduled Caste

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population was **16.02%**, which increased to **17.14%** in 2011. This indicates a high concentration of Scheduled Caste population in Rahata after its formation as a separate tehsil.

Other tehsils with relatively high Scheduled Caste population percentages include **Newasa, Karjat, Shevgaon, Nagar, Rahuri, Jamkhed and Kopargaon**. In 2011, Newasa recorded **14.72%**, Shevgaon **14.72%**, Karjat **14.40%**, Nagar **14.18%**, Rahuri **13.51%**, Kopargaon **13.36%** and Jamkhed **12.99%**. These tehsils were above or near the district average and therefore represent important concentration zones of Scheduled Caste population.

Medium concentration areas

These tehsils have Scheduled Caste population close to the district average. Their distribution may be more balanced and influenced by both agriculture and local service activities. Tehsils with moderate Scheduled Caste population percentages include **Shrigonda** and **Pathardi**. In 2011, Shrigonda recorded **12.72%**, which is very close to the district average, while Pathardi recorded **9.88%**, which is below the district average but not the lowest in the district.

Low concentration areas

These are tehsils where Scheduled Caste population is below the district average. Hilly terrain, tribal presence, lower urbanization, or out-migration may be responsible. Tehsils with low Scheduled Caste population percentages are **Akole, Parner, and Sangamner**. In 2011, Akole had **4.56%**, Parner **6.97%**, and Sangamner **8.36%**. Among all tehsils, **Akole** had the lowest Scheduled Caste population percentage in all three Census years. This may be due to the greater concentration of tribal population and different social composition in the tehsil.

A comparison of male and female percentages also reveals some interesting trends. In several tehsils, the female Scheduled Caste percentage is slightly higher than the male percentage. For example, in **2011**, female percentages were higher than male percentages in Akole, Jamkhed, Karjat, Kopargaon, Nagar, Newasa, Parner, Pathardi, Rahata, Rahuri, Sangamner, Shevgaon, Shrigonda, and Shrirampur. This suggests a relatively balanced sex composition within the Scheduled Caste population.

Over the three Census years, some tehsils show fluctuation. For example, **Jamkhed** declined from **13.10%** in 1991 to **11.07%** in 2001, but rose again to **12.99%** in 2011. **Karjat** also declined from **14.13%** in 1991 to **13.53%** in 2001, and then increased to **14.40%** in 2011. **Kopargaon** declined in 2001 and recovered slightly in 2011. This indicates that Scheduled Caste population distribution is not static and changes over time.

Overall, the table clearly shows that the Scheduled Caste population in Ahilyanagar District is **unevenly distributed**. Some tehsils such as **Shrirampur, Rahata, Newasa, Shevgaon, Karjat, and Nagar** have high concentration, while **Akole, Parner, and Sangamner** have low concentration. The district average remained around **12% to 13%** during the entire study period, with a slight decline in 2001 and an increase in 2011.

Thus, Table 1 indicates that the distribution of Scheduled Caste population in Ahilyanagar District is marked by clear **regional disparity**. The highest concentration is found in tehsils like **Shrirampur and Rahata**, whereas the lowest concentration is observed in **Akole**. The data also show that the district experienced a slight overall increase in Scheduled Caste population percentage by 2011. Therefore, the table confirms that Scheduled Caste population distribution in Ahmednagar District is spatially uneven and temporally changing.

Rural and Urban Distribution

1. Rural Distribution

The rural-urban distribution of Scheduled Caste population is an important dimension of the study. In Ahilyanagar District, a large share of Scheduled Caste population is likely to be rural because the district has a strong agrarian base and a substantial rural population. Rural Scheduled Castes are often associated with agricultural labor, animal husbandry, village services, construction labor, and low-income occupations. The rural Scheduled Caste population in District is not uniformly **distributed** from one tehsil to another. The pattern indicates clear regional variation during **1991, 2001 and 2011**. In most rural tehsils, the proportion of Scheduled Caste population remained around **12% to 14%**, but some tehsils recorded much higher or much lower values.

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Table:2 Tehsil wise Rural SC Population distribution (%)

Sr. No	Tehsil	1991			2001			2011		
		Total	Male	Female	Total	Male	Female	Total	Male	Female
1	Akola	4.25	4.27	4.24	4.21	4.15	4.27	4.42	4.42	4.43
2	Jamkhed	13.19	13.22	13.14	12.00	11.77	12.24	13.32	13.10	13.56
3	Karjat	14.13	14.12	14.14	13.53	13.40	13.66	14.18	13.88	14.51
4	Kopargaon	13.84	13.84	13.83	12.67	12.57	12.78	12.61	12.47	12.76
5	Nagar	13.78	13.82	13.74	14.07	14.05	14.09	14.11	14.06	14.16
6	Newasa	14.15	14.18	14.12	14.01	13.87	14.15	14.72	14.52	14.92
7	Parner	6.93	7.03	6.83	6.72	6.75	6.69	6.97	6.84	7.11
8	Pathardi	12.04	14.09	9.91	9.44	9.37	9.51	9.79	9.67	9.92
9	Rahata	0.00	0.00	0.00	15.86	15.70	16.03	16.73	16.47	17.00
10	Rahuri	13.89	13.85	13.94	13.53	13.55	13.51	13.16	13.04	13.29
11	Sangamner	8.52	8.54	8.50	8.30	8.28	8.32	8.42	8.29	8.56
12	Shevgaon	14.33	14.28	14.39	13.75	13.72	13.78	14.72	14.49	14.96
13	Shrigonda	11.99	12.07	11.91	12.23	12.24	12.23	12.75	12.58	12.93
14	Shrirampur	18.43	19.61	17.18	17.94	17.72	18.16	19.56	19.17	19.98
Total		**12.22**	**12.50**	**11.93**	**11.72**	**11.67**	**11.76**	**12.21**	**12.06**	**12.37**

(**Source:** Census of India-1991, 2001 & 2011)

Among the tehsils, **Shrirampur** showed the highest rural Scheduled Caste concentration throughout the study period. It remained the leading tehsil in all three Census years, indicating a strong concentration of Scheduled Caste population in rural parts of this tehsil. Rahata, Newasa, Shevgaon, Karjat, and Nagar also recorded comparatively high rural Scheduled Caste percentages. These tehsils can be considered important rural concentration zones of Scheduled Caste population in District.

On the other hand, **Akola** showed the **lowest rural Scheduled Caste percentage** in all the Census years. **Parner** and **Sangamner** also recorded low rural Scheduled Caste concentration. This low share may be related to different social composition, tribal dominance in some areas, and regional differences in settlement pattern.

The table-2 also indicates that the district average of Scheduled Caste population remained close to **12 percent** during the study period. There was a slight decline in **2001** and a small increase again in **2011**. This shows that although the overall district pattern remained almost stable, tehsil-level variations were quite significant.

A comparison of male and female rural Scheduled Caste percentages shows that in many tehsils, the **female percentage was slightly higher than the male percentage**. This suggests a relatively balanced sex composition in the rural Scheduled Caste population.

Overall, the rural Scheduled Caste distribution in Ahmednagar District is marked by high concentration in Shrirampur, Rahata, Newasa, Shevgaon, Karjat, and Nagar**, and** low concentration in Akola, Parner, and Sangamner**.** Thus, the rural Scheduled Caste population is not equally distributed and reflects the influence of local social and economic conditions.

The rural Scheduled Caste population in Ahilyanagar District shows **spatial inequality**. Some tehsils have high concentration, while others have low concentration. Therefore, rural SC distribution in the district is geographically uneven.

2. Urban Distribution

Urban Scheduled Caste population is found in towns and cities where employment opportunities are comparatively diversified. In urban areas they may work in factories, transport, trade, municipal services, education support services, domestic work, and informal labor sectors. The growth of urban centers like Ahmednagar city, Shrirampur, Kopargaon, Sangamner, and Rahuri has influenced such concentration.

The rural concentration of Scheduled Castes reflects the historical rural social structure, while the urban concentration reflects migration, economic change, and the search for better livelihood.

The urban Scheduled Caste population in Ahmednagar District shows clear tehsil-wise variation during 1991, 2001 and 2011. At the district level, the urban SC population was 13.39% in 1991, 13.12% in 2001 and 14.29% in 2011. This shows a slight decline in 2001 and a noticeable increase in 2011. The female urban SC percentage was slightly higher than the male percentage at the district level.

Among the tehsils, Shrirampur recorded the highest urban SC population percentage in 1991 (19.80%) and 2001 (20.98%). In 2011, Rahata (18.97%), Karjat (18.63%) and Shrirampur (18.69%) were the major urban concentration centers of Scheduled Caste population. Kopargaon, Nagar, and Rahuri also showed comparatively high urban SC percentages.

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Table:3 Tehsil wise Urban SC Population distribution (%)

Sr. No.	Tehsil	1991			2001			2011		
		Total	Male	Female	Total	Male	Female	Total	Male	Female
1	Akola	0.00	0.00	0.00	0.00	0.00	0.00	8.57	8.04	9.15
2	Jamkhed	0.00	0.00	0.00	11.88	11.79	11.97	11.78	11.60	11.97
3	Karjat	0.00	0.00	0.00	0.00	0.00	0.00	18.63	17.99	19.32
4	Kopargaon	14.76	13.74	15.97	12.95	12.70	13.21	16.07	15.86	16.29
5	Nagar	12.25	11.96	12.57	12.42	11.86	13.05	14.22	13.85	14.62
6	Newasa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	Parner	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	Pathardi	11.41	11.56	11.23	10.46	10.14	10.82	10.68	10.33	11.06
9	Rahata	0.00	0.00	0.00	16.84	16.12	17.61	18.97	18.62	19.35
10	Rahuri	13.06	13.12	12.98	12.90	12.90	12.90	14.77	14.55	15.01
11	Sangamner	6.26	6.09	6.45	7.09	6.98	7.21	8.10	8.15	8.04
12	Shevgaon	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	Shrigonda	12.20	12.35	12.04	13.39	13.23	13.57	12.51	12.14	12.90
14	Shrirampur	19.80	19.86	19.73	20.98	20.85	21.11	18.69	18.39	19.00
Total		**13.39**	**13.07**	**13.73**	**13.12**	**12.72**	**13.55**	**14.29**	**13.98**	**14.61**

(**Source:** Census of India-1991, 2001 & 2011)

On the other hand, Sangamner showed a low urban SC percentage, with 6.26% in 1991, 7.09% in 2001, and 8.10% in 2011. Akola had no urban SC population in 1991 and 2001, but it recorded 8.57% in 2011. Some tehsils such as Newasa, Parner, and Shevgaon showed 0.00 percent because of the absence of urban population or urban units in those years.

Overall, the urban SC population in Ahmednagar District is not evenly distributed. High concentration is found in Shrirampur, Rahata, Karjat, Kopargaon, Nagar, and Rahuri, while low concentration is seen in Sangamner and Akola. Thus, the urban SC population distribution in the district is spatially uneven and changed over time.

Thus, the urban Scheduled Caste population in Ahilyanagar District shows clear spatial variation. High concentration is observed in **Shrirampur, Rahata, and Karjat**, while low concentration is found in **Sangamner and Akola**. The district also experienced an increase in urban SC population percentage by 2011. Therefore, the urban SC distribution in Ahmednagar District is uneven and changing over time**.**

Sex Composition of Scheduled Caste Population

The sex composition of Scheduled Caste population is another important aspect. Usually, the male and female Scheduled Caste population in the district remains nearly balanced, but the sex ratio may vary between rural and urban areas. Rural areas often show a more balanced structure, while urban areas may be influenced by male-selective migration for work. According 2011 the overall sex ratio of the district is approximately 967; while rural and urban is 963 and 984 respectively. Overall, rural and urban sex ratio in 1991 was 919, 911 and 960 respectively; while in 2001 it was 924, 955 and 966 respectively.

A favourable sex ratio suggests balanced demographic conditions, while an unfavourable ratio may indicate migration, social inequality, or lower female survival in some areas. The study of sex composition is useful for welfare planning, especially in education, health, and women-oriented development schemes.

Factors Influencing Scheduled Caste Population Distribution

The distribution of Scheduled Caste population in District is influenced by several geographical and socio-economic factors.

1. Historical Factors

The caste-based settlement system in villages has historically shaped the location and concentration of Scheduled Castes. Many communities were traditionally linked with village services and labor activities.

2. Agricultural Economy

Since Ahilyanagar is an agricultural district, labor demand in farming, irrigation works and sugarcane cultivation has attracted and retained Scheduled Caste population in certain regions.

3. Irrigation and Sugar Industry

Areas with irrigation and sugar factories provide employment in cultivation, transport, mills and allied activities. Such areas often show greater concentration.

4. Urbanization

Urban centers provide opportunities in industry, trade, construction, transport, and public services. Hence, towns attract Scheduled Caste migrants from nearby rural areas.

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5. Social and Educational Factors

Access to schools, government schemes, hostels, and welfare measures can influence settlement stability and upward mobility.

6. Migration

Both rural-to-urban migration and seasonal migration affect local distribution. Young workers often move toward towns or irrigated agricultural areas.

Spatial Interpretation

From a geographical point of view, the Scheduled Caste population in Ahmednagar District shows a pattern of clustering rather than uniform spread. This clustering is usually seen in: densely settled agricultural villages, irrigation command areas, sugar belt regions, towns and transport corridors, industrial and service centers, etc.

Areas with weak resource base, hilly terrain, lower irrigation, or a different social composition may show lower Scheduled Caste concentration. Thus, the pattern reflects the interaction between environment, economy, history, and society.

Major Findings

The major findings of the study are as follows:

1. Scheduled Castes form an important component of Ahmednagar District's population, accounting for roughly one-eighth of the total population in the 2011 Census.
2. Their distribution is uneven and varies significantly from one tehsil to another.
3. Rural areas contain a major share of the Scheduled Caste population because of the agrarian economy of district.
4. Urban centers also show considerable concentration due to employment opportunities and migration.
5. The sex composition of Scheduled Caste population is relatively balanced, but rural-urban differences may occur.
6. Irrigation, sugar industry, urbanization, and historical settlement pattern are major factors influencing their distribution.
7. The uneven distribution highlights the need for region-specific welfare and development planning.

Suggestions

On the basis of the study, the following suggestions can be made:

1. Educational facilities should be strengthened in rural and socially backward areas.
2. Special attention should be given to female education among Scheduled Castes.
3. Skill development and vocational training should be expanded in both rural and urban areas.
4. Employment generation programs should be promoted in drought-prone and economically weaker tehsils.
5. Housing, sanitation, and drinking water facilities should be improved in Scheduled Caste localities.
6. Welfare schemes should be implemented with better local targeting.
7. Urban poor settlements with Scheduled Caste concentration should receive improved civic amenities.
8. Village-level and ward-level planning should be adopted for effective social justice measures.
9. Scholarships, hostels, and digital access should be increased for Scheduled Caste students.
10. Periodic monitoring of social indicators should be carried out for balanced district development.

Conclusion

The present study on Scheduled Caste population distribution in Ahilyanagar District shows that social groups are not evenly distributed in geographical space. The distribution pattern of Scheduled Castes is shaped by agricultural economy, irrigation, settlement history, urban growth, and employment opportunities. Census data provides a valuable basis for understanding these patterns.

The study makes clear that Scheduled Castes occupy an important place in the demographic and social structure of the district. Their concentration is higher in some regions and lower in others, creating a varied social geography. Rural areas continue to hold a major share, though urban centers are becoming increasingly important due to migration and economic diversification. Literacy and work participation reveal both progress and continuing inequality.

Therefore, the study of Scheduled Caste population distribution is highly useful for social welfare planning, inclusive development, and balanced regional progress in Ahmednagar District.

Acknowledgment

I would like to express my sincere gratitude to all those who have supported and guided me in the successful completion of my project titled "A Geographical Analysis of Scheduled Caste Population Distribution in Ahilyanagar District."

First and foremost, I am deeply thankful to my project guide/mentor for their invaluable guidance, constant encouragement, and insightful suggestions throughout the course of this study. Their support helped me understand the spatial distribution and geographical aspects of population studies.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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Original Article

A Study of the Role of Artificial Intelligence in the Development of Teaching Skills among B.Ed. Teacher Trainees

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Abstract

The present study titled "A Study of the Role of Artificial Intelligence in the Development of Teaching Skills among B.Ed. Teacher Trainees" focuses on examining how Artificial Intelligence (AI) supports the development of teaching competencies among teacher trainees. In the 21st century, technological advancements have transformed educational practices, and AI has emerged as an effective tool to support teaching–learning processes. AI tools assist teachers in preparing lesson plans, generating teaching materials, designing presentations, creating assessments, and providing feedback.

Teacher education institutions play a crucial role in preparing competent teachers for modern classrooms. Therefore, integrating AI into teacher education programs can help B.Ed. trainees develop essential teaching skills such as lesson planning, classroom interaction, use of teaching aids, and assessment techniques.

The present study adopted the descriptive survey method. A researcher-made questionnaire using the Likert scale was used for data collection. The sample consisted of 164 B.Ed. teacher trainees selected purposively from two Colleges of Education affiliated with Savitribai Phule Pune University in Ahilyanagar district, Maharashtra during the academic year 2025–2026.

The collected data were analyzed using the percentage method, and the results were represented through bar graphs. The findings revealed that the majority of teacher trainees believe AI tools are highly useful in lesson planning, preparing digital teaching materials, creating innovative teaching methods, and designing assessment tools. The study also highlights that AI enhances teaching effectiveness, improves confidence, and supports student-centered teaching practices. Furthermore, the respondents strongly emphasized the need to include AI training in B.Ed. programs for the effective development of teaching skills.

Keywords: *Artificial Intelligence, Teaching Skills, B.Ed. Teacher Trainees, Teacher Education, Educational Technology, Lesson Planning, Student-Centered Teaching, Assessment Practices.*

Introduction:

In the twenty–first century, the field of education has been greatly influenced by rapid technological developments. Among these advancements, Artificial Intelligence (AI) has gained significant attention for its ability to support and improve the teaching–learning process. AI-based tools enable teachers and learners to access a wide range of resources and assist in preparing teaching materials, designing presentations, generating assessments, and providing quick feedback. As a result, traditional classroom practices are gradually transforming into more engaging, interactive, and learner-centered approaches.

Teacher education plays an important role in preparing future teachers to meet the demands of modern classrooms. B.Ed. teacher trainees are expected to acquire essential teaching skills such as lesson planning, effective presentation, use of teaching aids, classroom communication, and appropriate evaluation techniques. Developing these competencies requires not only theoretical knowledge but also exposure to innovative teaching methods and modern technological tools.

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In this context, Artificial Intelligence can serve as a supportive resource for teacher trainees. AI tools can help them design lesson plans, create digital learning materials, explain complex or abstract concepts more clearly, and develop interactive learning activities for students. In addition, these tools assist teachers in organizing their instructional plans, managing classroom time effectively, and preparing evaluation methods such as quizzes and question papers.

Therefore, the integration of Artificial Intelligence in teacher education programs has the potential to strengthen the professional competencies of future teachers. Considering this growing importance, it is necessary to examine how AI contributes to the development of teaching skills among teacher trainees. Hence, the present study focuses on "The Role of Artificial Intelligence in the Development of Teaching Skills among B.Ed. Teacher Trainees."

Research Objectives:

1. To study the role of Artificial Intelligence tools in assisting B.Ed. teacher trainees in lesson planning and preparation of teaching–learning materials.
2. To examine the role of Artificial Intelligence in enhancing teaching skills and promoting innovative and student-centered teaching practices among B.Ed. teacher trainees.
3. To analyze the effectiveness of Artificial Intelligence in improving teaching effectiveness, assessment practices, and confidence among B.Ed. teacher trainees.
4. To study the perceived need for integrating Artificial Intelligence training in B.Ed. programs for the development of teaching skills.

Scope of the Study:

1. The present study is related to B.Ed. teacher trainees undergoing teacher training during the academic year 2025–2026.
2. The study includes both first-year and second-year B.Ed. students.
3. The study is limited to Colleges of Education located in Ahilyanagar district Maharashtra.
4. In the present research includes teacher trainees from Swami Sahajanand Bharati College of Education, Shrirampur and Abasaheb Kakade Shikshanshastra Mahavidyalaya, Shevgaon.
5. The study focuses on examining the role of Artificial Intelligence in the development of teaching skills among B.Ed. teacher trainees.
6. The sample of the study consists of 164 B.Ed. students selected from two Colleges of Education in Ahilyanagar district.
7. The findings of the study are confined to the academic context of the year 2025–2026.

Limitations of the Study:

1. The study is limited only to B.Ed. teacher trainees of the academic year 2025–2026.
2. The study includes only first-year and second-year B.Ed. students and does not consider other teacher education programs.
3. The study is confined to two Colleges of Education in Ahilyanagar district, therefore the findings may not be generalized to other districts or institutions.
4. The sample size of the study is limited to 164 students only.
5. The study focuses only on the role of Artificial Intelligence in the development of teaching skills and does not cover other aspects of teacher education.

Research Questions:

1. What is the level of awareness of Artificial Intelligence among B.Ed. teacher trainees?
2. How frequently do B.Ed. teacher trainees use Artificial Intelligence tools for teaching–learning purposes?
3. What teaching skills are influenced by the use of Artificial Intelligence tools?
4. How does Artificial Intelligence help B.Ed. teacher trainees in lesson planning and content preparation?
5. What are the perceived advantages of using Artificial Intelligence in the development of teaching skills?
6. What challenges do B.Ed. teacher trainees face while using Artificial Intelligence in teaching practice?

Research Methodology:

In the present research, the researcher's objective is to examine the role of artificial intelligence in the development of teaching skills of B.Ed. teacher trainees. Therefore, the survey research method in the descriptive research method has been used for this research.

Tools for Data Collection:

In the present research, a researcher-made questionnaire has been used as the tool for data collection. The questionnaire includes a total of ten multiple-choice questions. It has been designed using the Likert Scale method, and three options have been provided for each question.

The questionnaire has been prepared with the help of Google Forms. Furthermore, to ensure the validity and appropriateness of the questionnaire, it has been reviewed and verified by subject experts.

Sample Selection:

For the present research, out of the 18 Colleges of Education in Ahilyanagar district, 160 B.Ed. teacher trainees from two Colleges of Education (Savitribai Phule Pune University) have

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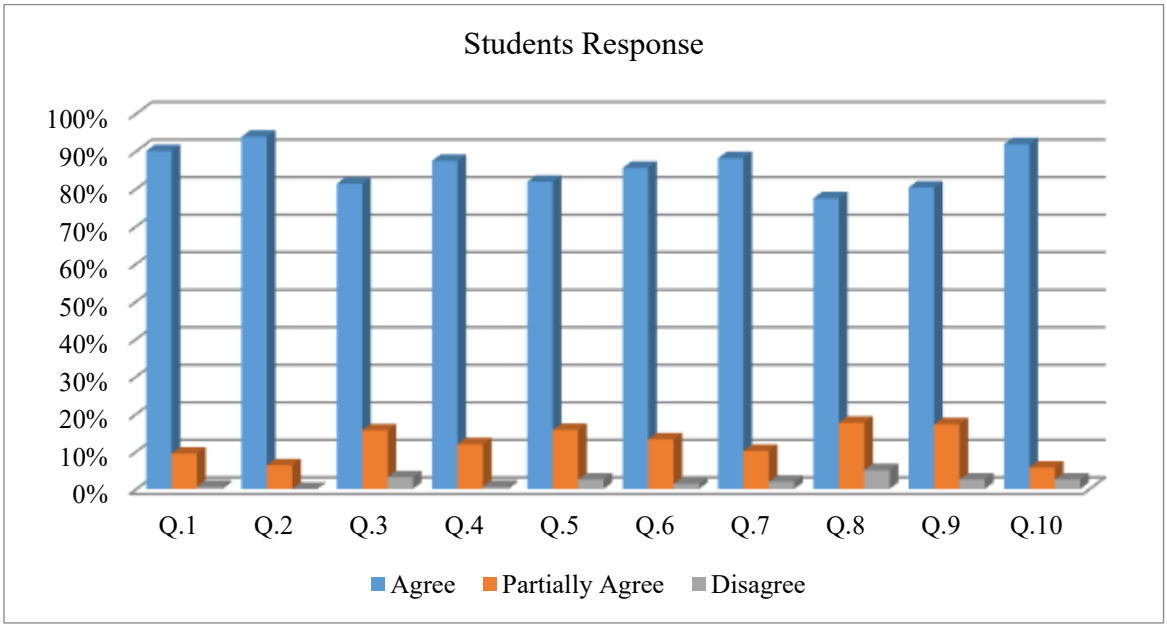
been selected purposively (using purposive sampling method) as the sample for the study.

Analysis and Interpretation of Collected Data:

In the present research, the percentage technique has been used for the analysis of the collected data. To represent the comparative responses of the respondents, a bar graph has been used.

Question No.	Response		
	Agree	Partially Agree	Disagree
1	90% (144)	9.4% (15)	0.6% (1)
2	93.8% (150)	6.3% (10)	0% (0)
3	81.3% (130)	15.6% (25)	3.1% (5)
4	87.4% (139)	11.9% (19)	0.6% (1)
5	81.8% (130)	15.7% (25)	2.5% (4)
6	85.5% (140)	13.2% (21)	1.3% (2)
7	88.1% (140)	10.1% (16)	1.9% (3)
8	77.4% (123)	17.6% (28)	5% (8)
9	80.3% (126)	17.2% (27)	2.5% (4)
10	91.8% (145)	5.7% (9)	2.5% (4)



Question 1. Do Artificial Intelligence tools help B.Ed. teacher trainees in preparing lesson plans?

Observation:

From the above bar chart, it is observed that 144 (90%) respondents selected the "Agree" option, while 15 respondents selected the "Partially Agree" option, which constitutes 9.4% of the total responses.

Interpretation:

From the presented data, it can be concluded that Artificial Intelligence tools help B.Ed. teacher trainees in preparing lesson plans.

Question 2. Is artificial intelligence useful for creating images, videos, and presentations for teaching?

Observation:

From the above bar graph, it is observed that 150 (93.8%) respondents selected the "Agree" option, while 10 (6.3%) respondents selected the "Partially Agree" option.

Interpretation:

From the given data, it can be concluded that Artificial Intelligence is useful for preparing images, videos, and presentations for teaching purposes.

Question 3. Does the use of Artificial Intelligence in teaching help in developing the skill of clearly explaining difficult and abstract concepts?

Observation:

From the above graph, it is observed that 130 respondents (81.3%) selected the "Agree" option, while 25 respondents selected the "Partially Agree" option, which accounts for 15.6%. A very

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small number of respondents, 5 (3.1%), selected the "Disagree" option.

Interpretation:

From the above data, it can be inferred that the use of Artificial Intelligence in teaching helps in developing the skill of clearly explaining difficult and abstract concepts.

Question 4. Does artificial intelligence help in discovering new and innovative teaching methods for Classroom teaching?

Observation:

From the above graph, it is observed that 139 (87.4%) respondents selected the "Agree" option, while 19 respondents selected the "Partially Agree" option, which constitutes 11.9%. On the other hand, the "Disagree" option was chosen by a very small number of respondents, that is, only 1 (0.6%) respondent.

Interpretation:

From the above data, it can be inferred that Artificial Intelligence helps in discovering new and innovative teaching methods for teaching.

Question 5. Do artificial intelligence tools make it easier to create student-centered teaching activities?

Observation:

From the above graph, it can be seen that 130 (81.8%) respondents selected the "Agree" option, while 25 respondents (15.7%) selected the "Partially Agree" option. On the other hand, the "Disagree" option was chosen by a very small number of respondents, that is only 4 (2.5%) respondents.

Interpretation:

From the given data, it appears that Artificial Intelligence tools make it easier to create student-centered teaching activities.

Question 6. Can the use of Artificial Intelligence make teaching more effective and engaging?

Observation:

From the above graph, it is observed that 136 (85.5%) respondents selected the "Agree" option**,** while 21 respondents selected the "Partially Agree" option**,** which accounts for 13.2%**.** The "Disagree" option was chosen by a very small number of respondents, i.e., only 2 respondents (1.3%)**.**

Interpretation:

From the above data, it can be concluded that the use of Artificial Intelligence helps make teaching more effective and engaging.

Question 7. Is artificial intelligence useful in creating quizzes, question papers, and activities for assessment?

Observation:

From the above graph, it is observed that 140 (88.1%) respondents selected the "Agree" option, while 16 respondents (10.1%) selected the "Partially Agree" option. On the other hand, the "Disagree" option was selected by a very small number of respondents that is only 3 respondents (1.9%).

Interpretation:

From the given data, it can be concluded that artificial intelligence is useful in preparing quizzes, question papers, and activities for assessment purposes.

Question 8. Does the use of Artificial Intelligence help in better planning of teaching and time management?

Observation:

From the above graph, it is observed that 123 (77.4%) respondents selected the "Agree" option, while 28 respondents selected the "Partially Agree" option, which accounts for 17.6%. On the other hand, the "Disagree" option was selected by a very small number of respondents, i.e., only 8 (5%) respondents.

Interpretation:

From the above information, it can be concluded that the use of Artificial Intelligence helps in improving lesson planning and time management in teaching.

Question 9. Does the use of artificial intelligence tools increase confidence while teaching?

Observation:

From the above graph, it is observed that 126 (80.3%) respondents selected the option *Agree*, while 27 respondents (17.2%) selected the option *Partially Agree*. The option *Disagree* was selected by a very small number of respondents, that is only 4 (2.25%).

Interpretation:

From the given data, it can be concluded that the use of Artificial Intelligence tools increases confidence while teaching.

Question 10. Is it necessary to provide training in Artificial Intelligence for the development of teaching skills in B.Ed. training?

Observation:

From the above graph, it can be seen that 145 (91.8%) respondents selected the Agree option, while 9 respondents selected the Partially Agree option, which constitutes 5.7%. A very small number of respondents, only 4 (2.25%), selected the Disagree option.

Interpretation:

From the given information, it is evident that providing Artificial Intelligence (AI) training for the development of teaching skills in B.Ed. training is considered necessary.

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Findings:

1. The study revealed that 90% of respondents agreed that AI tools help in preparing lesson plans, and 93.8% agreed that AI is useful in creating teaching materials such as images, videos, and presentations. This indicates that AI tools significantly support teacher trainees in lesson preparation and instructional material development.
2. The data show that 81.3% respondents agreed that AI helps in explaining difficult concepts clearly, 87.4% agreed that AI helps discover innovative teaching methods, and 81.8% agreed that AI tools assist in designing student-centered teaching activities. Thus, AI contributes significantly to the development of modern and innovative teaching skills.
3. The study found that 85.5% respondents agreed that AI makes teaching more effective and engaging. Additionally, 88.1% respondents agreed that AI helps in preparing quizzes and question papers, while 80.3% believed that AI increases confidence during teaching. Hence, AI plays an important role in improving teaching effectiveness and assessment practices.
4. The results show that 91.8% respondents agreed that AI training should be included in B.Ed. programs. This clearly indicates a strong perceived need among teacher trainees for systematic training in AI tools to enhance their professional teaching competencies.

Conclusion:

The findings of the present study clearly indicate that Artificial Intelligence plays a significant role in the development of teaching skills among B.Ed. teacher trainees. AI tools assist teacher trainees in preparing lesson plans, creating digital instructional materials, and designing student-centered teaching activities. The study also reveals that AI contributes to improving teaching effectiveness, assessment practices, time management, and confidence during teaching practice.

Furthermore, the majority of respondents strongly emphasized the importance of integrating AI training into B.Ed. teacher education programs. Therefore, teacher education institutions should provide adequate training and guidance in the use of AI-based educational tools so that future teachers can effectively utilize technology in modern classrooms. Integrating AI into teacher education will help in developing innovative, competent, and technologically skilled teachers.

Acknowledgment

I would like to express my sincere gratitude to all those who have supported and guided me in the successful completion of my project titled "A Study of the Role of Artificial Intelligence in the Development of Teaching Skills among B.Ed. Teacher Trainees."

First and foremost, I am deeply thankful to my project guide/mentor for their invaluable guidance, constant encouragement, and insightful suggestions throughout the course of this study. Their support helped me understand the role of artificial intelligence in enhancing teaching skills and modern educational practices.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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Original Article

Iran-Israel-US Conflict: Impact on Global Politics and India's Energy Security

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Abstract

The ongoing conflict involving Iran, Israel, and the United States has emerged as a significant geopolitical crisis with far-reaching implications for global politics and energy security. This study examines the impact of the conflict on international relations, global power dynamics, and economic stability, with a particular focus on India's energy security.

For India, which imports a substantial portion of its crude oil requirements, the crisis poses serious challenges including rising import bills, inflationary pressures, and risks to economic stability. The study highlights India's strategic responses, such as diversification of energy sources, strengthening of strategic petroleum reserves, and emphasis on renewable energy transition. It also evaluates the broader implications for global energy governance and geopolitical alignments.

Overall, the research underscores the need for resilient energy policies and diplomatic strategies to mitigate the adverse effects of such conflicts on global and national economies.

Keywords: *Iran–Israel–US Conflict, Global Politics, Energy Security, India, Strait of Hormuz, Crude Oil Prices, Geopolitics, Supply Chain Disruption, Strategic Petroleum Reserves*

Introduction:

The conflict in the Middle East and global geopolitical economics have become central to international politics in the 21st century. In particular, the relationships among Iran, Iraq, Israel, and United States are no longer limited to conventional military confrontations, but have evolved under the shadow of a new form of "Cold War." The core of this conflict lies in the struggle for religious dominance, control over natural resources (especially oil and gas), and geopolitical influence. The tensions among Iran, Iraq, Israel, and United States have a profound impact on the global economy. Over the past few decades, the strategic alliance between United States and Israel has aimed to contain Iran's growing nuclear capabilities and its expanding regional influence. On the other hand, Iraq has emerged as a major battlefield in this conflict, where competing interests of global and regional powers intersect. Iran's use of proxy warfare strategies and the economic sanctions imposed by the United States have contributed to a persistent state of tension in the region. This tension has now transformed into a form of Cold War, where economic blockades and cyber warfare are increasingly used instead of direct military confrontation. This regional conflict significantly affects the global economy. Since a large portion of the world's energy resources is concentrated in this region, even minor developments can create a "butterfly effect" on a global scale. For instance, when the United States imposes sanctions on Iran, or when tensions escalate between Israel and Iran, it directly impacts crude oil prices, disrupts global supply chains, and creates volatility in stock markets.

Rise in Crude Oil Prices

The instability in the Middle East has the most significant impact on global oil supply. Iran and Iraq are major oil-producing countries.

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Due to fears of war, crude oil prices have been rising steadily, leading to increased inflation in India and across the world, thereby affecting overall economic stability. The Strait of Hormuz, through which nearly 20% of the world's crude oil supply passes, plays a crucial role in global energy security. Any disruption in this route leads to a sharp rise in global oil prices. Experts estimate that if the conflict continues for a prolonged period, crude oil prices may reach between $120 and $150 per barrel.

Supply Chain Disruptions

The Strait of Hormuz is a vital global trade route. If this route is blocked due to tensions between Iran and United States, global shipping and trade could be severely disrupted. This would reduce the supply of crude oil and directly impact transportation and logistics sectors. Rising fuel and natural gas prices have increased transportation costs, which in turn have raised the prices of food grains and fertilizers. As a result, global inflation may increase by approximately 0.5% to 0.8%. Additionally, tensions in the Red Sea have forced ships to reroute, causing delays in global trade and significantly increasing freight costs.

Stock Markets and Investment

War-like conditions create volatility in global stock markets. Investors tend to withdraw funds from risky assets such as stocks and shift towards safer assets like gold and the US dollar. This leads to a rise in gold prices and instability in both global and domestic stock markets.

Défense Spending

Due to the "Cold War"-like situation in the Gulf region, countries around the world are increasing their defines expenditure. As a result, budgets allocated for development sectors such as education and healthcare are often reduced and diverted towards military spending.

Impact on Global Economy

This conflict is expected to slow down global GDP growth by approximately 0.3%. Many countries are experiencing sharp declines in their stock markets due to the uncertainty and instability caused by the conflict.

Geopolitical Instability

As the United States shifts its focus toward the Middle East, there is a possibility of reduced attention toward the Indo-Pacific region, allowing China to expand its influence. Additionally, the involvement of countries like Russia and China is reshaping global political alignments. The conflict has also led to humanitarian and environmental crises, including large-scale loss of life and property. Military operations are causing severe environmental damage and posing risks to public health.

Impact on India

India imports more than 80% of its crude oil requirements. Therefore, rising oil prices increase India's Current Account Deficit (CAD), putting pressure on the economy and leading to depreciation of the Indian rupee. In terms of energy security, about 91% of India's LPG supply and a significant portion of crude oil imports pass through the Strait of Hormuz. Disruptions in this route have already led to an increase of approximately ₹60 in domestic LPG cylinder prices and ₹114–₹115 in commercial cylinder prices. With crude oil prices crossing $120 per barrel, India's import bill is expected to rise further. Higher fuel and gas prices have increased the cost of fertilizers and transportation, which in turn has raised food prices and increased domestic inflation. Due to tensions in the Gulf region, airlines such as Air India have had to alter flight routes. For example, flights to New York and Newark now require stopovers in Rome, increasing both travel time and costs. Around 10 million Indians are employed in the Middle East. In case of escalation, ensuring their safety and evacuation would be a major challenge for India. Additionally, due to geopolitical instability, Foreign Portfolio Investors (FPIs) are withdrawing investments from Indian markets and shifting towards safer assets like gold, leading to volatility in the Indian stock market. India has emphasized maintaining "strategic autonomy" in this situation and has urged all sides to exercise restraint.

Policy Measures

Strategic Measures at the Government Level

India should reduce its dependence solely on the Middle East by increasing crude oil imports from countries such as Russia, African nations, and the United States. To maintain domestic price stability during emergencies, India should effectively utilize its strategic petroleum reserves located at Visakhapatnam, Mangalore, and Padur. In order to reduce rising transportation costs caused by tensions in the Red Sea, India should make effective use of alternative trade routes such as the Chabahar Port and other maritime corridors. Additionally, India should maintain its policy of "strategic autonomy" by engaging diplomatically with all sides and taking initiatives to promote peace, thereby ensuring the stability of global supply chains.

Economic Measures

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To reduce dependence on the US dollar, India should promote trade with friendly nations in Indian rupees, which would help reduce pressure on foreign exchange reserves. Furthermore, to protect common citizens from rising fuel prices, both central and state governments should consider temporarily reducing taxes on fuel and implementing appropriate relief measures.

Long-Term Changes in the Energy Sector

India should focus on increasing the use of renewable energy sources such as solar and wind power to permanently reduce dependence on fossil fuels.In the transportation sector, greater emphasis should be placed on promoting electric vehicles (EVs) and ethanol-blended fuels as alternatives to petrol and diesel.

Conclusion

The conflict among Iran, Israel, and the United States has posed a serious threat to global energy security and supply chains. As a result, oil-importing countries like India are facing a significant burden of inflation. To address this situation, it is essential for India to diversify its energy sources and prioritize renewable energy. In times of geopolitical instability, maintaining strategic autonomy while actively contributing to global peace efforts remains the most effective path toward economic stability.

Acknowledgment

I would like to express my sincere gratitude to all those who have supported and guided me in the successful completion of my project titled "Iran–Israel–US Conflict: Impact on Global Politics and India's Energy Security."

First and foremost, I am deeply thankful to my project guide/mentor for their invaluable guidance, constant encouragement, and insightful suggestions throughout the course of this study. Their support helped me understand the complex geopolitical dynamics and their implications on global politics and energy security.

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Conflicts of interest

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Original Article

Spatio-Temporal Analysis of Rainfall Variability and Its Implications for Water Management in Ahmednagar District, Maharashtra

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Abstract

Ahmednagar district, also known as Ahilyanagar, is the largest district of Maharashtra and is officially recognized as being a drought-prone region with a significant level of spatial unevenness in the rainfall distribution and an acute reliance to the agricultural sphere and groundwater sources (District Administration Ahilyanagar, 2026; Government of India, 2014). The present paper analyses the temporal variability of rainfall in districts and explains its implications to managing water in the district based on secondary data only. The sampling depends mostly on year-wise/tahsilwise rainfall data available in the district administration and published in 1981-2014, with the addition of district agriculture and groundwater reports (District Administration Ahilyanagar, 2026; Government of India, 2014; Central Ground Water Board, 2018). The published June-October values of the rainfall in the compiled series of district give the mean annual rainfall of 527.23 mm, coefficient of variation of 24.06 and annual series exhibits a high inter-annual fluctuation that has a weak long-run linear trend over the period of study. These findings point to the fact that the central hydro-climatic problem of the district is not a monotonic reduction in rainfall, but its variability. The paper will suggest that it is more suitable to respond to semi-arid, drought-prone conditions by decentralized storage, recharging aquifers, planning crops, micro-irrigation, and water budgeting based on rainfall rather than supply expansion alone (Government of India, 2014; Central Ground Water Board, 2018; Sivararajan et al., 2019).

Keywords: *Ahmednagar district; rain fall variability; drought prone area; ground water; water management; secondary data; Maharashtra*

Introduction:

One of the underlying controls of the semi-arid areas on agriculture, recharging ground water, surface storage, and risk of drought, is rainfall variability. Even small changes in the beginning, intensity, and intra-seasonal distribution of monsoon rainfall may change crop outcomes and seasonal water availability in other parts of the year in districts that have a seasonal pattern of concentrated distribution (Das et al., 2020; Kumar et al., 2025). It is based on this reason why spatial-temporal examination of precipitation continues to focus on water management and planning in regions.

It is also important to consider the Ahmednagar district due to the fact that according to the description of the district administration, the climate of the area is largely hot and dry and the district falls under the drought-prone category with the uneven rainfall distribution across the talukas whereas the agricultural contingency plan covers the majority of the district with the Western Maharashtra Scarcity Zone (District Administration Ahilyanagar, 2026; Government of India, 2014). The profile of agriculture in the district also reveals that the area under rainfed is large, as well as the large reliance on wells to irrigate agricultural products, making the district more susceptible to irregular seasonal rainfall (Government of India, 2014).

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Past experiments of Ahmednagar and other dry areas of India also highlight huge temporal changes in rainfall, correlations between dry years and groundwater strain, and the usefulness of statistical rainfall data analysis in agricultural and water management (Salunke, 2021; Jadhav et al., 2021; Sivarajan et al., 2019). It is based on this literature that the current paper will utilize secondary data to synthesize the behavior of rainfall at the district scale and to translate the results to the real-world application of the same in managing water.

Objectives

- To explain the space and time nature of the variability of rainfall in Ahmednagar district in terms of published secondary data.
- To briefly sum up the inter-annual variation in rainfall in 1981-2014 using the official district rainfall series.
- To derive the implications of the variability of rainfall on groundwater, irrigation planning, and decentralized water management in the district.

Study Area

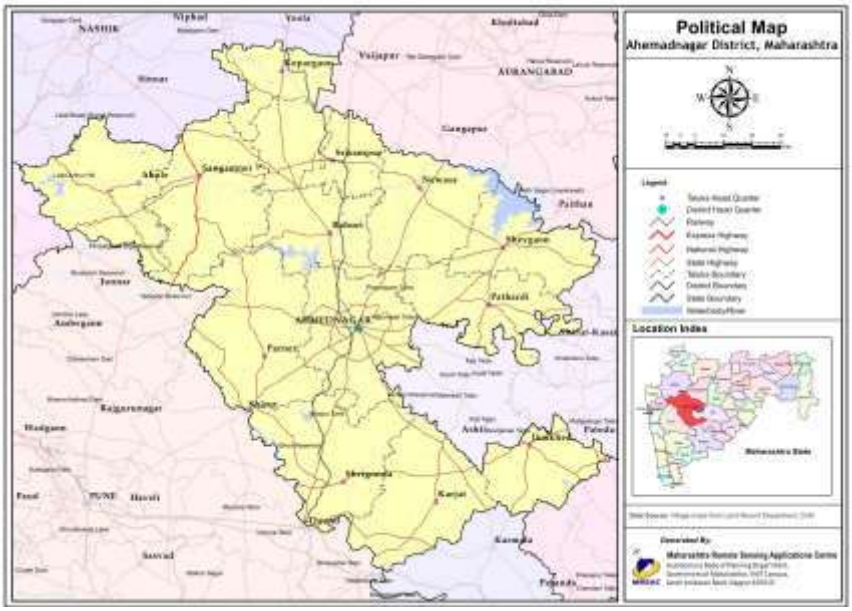

Figure 1. Study area map of Ahmednagar District, Maharashtra. Source: Maharashtra Remote Sensing Applications Centre district political map.

The Ahmednagar district is situated in a part of western Maharashtra between 18.2deg to 19.9deg north and 73.9deg to 75.5deg east and the district spans approximately 17,048 sq.km as defined by the Ahmednagar district administration (District Administration Ahilyanagar, 2026). It is surrounded by Nashik to the north-western side, Aurangabad to the north-eastern, Pune to the western and south-western sides, Solapur to the south, and Beed to the east and south-eastern sides, which provides it with a transitional location between drier interior regions and higher-rainfall western ones (District Administration Ahilyanagar, 2026; Census of India, 2011).

The agricultural contingency plan categorizes the district into the Deccan Plateau hot semi-arid eco-region and the Western Maharashtra Scarcity Zone and documents normal rainfall of 561.6 mm of the south-west monsoon, which forms the significant portion (Government of India, 2014). According to the same document, there is a high amount of cultivated land, significant rainfed agriculture, and an extreme reliance on open wells as sources of irrigation, which made rainfall behavior extremely important to rural livelihood and water security (Government of India, 2014).

Data and Methodology

The paper is purely secondary data based. The major dataset is the annual /tahsil wise rainfall history that is available on the district rainfall portal of the Ahilyanagar district administration, and it has the values of rainfalls during June-October of 1981-1989, 1990-1999, 2000-2004, and 2005-2014 (District Administration Ahilyanagar, 2026). Temporal information on the location, area, agricultural conditions, irrigation and drought-prone was sourced to the district website, District Census Handbook, the district agriculture contingency plan and Central Ground Water Board reports (District Administration Ahilyanagar, 2026;

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Census of India, 2011; Government of India, 2014; Central Ground Water Board, 2018).To provide the temporal graph, annual average rainfall series of the district was compiled as the published summary rows on the district rainfall portal. In the case of 1990-1999, where the extracted webpage cuts off the last row of average, annual averages of the districts were estimated by simply dividing the published district average by the number of 13 talukas reported in the period; it is a transparent calculation out of the published table, not an estimate (District Administration Ahilyanagar, 2026). Mean, standard deviation, coefficient of variation and a simple linear trend were then computed using descriptive statistics.

The approach is adequate in terms of a secondary-based conference paper, though, two limitations must be mentioned. First, the values of rainfall show published June-October maximums instead of entire January-December climatological maximums, and thus the graph reflects monsoon-season pre-eminence, but not annual hydro-climate. Second, the district level mean is a compilation of taluka totals and not an area-weighted rainfall surface, thus the outcomes cannot be used as a gridded climatological reconstruction but only as an administrative rainfall surface (District Administration Ahilyanagar, 2026).

Results and Discussion

1. Temporal variability of rainfall

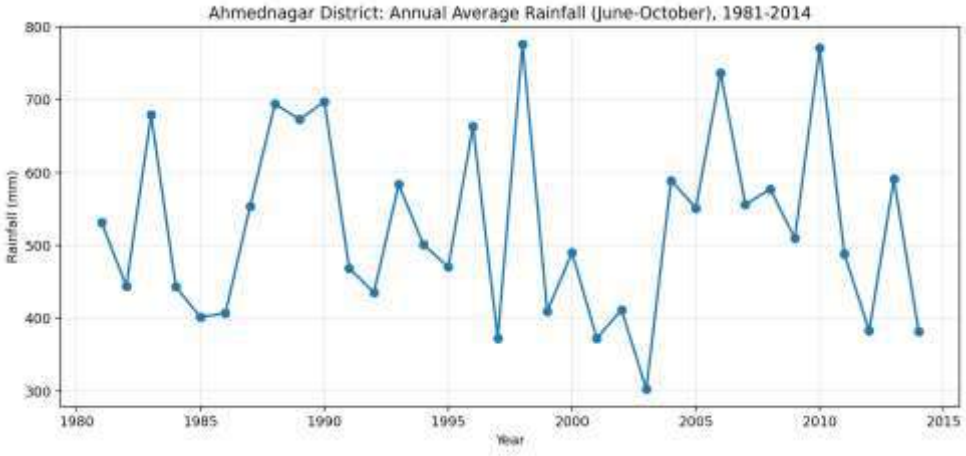

Figure 2. District annual rainfall indicator assembled from official published June-October rainfall values, 1981-2014. Source: compiled from District Administration Ahilyanagar rainfall records.

The tabulated district rainfall indicator of 1981-2014 indicates a mean of 527.23 mm and coefficient of variation of 24.06 percent implying significant inter annual variance. The highest year of the compiled series is 1998 of approximately 776.42 mm and the lowest is 2003 with approximately 303.00 mm. This broad distribution attests to the fact that the instability of rainfall rather than the low mean rainfall is a characteristic of the hydro-climate of the district (for example, the slope of this simple linear trend is approximately -0.30 mm per year; p-value: 0.894), the official series is characterized by oscillation and occasional wet and dry years, but not a substantial negative trend. This explanation is in line with a larger body of semi-arid rainfall research, which observes that variability and discontinuities tend to be of higher planning importance than a positive long-run linear trend (Das et al., 2020; Assessment of Rainfall Trend and Variability of Semi-Arid Region of Godavari Basin, 2021).

2. Period-wise summary

Period	Mean rainfall (mm)	SD (mm)	Minimum (mm)	Maximum (mm)
1981-1989	536.57	120.51	401.80	694.20
1990-1999	538.06	135.43	372.77	776.42
2000-2004	433.48	110.33	303.00	589.21
2005-2014	554.88	128.03	382.11	771.30

As indicated by Table 1, 2000-2004 sub-period recorded the lowest mean rainfall in the published blocks whereas 2005-2014 exhibited the highest mean in the assembled series. Meanwhile, standard deviation is large within and between periods indicating that wet and dry years keep alternating in a sharp manner. This trend can be

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used to understand why a single or two good monsoon years cannot eradicate water stress in the long term in the district (District Administration Ahilyanagar, 2026; Government of India, 2014).

3. Spatial unevenness and drought context

The district rainfall portal clearly states that rainfall is not uniform and the western end of Akole and Sangamner tends to get higher rainfall than most of the other talukas though, consistency cannot be guaranteed (District Administration Ahilyanagar, 2026). This interpretation is supported by such west-to-east differentiation of the districts affected by the Western Ghats rain-shadow effect and means that a single average in a district could conceal important local variations in crop water availability and recharge potential (Mukherjee, 1980; Salunke, 2021).The interpretation is corroborated by the fact that the agriculture contingency plan places most of Ahmednagar in a scarcity zone, and records that the district has a large rainfed area relative to irrigated area (Government of India, 2 With low and uneven rain, all dryer talakas cause more villages to be exposed to delayed sowing, extended dry periods and increased reliance on groundwater pumping to provide protective irrigation.

4. Rainfall variability and groundwater stress

The variability in rainfall has direct consequences on ground water since recharge in hard-rock semi-arid areas is extremely seasonal and requires the patterns and quantity of monsoon rainfall. According to the district agriculture contingency plan, it is reported that the irrigation source in the district is largely reliant on wells, and according to the Central Ground Water Board material, the district includes over-exploited, critical, and semi-critical blocks (Government of India, 2014; Central Ground Water Board, 2018).

The literature review of Ahmednagar also demonstrates a high block-wise difference in groundwater levels and indicates a reduction in water levels in most areas of the district, particularly during drought periods (Sivarajan et al., 2019). This implies that in a poor rainfall year, seasonal soil moisture is not simply brought down, but also increases the abstraction of groundwater, and may exacerbate stress in the medium term on aquifers.

5. Implications for water management

The first one is that water management in Ahmednagar must be responsive to rainfall as opposed to being uniform. Due to sharp changes in annual rainfall, water budgeting at the village and watershed scales is necessary annually in order to ensure that the decision to sow, the operation of a tank, the recharge projects as well as the protection irrigation plans are synchronized with the anticipated annual availability of water (Government of India, 2014; Central Ground Water Board, 2018). The second implication is that there is a need to reinforce decentralized water conservation. The district contingency plan particularly suggests water saving techniques, desilting of reservoirs, rainwater harvesting, water body formation and watershed control exercises to preserve rainwater and enhance the levels of ground water (Government of India, 2014). These are especially appropriate in a district whereby rainfall is received in seasonal pulse form.

The third implication is the issue of demand management in agriculture. In places with uncertain rainfall and stressed ground water, the occurrence of water intensive crop agriculture without hydrological accounting is a dangerous move. Increased use of micro-irrigation, diversification of crops, protective irrigation, and pattern of crops, based on the local rainfall and aquifer conditions, would enhance water productivity and minimize the risk of negative outcomes during dry periods (Government of India, 2014; Central Ground Water Board, 2018; Kumar et al., 2025). The fourth implication is institutional. The planning of the districts and taluks should incorporate the rainfall data, ground water conditions and crop alerts under a single drought-control system. This type of integration is more efficient compared to considering meteorology, agriculture, and groundwater administration as independent industries, particularly in a semi-arid area where recurrent drought arises (Sivarajan et al., 2019; Salunke, 2021).

Conclusion

The analysis of secondary data reveals that the Ahmednagar district has a high level of rainfall variability both over the years and space. The compiled 1981-2014 series have shown a mean June-October rainfall indicator of approximately 527 mm but what is far more important is the fact that there is a great deal of variability around the mean each year. This instability is one of the reasons why the risk of drought, groundwater stress, and uncertainty in agricultural planning are maintained even in the case when selected years are above-average rainy (District Administration Ahilyanagar, 2026; Government of India, 2014).Effective water management in Ahmednagar should include rainwater harvesting, watershed development, groundwater recharge, annual water budgeting, and efficient irrigation with local hydro-climatic constraints reflected in the annual crop planning. This paper can be extended to future work through the use of longer rainfall series, gridded data and taluka-specific GIS analysis to enhance the spatial

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interpretation, although even the current secondary-data evidence is overwhelmingly in favour of a decentralised and climate-resilient method to district water management (Central Ground Water Board, 2018; Sivarajan et al., 2019).

Acknowledgment

I would like to express my sincere gratitude to all those who have supported and guided me in the successful completion of my project titled "Spatio-Temporal Analysis of Rainfall Variability and Its Implications for Water Management in Ahmednagar District, Maharashtra."

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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Original Article

Growth of Digital Payment Systems and Their Impact on the Indian Banking Sector

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Abstract

The current research investigates the expansion of digital payment systems in India and their effects on the Indian banking industry from 2016 to 2025. The research utilizes secondary data obtained from credible sources, including reports from the Reserve Bank of India, the National Payments Corporation of India, government publications, academic journals, and internet databases. We have employed a number of statistical methods to make sense of the data, such as percentage analysis, trend analysis, tabular presentation, and graphical analysis. The results show that digital payment transactions have been growing steadily and significantly, especially after 2020. This is because platforms like UPI, mobile banking, and internet banking have become so popular. The research shows that digital payments have had a good effect on the banking industry by making operations more efficient, lowering the need for cash, making it easier for customers, and encouraging financial inclusion. But there are still problems that keep digital payment systems from reaching their full potential, such as cybersecurity issues, a lack of digital literacy, and problems with infrastructure. The report finds that digital payments have been a key part of modernizing Indian banks and helping the country move toward a less-cash economy. It stresses the need to make security measures stronger, raise knowledge of digital issues, and improve infrastructure to make sure that digital payment systems in India can flourish in a way that is long-lasting and benefits everyone.

Keywords: *Digital Payments, UPI, Banking Sector, Financial Inclusion, Digital Banking, Cashless Economy, Cybersecurity, FinTech, Mobile Banking, India*

Introduction:

Digital payment systems are ways to do business electronically without using currency. Some of the instruments that these systems use include debit and credit cards, mobile wallets, online banking, and the Unified Payments Interface (UPI). Digital payments have come a long way from their early days as simple electronic bank transfers. Now, they include more complicated systems that let you pay in real time. Technological progress, government programs, and more people using digital platforms have all played a role in this change in India.

The rise of India's digital financial infrastructure has been very important for the expansion of digital payments. Programs like Aadhaar, Jan Dhan Yojana, and Digital India have made the digital economy stronger. The creation of safe payment gateways, better banking networks, and extensive internet access has made it possible for people all around the nation to do business without any problems. In the last several years, more and more people have started using mobile banking, online banking, and UPI. As more people use smartphones and internet connections become cheaper, consumers are choosing digital payment methods more and more because they are easy to use, fast, and accessible. UPI has become a popular platform since it is easy to use and lets you send money right away.

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Digital payments are now a must for contemporary banking since they make things run more smoothly, lower transaction costs, and make customers happier. They also assist cut down on cash handling and make financial transactions more open.

The importance of this research is that it helps us understand how digital payment systems are growing and affecting Indian banks. It shows how digital transformation is changing financial services and points out the pros and cons of using digital payments.

Statement of the Problem

The old banking system in India has changed a lot since digital payment platforms have grown so quickly. As more and more people use mobile banking, online banking, and UPI, the way people undertake financial transactions has changed a lot. This change has brought both chances and problems for the financial industry. In order to be competitive and efficient, banks must to adapt to digital platforms. They also need to deal with important problems including cybersecurity risks, data privacy difficulties, and changing consumer expectations for quicker, easier, and safer services. As more and more things become digital, banks need to keep coming up with new ideas and improving their infrastructure.

So, it's important to know how digital payment systems affect banks in order to make good policy and commercial choices. It helps figure out how digital transformation affects banking operations, how customers respond, and the general stability of the financial system.

Objectives of the Study

The current research seeks to investigate many facets of digital payment systems in India and their impact on the banking industry. Digital transactions are growing quickly, therefore it's crucial to understand how they are growing, what they mean, and the problems they cause.

The main objectives of the study are as follows:

1. To analyze the growth trend of digital payment systems in India and understand how digital transactions have increased over time.
2. To examine the impact of digital payments on the Indian banking sector, particularly in terms of efficiency, customer service, and financial inclusion.
3. To identify the challenges associated with the adoption of digital payment systems, including issues related to cybersecurity, digital literacy, and infrastructure.

Scope of the Study

This research examines digital payment methods in India and their impact on the banking sector's transformation. The goal is to help people understand how digital transactions have changed and how they affect banking as a whole. The research looks at big digital payment systems such mobile banking, online banking, card-based payments, and the Unified Payments Interface (UPI). These platforms are the main parts of India's digital payment ecosystem, and many people and companies utilize them. The analysis is confined to the years 2016 to 2025, which is a time of great increase in digital payments, particularly following big efforts to promote a cashless economy. This time range is helpful for looking at recent changes and trends in digital banking.

Limitations of the Study

There are certain limitations to this study that might impact the research's scope and results. The research relies only on secondary data obtained from many sources, including publications, journals, and internet databases. The study's accuracy relies on the dependability of these sources. Second, in certain circumstances, there isn't enough current statistical data, which might make it hard to fully analyze the most recent developments in digital payment systems. This may change how deep the investigation goes in certain areas. Finally, the report just looks at the Indian banking industry and doesn't compare it to other countries. So, the results may not apply to other nations or financial systems throughout the world.

Research Methodology

The current research utilizes secondary data obtained from many credible and legitimate sources. The Reserve Bank of India (RBI) papers and publications were used to get the data. These reports and publications provide a lot of information about how banks work and how digital transactions work. Also, information from the National Payments Corporation of India (NPCI) has been utilized to learn more about trends in UPI and other digital payment systems.

Additionally, government studies and policy papers have been used to learn more about programs that encourage digital payments. The study incorporates material from academic papers, books, and internet databases to facilitate analysis and ensure a thorough comprehension of the subject.

Statistics Used

The present study uses various statistical tools to analyze the data related to digital payment systems in India. These tools help in presenting, interpreting, and understanding the growth pattern effectively.

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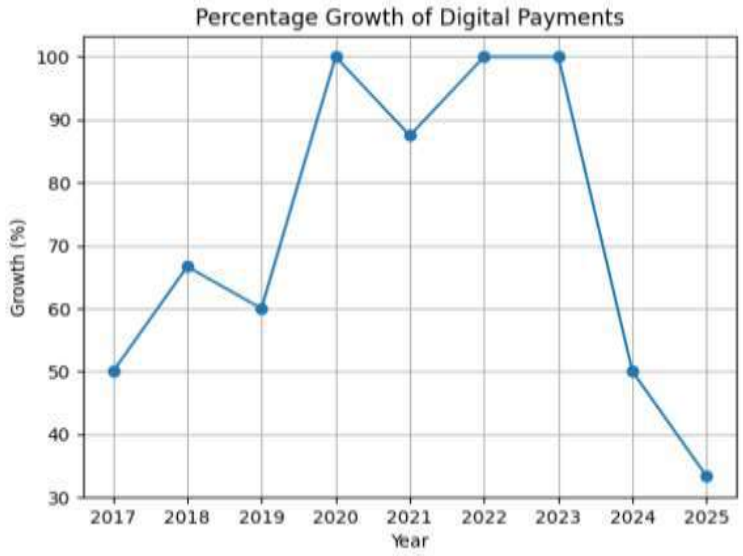
Percentage analysis

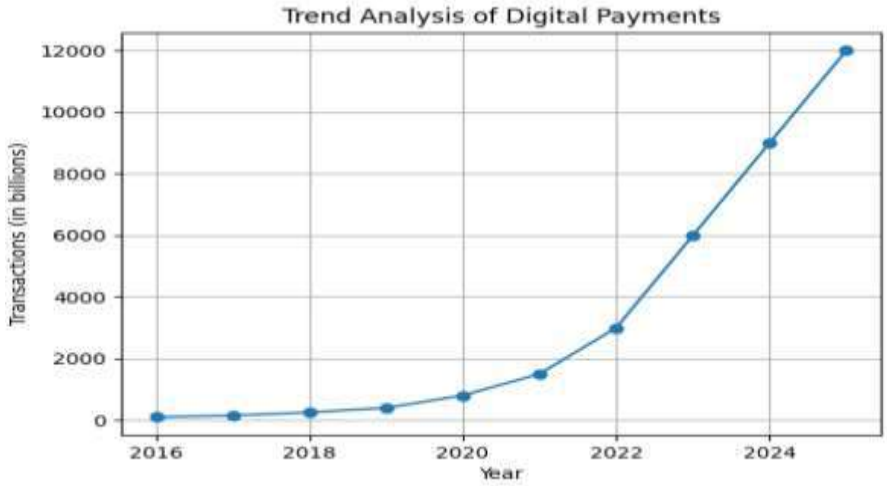
To find out how fast digital payment transactions are growing throughout the years, we employ percentage analysis. It allows you see changes from one year to the next and figure out how quickly digital payments are growing.



The graph indicates that digital payments in India grew quickly from 2017 to 2023, peaking at roughly 100% growth between 2020 and 2023. After this time, the growth rate slows down in 2024 and 2025. This means that the market is becoming saturated and stable, not because people are using it less. Overall, the trend shows that a lot more people are using it, thanks to backing from organizations like the Reserve Bank of India and the National Payments Corporation of India.

Trend analysis

Trend analysis is used to look at the general direction and pattern of digital payment transactions from 2016 to 2025. The trend chart plainly demonstrates that things are moving up all the time, which means that digital transactions are steadily rising, particularly after 2020.



From 2016 to 2025, the graph depicts a high and steady rise in digital payment transactions. In the first few years, growth is slow, but after 2020, it picks up speed, which shows that more people are using digital payment methods. The strong rise from 2022 forward shows that digital payments are widely used and accepted. This is a sign of the growth of India's digital payment ecosystem, which is backed by organizations like the Reserve Bank of India and the National Payments Corporation of India.

Tabular presentation

The table shows transaction statistics by year, which makes it simpler to compare and look at how digital payments have grown over time.

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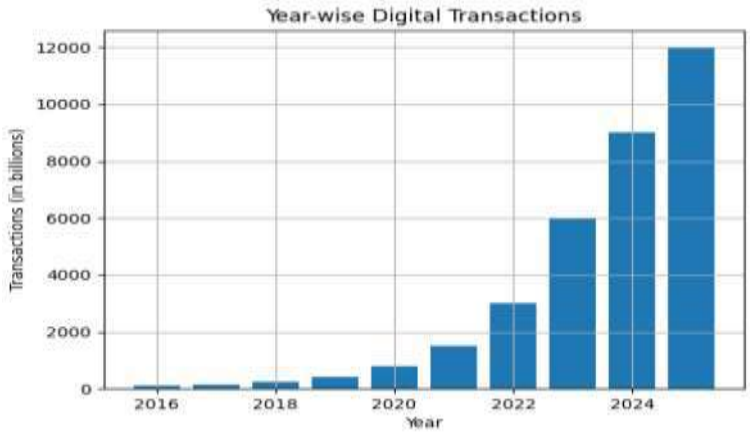
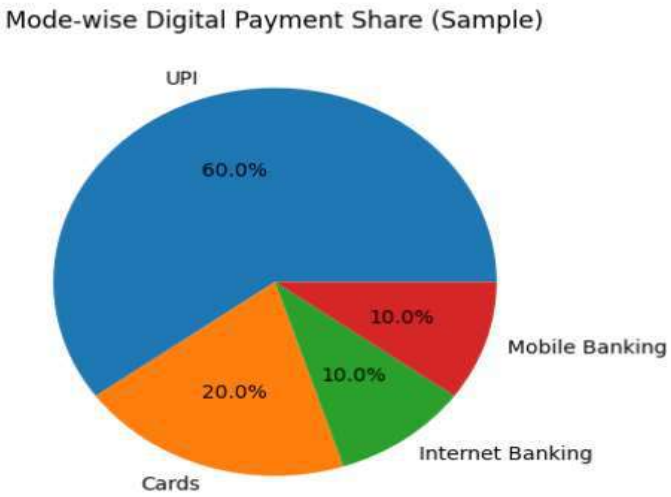


From 2016 to 2025, the bar chart indicates that the number of digital transactions went grown every year. In the first several years, growth is modest, but after 2020 it picks up speed quickly, with a big jump starting in 2022. This shows that more and more people are using digital payment methods. The trend shows that digital financial services are growing, thanks to organizations like the Reserve Bank of India and the National Payments Corporation of India.

Graphical analysis

The graphics make the study easier to grasp and more useful by clearly showing the growing trend and proportion of digital payments. In general, these data tools provide a clear and complete picture of how digital payment systems are growing and affecting India.



The pie graphic illustrates that UPI is the most popular way to pay online in India, with a 60% share. Payments made using cards make up 20%, while payments made over the Internet and mobile banking each make up 10%. This shows that people really want payment solutions that are quick, easy, and work on mobile devices. UPI's domination shows how important it is for digital transactions, which the Reserve Bank of India and the National Payments Corporation of India have encouraged.

Growth of Digital Payment Systems in India

Digital transactions are growing quickly.

Over the last ten years, India has seen a big increase in digital payment transactions. The number and value of transactions have expanded quickly, particularly after 2016. This shows a clear transition from cash-based transactions to digital ones as more people accept them and technology improves.

Growth of UPI (Unified Payments Interface)

UPI has become India's most popular way to pay online. The National Payments Corporation of India made it possible to send money instantly and in real time using mobile devices. It is widely used throughout the nation since it is simple, works with other systems, and is easy to use.

Mobile and online banking are growing

In the last several years, mobile banking and online banking services have grown a lot. Banks now have easy-to-use digital platforms that

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let clients do business anytime and anywhere, which cuts down on the need to go to a branch in person.

Support for government programs and policies

Government programs have been very important in getting people to use digital payments. Policies that favor the growth of a digital economy, together with regulatory backing from the Reserve Bank of India, have made the digital payment ecosystem stronger and more people are using it.

More people are using smartphones and the internet

Digital payments have grown because more and more people are using smartphones and connecting to the internet. More consumers, including those who live in remote regions, can now use digital payment systems since gadgets and internet services are cheaper.

The Rise of Digital Wallets and FinTech

Digital wallets and FinTech businesses have played a big role in the growth of digital payments. A lot of people use these platforms because they provide easy, quick, and safe ways to pay. This makes the digital ecosystem better as a whole.

Effects of the COVID-19 Pandemic

The COVID-19 epidemic sped up the use of digital payments. Because people and companies wanted to avoid touching things, they started using digital payment methods more, which caused a big rise in use.

Growth in Financial Inclusion

Digital payment methods have made it easier for people in rural and underserved regions to use banking services, which has helped with financial inclusion. More people can now use the official banking system thanks to mobile-based services.

Shift Towards a Cashless Economy

India is slowly shifting toward an economy that uses less currency. The growing preference for digital transactions over cash shows a change in how people handle money, which makes transactions more open and efficient.

Impact on the Banking Sector

Improved Operational Efficiency

Banks have become much more efficient because to digital payment technologies. Banks can now handle a lot of transactions swiftly and properly thanks to automated and real-time transaction technologies. This cuts down on the need for people to become involved, cuts down on mistakes, and boosts overall productivity. Because of this, banks can help more consumers in less time and with better service.

Reduction in Cash Transactions

Digital payments have made people less reliant on cash. Customers increasingly choose to pay for things like UPI, mobile banking, and card payments instead of cash. This has made it cheaper for banks to produce, handle, and manage currency. It has also made theft, loss, and fake money less likely to happen.

Cost Reduction for Banks

Banks may save money on operations by using digital payment systems. Costs for keeping up physical branches, handling currency, and doing things by hand have gone down. Digital platforms let banks provide services online, which is cheaper than doing things the old-fashioned way. This makes banks more profitable and lets them use their resources more effectively.

More convenient for customers

Digital payments have made things a lot easier for customers. Customers may send money, pay bills, and buy things online at any time and from any place. People are happier with their banks now that they may get financial services 24/7. This has also made the connection between banks and their clients stronger.

More digital banking services

Banks have added more digital banking services since more people are using digital payments. To accommodate client demand, banks are putting money into mobile apps, online banking systems, and digital wallets. This has led to the creation of new financial services and made the entire banking experience better.

More openness and responsibility

Recording digital transactions electronically makes financial operations more open. Every transaction creates a digital trail, which makes it simpler to keep an eye on and trace money movements. This makes it less likely that people would commit fraud, corruption, or tax evasion, which makes the financial system stronger.

Getting people to use money

Digital payment systems have been very important in making sure that everyone can use money. People in rural and isolated locations may now use their phones to do their banking without having to go to a bank office. This has allowed those who don't have bank accounts into the official financial system, which is good for economic growth that includes everyone.

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More collaboration in FinTech

Banks are working more and more with FinTech startups to make digital payment systems better. These agreements help banks keep up with the changing financial world by adopting new technology, improving service delivery, and staying competitive. New technologies in FinTech have made banking safer, easier to use, and faster.

Challenges in Digital Payments

Risks to Cybersecurity and Fraud

Cyber dangers including hacking, phishing, and online fraud may easily get into digital payment systems. Cybercriminals might go for sensitive financial information when transactions are done online. Security is a big worry since banks and customers might lose money, have their data stolen, or have their accounts hacked.

Not knowing how to use technology

A lot of people, particularly those who live in rural and semi-urban regions, don't know enough about digital technology. A lot of people don't know how to properly and efficiently utilize digital payment systems, which makes them less likely to use them and more likely to make mistakes or commit fraud.

Infrastructure that isn't good enough

For digital payments to work, the internet and technology must be trustworthy. In many rural locations, inadequate network connection, a shortage of smartphones, and restricted access to digital devices make it hard for digital payment systems to perform well and be used.

Problems with the system and technical issues

There are instances when digital payment services have technical problems, server outages, and failed transactions. These problems may make things harder for consumers and cause transactions to take longer or not go through at all, which can make users less confident in digital systems.

Worries about data privacy

When you make a digital payment, you provide your personal and financial information. People who utilize the service typically worry about how their data is kept, used, and safeguarded. If this data is misused or accessed without permission, it might cause major privacy problems and make people lose faith in digital systems.

Relying on Technology

Technology is the only thing that digital payment systems need. Transactions may stop if there is a power outage, a system breakdown, or a cyber-attack. This reliance makes people more vulnerable, particularly when they don't have much access to technology.

Not wanting things to change

Some people and companies still choose to do business with cash because they are used to it, don't trust digital technologies, or are afraid of them. This opposition makes it take longer for everyone to start using digital payment systems, especially elderly people and small businesses.

Conclusion

The report finds that digital payment systems in India grew very quickly between 2016 and 2025. The examination of secondary data unequivocally demonstrates a persistent rising trajectory in digital transactions, propelled by technology innovations, heightened smartphone use, and favorable government measures. UPI, mobile banking, and online banking are just a few examples of platforms that have completely changed how people do business. Digital payment systems have helped the Indian banking industry by making it easier for customers to do business, making it less reliant on cash transactions, and making it more convenient for customers. Digital platforms have helped banks provide services that are quicker, more dependable, and less expensive. Digital payments have also helped those who don't have access to banks by making banking services available to people in remote areas and those who don't have access to them.

The survey also points to certain problems, such as cybersecurity threats, a lack of digital literacy, and problems with infrastructure. To make sure that digital payment systems flourish in a safe and long-lasting way, these problems need to be addressed. Digital payments have changed the way Indian banks work and are anticipated to keep pushing the nation toward a more open and paperless economy.

Suggestions / Recommendations

Making cybersecurity and data protection stronger

Banks and other financial institutions should make it a priority to use modern cybersecurity safeguards to protect online transactions. This means using technology like encryption, multi-factor authentication, and systems that can find fraud in real time. To lower threats, there should also be regular security audits, training for employees, and campaigns to raise awareness among users. Making cybersecurity stronger will make users more confident and make sure that digital payment systems can flourish safely.

Improving users' digital skills and knowledge

Digital literacy has to be improved a lot, particularly in rural and semi-urban regions. Government agencies, banks, and other financial organizations should provide seminars, training

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sessions, and awareness campaigns to teach people how to utilize digital payment systems safely and correctly. More people will utilize it if they know about it, and it will also lower the risk of fraud and abuse.

Making digital infrastructure better

Digital payment systems need a strong digital infrastructure to work properly. We should endeavor to make the internet faster, more reliable, and easier to get to digital devices, especially in rural and distant areas. Working together, the government and the business sector can help close the digital gap and make sure that everyone has access to digital payment services.

Making the rules stronger and protecting customers

Regulatory agencies like the Reserve Bank of India should keep updating their rules and regulations to deal with new problems that come up with digital payments. Strong rules should preserve people's privacy, provide them rights, and include ways for them to complain. Strict compliance will make the system more reliable, open, and accountable.

Using digital innovation to help people get access to money

Banks and other financial organizations should work on making digital payment services available to those who don't have bank accounts or don't have enough access to them. Easier processes, cheap digital solutions, and financial services that work on mobile devices may all help make things more accessible. Working with FinTech businesses may lead to more new ideas and easier-to-use solutions, which will help the financial system expand in a way that includes everyone.

Acknowledgment

I would like to express my sincere gratitude to all those who have supported and guided me in the successful completion of my project titled "Growth of Digital Payment Systems and Their Impact on the Indian Banking Sector."

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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Original Article

Land Use and Land Cover Change and Its relation with Land Surface Temperature: A Spatio-Temporal Study of Kopargaon Tahsil, Maharashtra state

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Abstract

The present study investigates the spatio-temporal changes of Land Use/Land Cover and its impact on LST in Kopargaon Tahsil, Maharashtra. Multi-temporal Landsat 8 satellite data was used to study land use and land cover patterns for 2015 and 2025, and GIS-based techniques were applied to classify land cover categories such as agricultural land, built-up area, water bodies, vegetation, and barren land. Land Surface Temperature was derived from the thermal bands of Landsat satellite image, and spatial relationships between LULC classes and LST were examined using geospatial analysis. The overall results show significant changes in land use patterns, due to the expansion of built-up areas and reduction of vegetation cover. The areas dominated by built-up and barren land recorded comparatively higher surface temperatures, while vegetated and water body regions showed lower LST values. The study demonstrates a strong relationship between land cover transformation and surface temperature variation, indicating that urbanization and land modification contribute to localized warming effects.

Keywords: *Land Use and Land Cover, Land Surface Temperature, Remote Sensing, GIS.*

Review Of Literature

Many researchers have studied the relationship between Land Use and Land Cover changes and Land Surface Temperature (LST) using remote sensing and GIS techniques. These studies highlight how changes in vegetation cover, urban expansion, and land transformation influence surface temperature patterns. ***Jiang et al. (2021),*** analyzed the relationship between LULC change and land surface temperature in Bangui using Landsat satellite data and GIS techniques. The study find that the expansion of built-up areas led to an increase in surface temperature, while vegetated areas and water bodies maintained relatively lower temperatures. The research emphasized that urban growth significantly alters the thermal environment of cities and contributes to the development of urban heat islands. **D. *Kikon and G. Singh (2020),*** studied the impact of land use and land cover changes on surface temperature in Pune, India, the researchers observed a substantial increase in built-up areas from 1990 to 2019 accompanied by a decline in vegetation and agricultural land. Their results shows that areas with dense urban structures recorded higher land surface temperatures compared to areas with natural vegetation. ***S. Mondal and S. Sharma (2019),*** examined LULC transformation and its influence on LST in Barrackpore Subdivision, West Bengal. The research examined that conversion of open spaces and vegetation into built-up areas resulted in rise in land surface temperature. ***M. Khandelwal et al. (2014),*** have studied in Ajmer District, Rajasthan analyzed temporal changes in land cover and their relationship with surface temperature using remote sensing data. The results demonstrated a strong correlation between vegetation cover and surface temperature.

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Areas with higher vegetation density showed lower temperature values, confirming the cooling effect of ***Debabrata Swain et al. (2019),*** studied long-term land use and temperature changes in eastern India. his study indicated that a significant portion of the increase in regional temperature could be attributed to land use and land cover changes, particularly deforestation and conversion of natural land into agricultural or built-up areas. ***A. Alqurashi and L. Kumar (2013)***, studied the influence of LULC patterns on surface temperature using satellite image such as NDVI and NDBI. The research shows that built-up areas tend to exhibit higher LST values, whereas vegetation and water bodies contribute to lower temperature levels.

Introduction

Land Use and Land Cover changes are the most significant environmental processes influencing the local climatic conditions. Rapid population growth, urban expansion, and increasing human activities have led to transformation of natural landscapes into agricultural and built-up areas. These modifications affect the physical characteristics of the land surface, such as vegetation cover, soil moisture, and surface albedo, which in turn influence the thermal properties of the land. The Land Surface Temperature (LST) is an important environmental indicator that reflects the temperature of the Earth's surface and helps in understanding the impact of land cover changes on the local climate and ecological conditions. The remote sensing and Geographic Information System (GIS) technologies have made it possible to analyse spatio-temporal variations in land use and land cover and their relationship with surface temperature.

Objective Of Study

The main objectives of the present study are f:

1. To study the spatio-temporal changes in Land Use and Land Cover patterns in Kopargaon Tahsil, Maharashtra using GIS techniques.
2. To Study the influence of Land Use and Land Cover changes on Land Surface Temperature (LST) in the study area.

Database And Methodology

The present study is based on both satellite data to analyze the relationship between Land Use and Land Cover change and Land Surface Temperature (LST) in Kopargaon Tahsil, Maharashtra. Multi-temporal satellite images obtained from the United States Geological Survey (USGS) Earth Explorer platform were used for the analysis. Landsat satellite data such as Landsat 8 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS) imagery were used to get land use and land cover as well as land surface temperature.

The methodology of the study involves several steps using GIS techniques. First, the satellite images were downloaded and pre-processed to correct atmospheric and geometric distortions. After that, supervised classification was performed to classify the images into major land use and land cover categories. The Land Surface Temperature (LST) was then derived from the thermal bands of the Landsat imagery, including radiance conversion, brightness temperature calculation, and emissivity correction. Finally, spatial analysis was done in ArcGIS software to examine the relationship between LULC classes and LST distribution.

Study Area

Kopargaon is one of the important tahsils located in Ahmednagar District in the state of Maharashtra. The tahsil is situated in the northern part of the district and lies within the basin of the Godavari River. Geographically, Kopargaon Tahsil is located approximately between 19°45′ to 20°00′ North latitude and 74°20′ to 74°40′ East longitude. It is well connected with nearby urban centres such as Shirdi and Yeola, which play an important role in the economic and cultural activities of the region. The study area mainly consists of plain terrain with fertile agricultural land influenced by the Godavari River system. The climate of the region is tropical monsoon, characterized by hot summers, moderate winters, and seasonal rainfall during the southwest monsoon. Agriculture is the dominant land use activity in the tahsil, with crops such as sugarcane, wheat, and vegetables being widely cultivated. In recent years, the area has experienced noticeable changes in land use due to agricultural development, expansion of settlements, and infrastructural growth. These changes make Kopargaon Tahsil an important region for analysing land use and land cover study and their influence on land surface temperature patterns.

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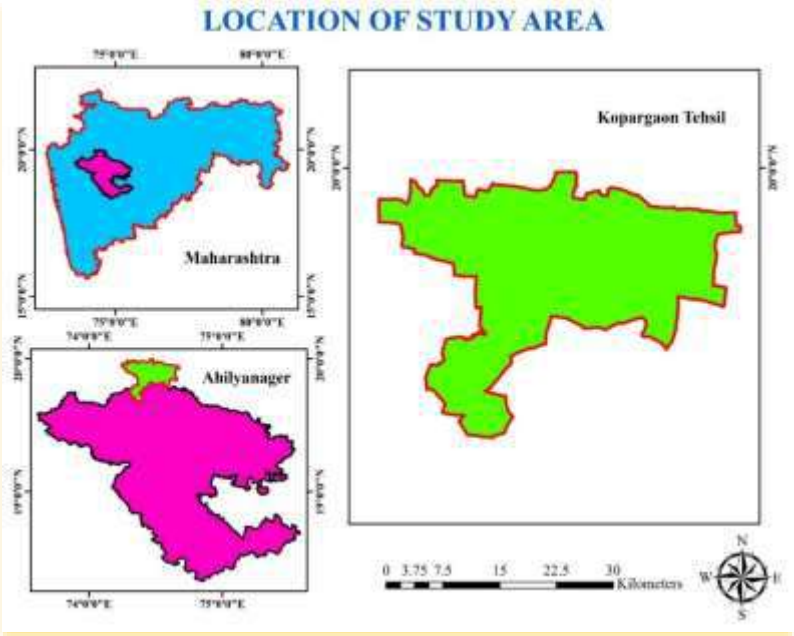
Map No. 1
Location of study area



Spatial Distribution of Lulc and Lst

The spatial distribution of Land Use and Land Cover in Kopargaon Tahsil shows changes between 2015 and 2025. Basically in 2015, the built-up area covered 570.16 sq. km (78.3%), making it the dominant land use type, followed by vegetation (64.55 sq. km, 8.86%), agriculture (39.53 sq. km, 5.43%), barren land (34.79 sq. km, 4.78%), and water bodies (19.14 sq. km, 2.63%). By 2025, built-up areas expanded to 624.36 sq. km (85.74%), while vegetation and agricultural land decreased to 52.07 sq. km (7.15%) and 15.08 sq. km (2.07%), respectively. Water bodies reduced 6.24 sq. km (0.86%), and barren land showed a minor decrease to 30.42 sq. km (4.18%). The expansion of built-up areas and reduction of vegetation and agricultural land clearly indicate urbanization and land transformation in the tahsil over the decade.

These changes in land cover have strongly affected the Land Surface Temperature patterns in the study area. In 2015, LST ranged from 16.2°C to 36.5°C with a difference of 20.3°C, reflecting the moderating effect of vegetation and agricultural areas. in 2025, the minimum and maximum LST increased to 18.6°C and 41.2°C, respectively, with a larger difference of 22.6°C. The increase in built-up areas corresponds to higher LST, while the reduction in vegetation and water bodies resulted in a loss of natural cooling system. The areas dominated by built-up land show the highest temperatures, whereas remaining vegetated and agricultural zones maintain relatively lower surface temperatures.

Table No. 1

Land Use/Land Cover Distribution in Kopargaon Tahsil (2015)

Sr. No	Type of Land use	Area	Percentage (%)
1	Built up area	570.16	78.3
2	Water Body	19.14	2.63
3	Vegetation	64.55	8.86
4	Barren land	34.79	4.78
5	Agriculture	39.53	5.43
	Total	**728.16**	**100**

(Source: Computed by Researcher**)**

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Table No. 2

Land Use/Land Cover Distribution in Kopargaon Tahsil (2025)

Sr. No	Land Use Type	Area in sqkm	Percentage (%)
1	Built up area	624.36	85.74
2	Water Body	6.24	0.86
3	Vegetation	52.07	7.15
4	Barren land	30.42	4.18
5	Agriculture	15.08	2.07
	Total	**728.16**	**100**

(Source: Computed by Researcher**)**

Table No. 3

Spatial Distribution of Land Surface Temperature 2015 And 2025

Sr. No.	Study Period (March–May)	Minimum LST (°C)	Maximum LST (°C)	LST Difference (°C)
1	2015	16.2	36.5	20.3
2	2025	18.6	41.2	22.6

(Source: Computed by Researcher**)**

Map No.1

LST and LULC Comparison 2015 and 2025

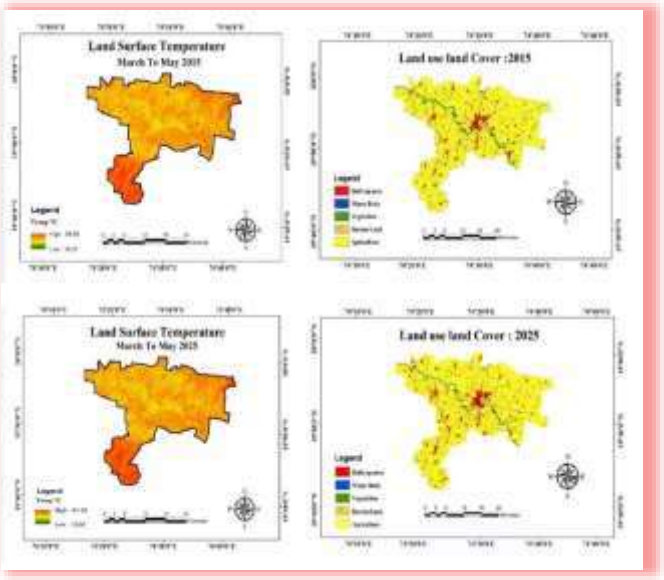

Table No. 4

Comparison Of Lulc and Lst in Kopargaon Tahsil 2015 And 2025

Sr. No	Land Use Type	Area 2015 (sq. km)	Area 2025 (sq. km)	Change (sq. km)	Percentage Change (%)	LST Influence (Observed Trend)
1	Built-up Area	570.16	624.36	54.2	7.44	Strong increase in LST
2	Water Bodies	19.14	6.24	−12.90	−1.77	Reduction in cooling effect
3	Vegetation	64.55	52.07	−12.48	−1.71	Loss of evapotranspiration
4	Barren Land	34.79	30.42	−4.37	−0.60	Minor contribution
5	Agriculture	39.53	15.08	−24.45	−3.36	Increased surface heating
	Total Area	**728.16**	**728.16**	—	—	—

(Source: Computed by Researcher**)**

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Table No. 5

Lst Variation Corresponding to Lulc Change

Sr. No	Study Period (March–May)	Minimum LST (°C)	Maximum LST (°C)	LST Range (°C)	Dominant LULC Condition
1	2015	16.2	36.5	20.3	Higher vegetation & agriculture
2	2025	18.6	41.2	22.6	Dominance of built-up area

(Source: Computed by Researcher**)**

Conclusion

The spatio-temporal analysis of Kopargaon Tahsil between 2015 and 2025 showing changes in Land Use and Land Cover changes with relation of Land Surface Temperature. The built-up area increased from 570.16 sq. km (78.3%) in 2015 to 624.36 sq. km (85.74%) in 2025, showing an expansion of 54.2 sq. km (7.44%), while agricultural land decreased from 39.53 sq. km (5.43%) to 15.08 sq. km (2.07%), and vegetation declined from 64.55 sq. km (8.86%) to 52.07 sq. km (7.15%). Water bodies also reduced drastically from 19.14 sq. km (2.63%) to 6.24 sq. km (0.86%).

These Land use and land cover changes strongly related to surface temperature variations. The minimum LST increased from 16.2°C in 2015 to 18.6°C in 2025, while the maximum LST rose from 36.5°C to 41.2°C, resulting in an increased LST range from 20.3°C to 22.6°C. The expansion of built-up areas and the reduction of vegetated This study clearly demonstrates the direct influence of Land use and land cover changes on land surface temperature.

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Original Article

The Study of Entrepreneurial Innovation and the Start-up India Agenda in Economic Transformation

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Abstract

The Start-up India initiative, launched in the year 2016, has been instrumental in transforming India's entrepreneurial landscape by fostering innovation, job creation, and digitalization. This paper presents a novel analysis of the evolving relationship between innovation and start-ups in India, focusing on the future trajectory of the Start-up India Vision. It offers new perspectives on how India can build a sustainable, inclusive start-up ecosystem that leverages emerging technologies, global partnerships, and region-specific needs. This paper also tries to introduces new policy frameworks aimed at scaling innovation-driven entrepreneurship across the nation, especially in underserved and rural sectors, while focusing on the societal impact of start-ups.

Keywords: *Entrepreneurial Innovation, Start-up Ecosystem, Start-up India Initiative, Economic Transformation, Innovation and Development, Entrepreneurship Development, Small and Medium Enterprises (SMEs), Digital Economy*

Introduction:

India stands at the crossroads of economic transformation, with its vibrant demographic dividend and technological advances creating a unique environment for innovation in the country. As the world's largest democracy and one of the fastest-growing economies, India has the potential to emerge as a global innovation hub, driven by the entrepreneurial spirit of its youth. The Start-up India Vision, introduced by the Government of India in the year 2016, plays a pivotal role in realizing this ambition. Its aim is not only to support technology-driven start-ups but also to transform key sectors such as agriculture, healthcare, and education through innovation.

This paper explores the critical relationship between innovation and start-ups within India's entrepreneurial ecosystem. It identifies gaps in current policy frameworks and proposes new strategies to scale innovation in diverse sectors. The paper also highlights the importance of regional inclusivity and the social impact of start-ups, presenting actionable insights for enhancing the impact of the Start-up India Vision on national economic growth.

Literature Review:

1. Reimagining Innovation Beyond Technology:

Innovation is often viewed narrowly in terms of technological advancements. However, the real opportunity for Indian start-ups lies in redefining innovation to include areas such as business models, social impact, and sustainability. While technology remains central, the next wave of breakthroughs may come from interdisciplinary solutions that blend local knowledge with cutting-edge tech, providing scalable solutions to socio-economic challenges (Cunningham & Lichtenstein, 2018).

This approach resonates with Schumpeter's (1934) theory of "creative destruction," where the economic environment is transformed not merely by incremental technological improvements but by disruptive models that transcend traditional industries.

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2. The Role of Government Policy in Scaling Innovation:

The government's role in fostering innovation has been widely studied, with particular emphasis on financial incentives, regulatory reforms, and infrastructure development (Audretsch, 2017). The Start-up India Vision has successfully targeted these areas, offering tax exemptions, ease of doing business, and various funding schemes. However, the focus must now shift toward building systemic policy frameworks that encourage cross-sector collaborations and local innovations.

Scholars such as Chesbrough (2003) and Teece (2018) suggest that open innovation and collaborative ecosystems between start-ups, corporations, and public institutions are crucial for scaling innovation sustainably.

Analysis:

1. Decentralized Innovation Ecosystems:

India's vast geographical and socio-economic diversity presents both a challenge and an opportunity. While metropolitan areas like Bengaluru, Delhi, and Hyderabad are home to dynamic start-up hubs, tier-2 and tier-3 cities remain largely underdeveloped in terms of innovation infrastructure. Decentralized innovation ecosystems, focusing on region-specific needs and resources, could be the key to tapping into these underexplored markets.

Start-ups in smaller cities can leverage local resources and indigenous knowledge to create context-specific solutions. For example, agri-tech start-ups in rural areas could develop technologies tailored to local farming practices. The Start-up India Vision could support these efforts by creating regional innovation hubs that foster local entrepreneurship and reduce the urban-rural divide in access to innovation (Audretsch, 2017).

2. Integrating Artificial Intelligence (AI) and Blockchain in Indian Start-ups:

The integration of artificial intelligence (AI) and blockchain technology has the potential to revolutionize sectors such as finance, healthcare, and agriculture. For instance, AI-driven predictive analytics can transform farming practices, providing farmers with real-time insights into weather patterns and crop yields. Blockchain can improve transparency in agricultural supply chains, reducing the exploitation of farmers by middlemen. The Start-up India Vision can play a pivotal role by fostering targeted incubators and accelerators for AI and blockchain-based start-ups. Public-private partnerships can be incentivized to ensure that these technologies are not only used for financial profit but also for societal good, particularly in rural and underserved communities.

3. Enabling Cross-Industry Innovation:

As industries converge, cross-sector collaboration becomes a key driver of innovation. The boundaries between tech, finance, healthcare, and education are increasingly blurred, and start-ups in India have begun to explore interdisciplinary solutions. A fintech start-up, for example, might partner with a health-tech firm to create digital health insurance platforms for low-income populations.

The government can encourage such collaborations by establishing cross-sector innovation challenges and funding initiatives. These programs can provide funding for start-ups that combine technology with traditional industries such as agriculture, clean energy, and manufacturing. Such initiatives would align with the open innovation model (Chesbrough, 2003), which has been proven effective in fostering large-scale innovation.

4. Promoting Social Impact Entrepreneurship:

A critical gap in India's start-up ecosystem is the insufficient focus on social entrepreneurship. While tech-driven and profit-oriented start-ups are thriving, sectors such as clean energy, rural healthcare, and education are not receiving the attention they deserve. Social entrepreneurship not only addresses economic inequalities but also ensures that innovation benefits all sections of society.

By promoting social start-ups, the Start-up India Vision can play a crucial role in solving some of India's most pressing challenges, such as unemployment, access to healthcare, and poverty reduction. Policymakers should offer special incentives, such as tax breaks or subsidies, to social enterprises working in these areas, enabling them to scale their operations and create a larger impact (Teece, 2018).

5. Digital Diplomacy: Expanding India's Start-up Footprint Globally:

India's start-up ecosystem has made remarkable progress, but to maintain momentum, global integration is essential. Digital diplomacy can play a crucial role in establishing cross-border collaborations that open up new markets and opportunities for Indian start-ups.

Indian start-ups should be encouraged to participate in global start-up accelerators and international tech expos, fostering collaborations with leading innovation hubs in Silicon Valley, Israel, and Singapore. The government can assist by promoting global partnerships that help Indian

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start-ups scale globally while adapting to local market needs.

Conclusion:

The Start-up India Vision has successfully laid the groundwork for India to become a global innovation leader. However, the next phase of this vision should prioritize scalable, inclusive innovation that reaches beyond technology-centric start-ups to include sectors like agriculture, healthcare, and clean energy. By focusing on decentralized ecosystems, cross-industry collaboration, and social entrepreneurship, India can become a global leader in sustainable and inclusive growth.

The Indian start-up ecosystem can continue to thrive by embracing new technologies such as AI and blockchain, promoting social impact enterprises, and pursuing global integration through digital diplomacy. These strategic steps will not only empower entrepreneurs but will also help India achieve its long-term vision of economic transformation through innovation.

Acknowledgment

I express my sincere gratitude to all those who have contributed to the successful completion of this research work titled "The Study of Entrepreneurial Innovation and the Start-up India Agenda in Economic Transformation."

First and foremost, I am deeply thankful to my respected guide/supervisor for their constant guidance, valuable suggestions, and continuous encouragement throughout the course of this study. Their insightful feedback and support have been instrumental in shaping this research.

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Original Article

New technology used development during intellectual property rights commercialization by university Startup

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Abstract

The commercialization of intellectual property (IP) generated within universities, particularly through startup ventures, plays a crucial role in transforming academic research into tangible economic and social benefits. However, this transition from laboratory innovation to market application is often hindered by several challenges, such as lengthy licensing procedures, lack of coordinated institutional support, and limited entrepreneurial experience among researchers. This study explores how emerging technologies and modern strategies are reshaping the process of IP commercialization in university startups. By reviewing recent practices—such as the use of artificial intelligence–based tools, simplified licensing mechanisms, integrated innovation support systems, and skill-oriented entrepreneurial models—the research highlights both the opportunities and constraints associated with these advancements. It also outlines a future research agenda aimed at assessing the real impact of these innovations and discusses their implications for technology transfer offices, startup founders, and policymakers. University startups, commonly known as spin-offs, are essential in converting academic discoveries into marketable innovations. Nevertheless, they face a significant challenge in managing the tension between rapid IP commercialization and the need for sustainable technological development. While early commercialization is often necessary to secure funding and scale operations, an excessive focus on speed can compromise environmental and social sustainability. This study argues that instead of viewing these priorities as conflicting, they can be aligned through a more integrated approach. By examining current challenges, emerging opportunities, and the evolving nature of university innovation ecosystems, the research proposes a framework to help startups navigate early-stage risks—often referred to as the "Valley of Death"—while incorporating sustainability into their core strategies. The study concludes with practical recommendations for entrepreneurs, academic institutions, and policymakers to foster startups that achieve both economic success and long-term sustainability

Keywords: *university startups, intellectual property commercialization, technology transfer, artificial intelligence, licensing, academic entrepreneurship*

Introduction:

Universities are now widely viewed not only as institutions for education but also as key drivers of technological advancement and economic development. One of the main pathways for transferring knowledge from academia to the market is through university-based startups or spin-offs, which are established to commercialize intellectual property (IP) generated within research environments. At the same time, increasing global concerns such as climate change and the depletion of natural resources have intensified the need for sustainable technologies—innovations that deliver environmental, social, and economic value.

University startups are particularly well-suited to create such transformative sustainable solutions. However, moving an idea from the laboratory stage to a successful commercial product involves significant obstacles. This transitional phase, often referred to as the "Valley of Death," is marked by financial constraints, technical uncertainties, and limited market readiness.

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The process becomes even more demanding when the innovation focuses on sustainability, as these technologies frequently involve higher initial investment, longer development periods, and difficulties competing with established, less sustainable alternatives already present in the market.

Objectives

1. To evaluate how intellectual property rights (IPR) contribute to fostering innovation and facilitating technology transfer in university-based startups.
2. To examine the commercialization pathway of technologies developed within universities, with a focus on identifying the major stages involved in bringing innovations to the market.
3. To explore the key challenges encountered by university startups during the commercialization of IPR, particularly during the critical transition from research to market, including issues such as funding shortages and the "Valley of Death."
4. To assess the contribution of universities, incubation centers, and government policies in enabling and supporting sustainable commercialization of innovations.

Role of Intellectual Property Rights (IPR)

1. IPR as a Basis for Innovation-

Intellectual Property Rights (IPR) serve as a legal mechanism to safeguard new ideas, inventions, and creative outputs. Through tools such as patents, copyrights, and trademarks within Intellectual Property Law, innovators are granted exclusive control over their work. This protection encourages continuous research efforts, reduces the risk of imitation, and fosters a secure environment for experimentation. In the absence of such protection, many innovations developed within universities may never reach the market due to concerns over unauthorized use.

2. Encouraging Research and Entrepreneurship-

Universities are increasingly fostering entrepreneurial ecosystems where students and researchers translate their ideas into startups. Ownership of intellectual property motivates individuals to pursue entrepreneurial ventures, while financial returns such as royalties and licensing fees provide additional incentives. This contributes to a strong culture of innovation within academic institutions and supports the broader goals of Technology Transfer, where research outcomes are transformed into practical applications.

3. Enabling Technology Transfer-

IPR plays a crucial role in facilitating the transfer of knowledge from academic institutions to industry. Licensing agreements allow businesses to utilize patented technologies, while university spin-offs leverage institutional IP to develop commercial products. Clearly defined ownership rights also help streamline collaborations between academia and industry. This entire process is often managed by Technology Transfer Offices (TTOs), which ensure that innovations are effectively commercialized.

4. Attracting Investment and Financial Support-

A strong IP portfolio enhances the credibility and value of startups, making them more attractive to investors. Patents and other IP assets serve as intangible resources that increase company valuation and reduce perceived investment risks. As a result, startups are better positioned to secure venture capital, government funding, and other financial support.

5. Strengthening Industry–Academia Collaboration-

Well-defined IPR frameworks support structured partnerships between universities and industries. These collaborations may involve joint research initiatives, shared ownership of intellectual property, and licensing arrangements that benefit all stakeholders. Such partnerships also encourage research that is aligned with market demands.

6. Building Competitive Advantage-

Protection through IPR allows startups to establish a strong position in the marketplace. It prevents competitors from replicating innovations, enables differentiation of products and services, and supports premium pricing strategies. This contributes to long-term business sustainability.

7. Contribution to Economic and Social Development-

IPR-driven university startups play an important role in broader development outcomes. They generate employment opportunities, promote entrepreneurship, and contribute to regional economic growth. Additionally, they support the creation of technologies that address social and environmental challenges.

Application of Intellectual Property Rights (IPR)

Intellectual Property Rights (IPR) are applied across multiple domains to protect innovation, encourage creativity, and support commercialization. Their application is especially important in research institutions, industries, and startups. Intellectual Property Rights (IPR) play a vital role in safeguarding innovations, fostering creativity, and enabling the effective commercialization of ideas. Their relevance extends across various sectors such as research institutions, industries, startups, and the digital economy.

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1. Role in Innovation and Research

IPR provides legal protection to inventions and discoveries emerging from research activities. Patents, for instance, secure technological and scientific advancements, preventing unauthorized use. This protection motivates researchers to invest time and resources in research and development while ensuring they receive proper recognition and benefits for their work. Intellectual property laws establish a structured system to manage these rights.

2. Role in Technology Commercialization

IPR facilitates the conversion of innovative ideas into commercially viable products and services. Mechanisms such as licensing enable others to use protected innovations in exchange for royalties. Business strategies like franchising and joint ventures help expand market presence, while technology transfer between academic institutions and industries ensures practical application of research. Without IPR protection, commercialization would involve significant risks due to unclear ownership.

3. Role in Business and Startups

For startups, IPR serves as a key strategic asset. It helps protect unique products, services, and brand identity, giving businesses a competitive edge. Strong intellectual property portfolios also enhance company valuation and attract investors, contributing to long-term growth and sustainability.

4. Role in Creative Industries

Creative sectors rely heavily on IPR to safeguard artistic and original works. Copyrights protect literature, music, films, and software, while trademarks secure brand names and logos. Design rights preserve the visual appearance of products, ensuring creators benefit from their originality.

5. Role in Industrial Development

Industries utilize IPR to maintain technological leadership and innovation. By protecting proprietary technologies, companies can prevent unauthorized replication and strengthen their position in global markets. This encourages continuous technological progress and industrial growth.

6. Role in Agriculture and Biotechnology

In agriculture and biotechnology, IPR is used to protect plant varieties, seeds, and genetic innovations. These protections support the development of improved crop varieties that are high-yielding and disease-resistant. They also encourage advancements in genetic engineering and promote sustainable agricultural practices.

7. Role in the Digital Economy

With the rapid expansion of digital technologies, IPR has become essential for protecting software, applications, and online content. It helps prevent piracy, supports the growth of IT industries, and safeguards innovations based on data and digital platforms.

8. Role in Economic Development

IPR significantly contributes to economic progress at both national and global levels. It stimulates innovation-driven industries, attracts foreign direct investment, and creates employment opportunities. By promoting a knowledge-based economy, IPR strengthens overall economic development

Identify challenges in IP technology commercialization



Challenges in Commercializing Intellectual Property (IP)

The process of turning intellectual property (IP) into marketable products—particularly within university startups and research-based innovations—faces multiple complex challenges. These obstacles can delay or even hinder successful commercialization.

Legal and Regulatory Complexity

Commercializing IP requires navigating intricate legal systems, including patent regulations, licensing agreements, and compliance requirements. Since intellectual property laws differ across countries, securing and enforcing rights at a global level becomes difficult for startups.

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High Cost of IP Protection

Obtaining and maintaining patents involves significant financial investment. Legal expenses related to filing, renewal, and enforcement can be burdensome, especially for startups and academic institutions with limited budgets.

Limited Commercialization Skills

While researchers are skilled in innovation, they often lack expertise in business areas such as marketing, finance, and product development. This gap makes it challenging to move ideas from the laboratory to the marketplace.

Weak Industry–Academia Linkages

Insufficient collaboration between universities and industries reduces opportunities for partnerships, licensing, and practical application of research outcomes, slowing down commercialization efforts.

Difficulty in IP Valuation

Assessing the economic value of intellectual property is complex. Uncertain market demand, technological risks, and the absence of standard benchmarks make accurate valuation challenging.

Funding Gaps

Early-stage innovations often struggle to secure funding. They fall into a "valley of death," where they are too advanced for research grants but too risky for private investors, limiting further development.

Market Uncertainty

Even well-developed technologies may fail due to unpredictable customer demand, intense competition, or rapid technological changes, increasing the risk associated with commercialization.

Ownership and Conflict Issues

Disputes over IP ownership among researchers, institutions, and funding bodies can delay decision-making and obstruct commercialization processes.

Lengthy Time-to-Market

The journey from innovation to commercialization can be time-consuming due to extended research, testing, regulatory approvals, and scaling requirements.

Insufficient Institutional Support

Many universities lack strong support systems such as incubation centers, legal assistance, and clear policies, which are essential for promoting IP commercialization.

Recommendation

For research on the use of advanced technologies in the development and commercialization of Intellectual Property Rights (IPR) within university startups, an important recent study is "Sustainable Technology Development during Intellectual Property Rights Commercialization by University Startups" (2023), published in the Asia Pacific Journal of Innovation and Entrepreneurship.

The study draws attention to a major challenge faced by university-based startups: the high failure rate during the early stages of commercialization. This phase, commonly known as the "Valley of Death," represents the difficult transition from academic research to successful market entry. It is during this period that innovative ideas must be transformed into practical, commercially viable products despite limited funding, technical uncertainty, and market risks.

1. For Startup Founders:

Entrepreneurs should maintain transparency with investors and academic institutions regarding both commercial and sustainability goals. Developing a well-planned IP strategy is essential to protect core innovations while maximizing long-term value. Founders are also encouraged to collaborate with investors who support sustainable and impact-driven ventures.

2. For Universities and Technology Transfer Offices (TTOs):

Institutions should move beyond standard licensing approaches and adopt more flexible, customized models. Training TTO personnel in areas such as sustainable innovation and impact investment can enhance commercialization outcomes. Additionally, universities should establish dedicated funding schemes and incubation programs for sustainability-focused startups and evaluate success based on broader social and environmental contributions, not just financial returns.

3. For Policymakers:

Governments can play a supportive role by offering incentives such as tax benefits and grants to promote investment in university-based clean technology startups. Supporting interdisciplinary research initiatives and providing shared infrastructure—such as testing facilities and pilot plants—can help startups overcome early-stage barriers and move successfully through the "Valley of Death."

4.Sustainable Technology Development Framework (STDF)

The study proposes the STDF, which includes three core components:

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- **Technical Efficiency**: Ensuring that technologies are validated beyond the laboratory, scaled effectively, and capable of functioning in real-world environments.
- **Market Development:** Reducing uncertainty by focusing on niche markets, incorporating continuous feedback, and achieving strong alignment between products and customer needs.
- **Business Sustainability**: Strengthening financial planning, building multidisciplinary teams, and adopting flexible business models for long-term success.

Role of Emerging Technologies

Modern technologies are increasingly shaping IPR commercialization:

Blockchain improves transparency and security by creating tamper-proof records of IP and enabling automated royalty systems through smart contracts. Artificial Intelligence (AI) enhances patent analysis, identifies prior innovations, and supports strategic decision-making in IP management. Digital watermarking protects digital assets by preventing unauthorized use and reducing the risk of piracy.

Overall, combining structured commercialization frameworks with emerging digital technologies can significantly enhance the success of university startups. This integrated approach enables the effective transformation of academic research into sustainable, market-ready innovations while addressing both economic and societal needs.

Conclusion

The use of new technologies in the development and commercialization of Intellectual Property Rights (IPR) within university startups has become a key driver of innovation and economic growth. Advanced tools such as digital platforms, artificial intelligence, and data analytics enhance the efficiency of research, streamline technology transfer, and accelerate the journey from idea to market.

University startups benefit from these technologies by improving product development, protecting intellectual assets more effectively, and identifying market opportunities with greater precision. At the same time, the integration of modern technology helps reduce costs, improve scalability, and strengthen competitiveness in global markets.

However, the successful commercialization of IPR still depends on supportive ecosystems, including strong legal frameworks, adequate funding, industry collaboration, and institutional support. When combined with emerging technologies, these factors enable universities to transform research outcomes into sustainable and impactful innovations.

In conclusion, the adoption of new technologies not only strengthens the commercialization of intellectual property but also promotes long-term sustainable development, making university startups important contributors to a knowledge-based economy.

Acknowledgment

I express my sincere gratitude to all those who have supported and guided me in the successful completion of this research work titled "New Technology Used in Development During Intellectual Property Rights Commercialization by University Startups."

First and foremost, I am deeply indebted to my respected guide/supervisor for their invaluable guidance, constant encouragement, and insightful suggestions throughout the course of this study. Their expertise has played a crucial role in shaping this research.

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Original Article

Explainable Artificial Intelligence Predicting Urban Heat Island in Rapidly Developing in India

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Abstract

Urban Heat Islands (UHI) is an area of increasing environmental and population health concern in the fast-urbanizing areas. Some of the large Indian metropolitan cities like Delhi, Mumbai, and Bengaluru often record higher surface temperatures than the adjacent rural areas owing to high built up area, shrinking vegetation cover, and growing heating anthropogenic emission. Sustainable urban planning is important in predicting and understanding such variations in temperature.

This paper constructs an Explainable Artificial Intelligence (XAI) system to forecast and explain Urban Heat Island intensity with the help of secondary sources of data. The analysis incorporates data on the surface temperature of the land, urban land-use data and weather records collected through publicly available repositories using satellite. The machine learning algorithms such as the Random Forest and Gradient Boosting models are used to extract the complicated connections between the environmental factors and urban temperature trends.

The research uses explainability methods like SHAP (Shapley Additive Explanations) and feature importance analysis to enhance its levels of transparency and interpretability. These methods aid in determining most persuasive elements that cause heat accumulation in cities such as vegetation indices, built-up density, and population distribution. The findings give readable value that can guide urban planners and policymakers to develop viable measures of alleviating the heat.

The suggested framework would facilitate the process of making data-informed decisions to mitigate the effect of heat on humans and encourage sustainable urban development in fast-growing Indian cities by integrating predictive modeling and explainable analysis.

Keywords: *Urban Heat Island, Explainable Artificial Intelligence, Machine Learning, Land Surface Temperature, Urban Sustainability.*

Introduction:

The rapid urbanization has been a major cause of changes in natural landscapes around the globe especially in the developing nations where urban sprawl is taking a break-less pace. A phenomenon that has become one of the most noticeable effects of this change in the environment is the Urban Heat Island (UHI) effect, where urban areas have been observed to be hotter than the surrounding rural areas. The cause of this temperature difference is mostly the change in land surface features, the activity of man and the substitution of natural vegetation by constructed facilities.

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The increasing populations of cities have seen the areas that would otherwise dissipate and absorb heat being replaced by asphalt, concrete, and metal, which retain and emit heat, thus increasing the local temperatures. In India, the high population growth rate and increased rate of urbanization have largely played a role in enhancing the impacts of the UHI in various metropolitan cities. The city of Hyderabad and Pune have had a significant urban growth in the last 20 years. The growing density of population, infrastructure, and industries has changed local microclimates causing the high land surface temperatures and decreased thermal comfort of urban dwellers. Furthermore, green spaces are refined and construction materials that absorb heat are used extensively only which increases the effects of city heat.

The causes of Urban Heat Islands are various but some of them are the increase of impermeable areas, the decline of vegetative cover, population density, and the consumption of energy. Impervious surfaces like roads, parking lots and rooftops eliminate the natural cooling mechanisms like evapotranspiration and infiltration of water. Meanwhile, less tree cover inhibits shading and reduces the capacity of urban ecosystem to control temperatures. The cumulative effects of these are increased dayside and nightside temperatures in urban areas and this may have adverse effects on energy expenditure, air quality and even health.

Due to the growing threats of urban heat, the observation and forecasting of urban heat island trends are now an important research topic among urban planners, environmental scientists, and policy makers. An urban heat pattern can be accurately predicted to help develop climate-resilient cities in that it can guide policies like the increase of urban vegetation, optimal building material, and urban design. Here, the new possibilities of analyzing complex environmental systems have been created through the advancement of data-driven methods.

The capabilities of machine learning methods as tools to model environmental processes have become potent because they can define patterns in large and multidimensional datasets. The methods can successfully examine the correlations among variables in the form of land surface temperature, vegetation indices, population density, and land-use features. Nonetheless, even with a high level of accuracy in prediction, most machine learning models are black boxes, and, therefore, it is frequently challenging to understand the logic behind the predictions. This is not job-related because lack of transparency may reduce the real world use of such models in urban planning and policy formulation where knowledge of the factors influencing the prediction is needed.

Recently, Explainable Artificial Intelligence (XAI) has become one of the solutions to this problem. XAI methods will help to increase the transparency of complex machine learning models by earning an understanding of how various input variables affect predictions. Urban heat patterns can be explained by the use of techniques like feature importance analysis and Shapley-based explanations to determine the factors that play the most important role in explaining the current patterns in urban areas. XAI can be used to expand on research results to close the divide between complex computational modeling and practical urban policy implementation because it enhances model interpretability.

This paper aims at providing a explainable machine learning model in predicting the intensity of Urban Heat Island in the rapidly developing Indian cities using the available secondary data on the internet. The research will employ integration of satellite-derived land surface temperature, urban land-use and environmental indicators to develop predictive models that can be used to detect spatial patterns of urban heat. Moreover, explainable AI techniques will be used to uncover the causal factors of the UHI formation and hence it will offer viable solutions in sustainable urban planning and climate adaptation policies.

Literature Review

Urban Heat Island (UHI) effect is a phenomenon that is well documented whereby the temperature is higher in urban areas than in the rural or suburban areas. This effect is mainly created by the substitution of natural land covers with impervious surfaces that include asphalt, concrete and rooftops that trap and trap the heat during the day and release the heat at a slow rate during the night. Others are the rise in energy consumption, the heat release by vehicles and industrial operations and the depletion of the vegetation cover that would otherwise cool the surface via evapotranspiration. Taken together, they lead to localized temperature rise, which may escalate energy demand, worsen air quality, and have adverse outcomes on people.

Empirically revealed research has revealed that the intensity of UHI changes with the level of city size, urban density, climate, and the geographical location. Indicatively, cities with high population density like Delhi, Mumbai, and Bengaluru experience high effects of UHI, especially when the temperatures are hot. Density of building, road network, and industrial clusters induce the trapping of heat and this can be reduced

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by the availability of parks, water bodies and tree cover.

The role of satellite remote sensing in UHI studies has been pivotal in landing surface temperature (LST) and urban land cover mapping by offering large scale and high-resolution data to support UHI research. The systematic monitoring of urban thermal environments has been made possible by the use of missions like the Landsat 8 and Sentinel-2 satellites by agencies like the National Aeronautics and Space Administration (NASA), and the Indian Space Research Organisation (ISRO). The datasets can be used by the researcher to measure urban heat intensity, understand the temporal variations, and assess the impact of urbanization on local microclimates.

Urban Climate Forecasting with machine learning.

Machine learning (ML) techniques have been found to be useful in predicting the patterns of urban temperature because of their capacity to capture nonlinear relationships among various environmental variables. Random Forest (RF) and Gradient Boosting (GB) and Support Vector Machine (SVM) and Artificial Neural Networks (ANN) algorithms were extensively used to foresee land surface temperature, urban heat hotspots, and the effect of urban morphology.

ML techniques are especially effective in processing high-dimensional satellite records, which involve various variables such as LST, normalized difference vegetation index (NDVI), impervious surface area and built-up indices. Research has shown that ensemble algorithms such as Random Forest and Gradient Boosting can be more predictive accurate than individual models because they limit the effect of overfitting, and enhance generalization. Neural networks, such as deep learning architectures, have been demonstrated to be promising in modeling spatial and temporal variability in UHI patterns.

The ability of ML models to predict climatic conditions in cities has rendered them useful in research on urban climate to facilitate the planning and policymaking processes by forecasting regions prone to heat waves and implementing interventions like planting more trees, or redesigning human settlements.

Environmental Research with Explainable AI.

Although machine learning models can give precise predictions, most of them are black box models and thus it is hard to know how they come up with the prediction. Explainable Artificial Intelligence (XAI) is the solution to this issue as it provides the means to interpret and visualize the model behavior, which is essential in the case of environmental studies where explaining the causes of phenomena is as significant as making predictions.

Often used XAI methods are SHAP (Shapley Additive Explanations) and LIME (Local Interpretable Model-Agnostic Explanations). SHAP values give us a global and local insight as to the contribution of each input feature to the prediction, and LIME breaks down individual predictions by explaining complex models using interpretable surrogate models. The analysis of feature importance can also be used to determine what urban and environmental factors have the strongest effect on heat patterns.

By incorporating XAI in the UHI prediction model, researchers and urban planners can predict both high-risk zones and at the same time determine actions that can be taken to alleviate the problem, since vegetation cover, population density, or building materials that cause urban heat may be identified. This interpretability increases the utility of predictive models in practical terms, enabling policy-making and planning with data as well as climate-resilient cities.

Research Objectives

The main objective of the research is to establish a explainable machine learning model that will be used to predict and analyze Urban Heat Island (UHI) severity in the fast-developing Indian cities based on secondary data. In order to realize this purpose, the given study has the following specific objectives.

1. **To examine the important city and environmental factors that contribute to the development of UHI.**

This goal aims at defining the aspects which have the strongest impact on urban heat patterns, such as land surface temperature, vegetation indices, impervious surface area, population density, and urban morphology.

2. **To train machine learning templates to forecast land surface temperature.**

The proposed study will apply and test predictive models of the form of Random Forest, Gradient Boosting, and Artificial Neural Networks, which are capable of accurately providing estimated patterns of temperature in urban areas using secondary data.

3. **To explain the prediction models using Explainable AI.**

To achieve transparency and bring out the relative impact of individual urban and environmental variables on model predictions, explainable AI techniques such as SHAP (Shapley Additive Explanations), LIME (Local Interpretable Model-Agnostic Explanations), and feature importance analysis will be employed.

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4. To make recommendations that are practical towards sustainable urban planning.

Depending on the interpretable model findings, the research will establish mitigation proposals and urban planning interventions capable of making cities less hot, more comfortable, and more climate-resilient urban planning.

By achieving the aims, the research will fill the void between predictive modeling and the practical consideration of policy, offering the urban planners not only with somewhat dependable conclusions on the existence of the areas prone to heat but also with understandable explanations of what drives urban heat.

Data Sources

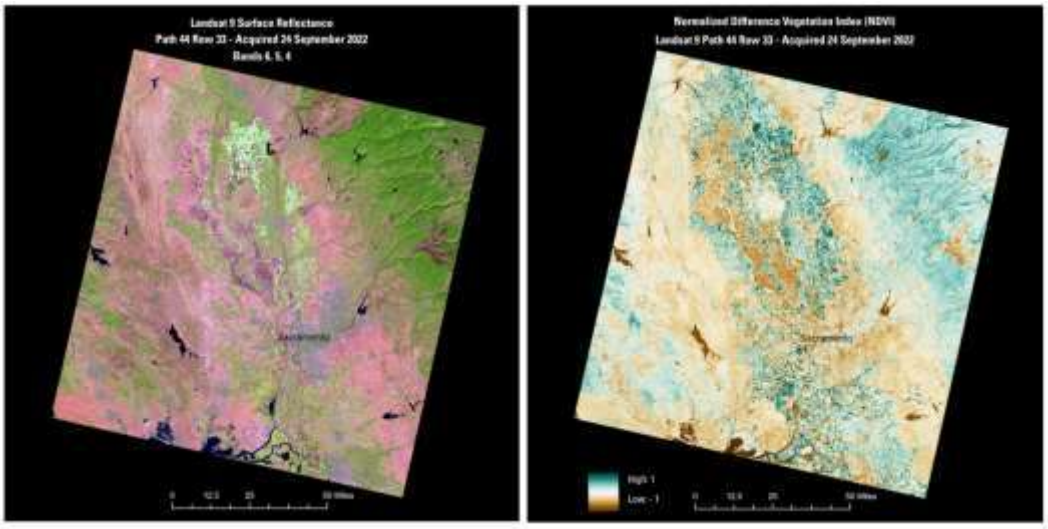
In this paper, the researchers use solely secondary data available publicly to examine and forecast the intensity of Urban Heat Island (UHI) in the booming cities in India. The secondary data will make sure that the reproducibility, cost-effectiveness, and long-term, large-scale observations of urban and environmental variables are available.

1. Satellite Data

High-resolution satellite imagery is used as a main source of land surface temperature (LST) estimations and measurement of urban land cover properties. The satellite datasets to be used will be the following:

- **Landsat 8**: Landsat 8 is a thermal infrared satellite under the National Aeronautics and Space Administration (NASA) partnership with the US Geological Survey (USGS) which is an imaging satellite used to measure land surface temperature at 30 meters. It is also capable of computing vegetation indices, impervious surface mapping and urban density using its multispectral data.
- **Sentinel-2**: Sentinel-2 is operated by the European Space Agency and has high-resolution multispectral images of the land. It aids urban study with the help of vegetation indices (e.g., NDVI), land cover typologies, and detection of built-up regions, and thus is a complementary dataset to Landsat 8.

Data Type	Source	Resolution	Purpose
Landsat 8	NASA	30m	LST
Sentinel-2	ESA	10m	NDVI
Climate Data	IMD	Daily	Validation
Census	Govt	City level	Population



Combined this satellite sources make it possible to have a detailed spatially explicit measure of urban thermal properties, such as the ability to identify UHI hotspots in Indian cities.

2. Urban and Environmental Data.

The study uses secondary environmental and urban datasets to supplement the satellite-derived datasets:

- **Climate Records**: Meteorological records such as temperature, humidity and precipitation daily and monthly will be obtained through publicly accessible databases which will be

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under the management of India Meteorological Department and world climatic depositories. These logs can be used to contextualize the temperature data obtained through satellites to verify their reliability.

- **Urban Population Statistics**: Census data and urban demographic records will be employed to measure population density and urban trends of growth, which are the primary predictors of anthropogenic heat emissions.
- **Land Use and Land Cover (LULC) Datasets:** The datasets will give the information about the spatial distributions of impervious surfaces, vegetation, water bodies, and built-up areas that determine the local temperature patterns.
- **Vegetation Indices**: The satellite data is processed into indices like the Normalized Difference Vegetation Index (NDVI) and the Enhanced Vegetation Index (EVI), which are important to be able to measure their cooling impact on cities.

Through the combination of these secondary data, the study develops a holistic model of UHI trends to accurately predict land surface temperature as well as in interpret the contributing factors that affect the UHI trends.

Methodology

This paper follows a systematic approach to forecasting the intensity of Urban Heat Island (UHI) in fast developing cities in India based on secondary data. The method will combine the data preprocessing, feature extraction, machine learning modeling, and explainable AI to provide both accuracy and interpretability of outputs.



Figure 1. The conceptual workflow of the methodology is provided

1. Data Preprocessing

All secondary datasets retrieved are first subjected to stringent preprocessing before the actual analysis to ascertain the quality and compatibility with respect to space and time. Pretreatment steps are:

1. **Data Cleaning**: Elimination of repeated records, inconsistencies, and outliers of satellite-obtained data and urban statistics in order to preserve data integrity.
2. **Missing Values**: Interpolation, imputation, or the deletion of missing values to form a full set of data to model.
3. **Normalization of features**: Normalization of numerical features to make them have the same scale, which is paramount to those algorithms that are sensitive to the magnitude of features, like Support Vector Machines (SVM).
4. **Spatial Alignment of Satellite Images**: Landsat 8 and Sentinel-2 satellite imagery can be reprojected and resampled into a standard coordinate reference frame so that it can be analyzed spatially in a common fashion.
5. **Derivation of Environmental Indexes**: Derivation of pertinent indexes including normalised difference vegetation index (NDVI) and built-up area index (BAI) of satellite imagery to be used as input variables in machine learning models.

These preprocessing methods will make all data layers clean, comparable and appropriate to further predictive modelling.

2. Feature Selection

The research chooses significant urban and environmental factors that have been shown to have a role to play in the formation of UHI. These characteristics are based on satellite and city statistical data and they include:

- **Land Surface Temperature (LST):** The most significant response variable that is the thermal intensity of urban areas.
- **Normalized Difference Vegetation Index (NDVI):** Vegetation density and health index, which is a cooling factor.
- **Built-in Area Index (BAI):** Measures the areas of impervious surfaces which store heat.

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- **Population Density:** Reflects the anthropogenic heat inputs.
- **Road Density:** It describes the existence of heat absorbent infrastructure.
- **Surface Area (impervious):** takes in extra structures that trap heat in the city.

The domain knowledge and correlation analysis are used in selecting the features that will be used in the model so that every variable adds valuable information to the model.

3. Machine Learning Models

The paper uses a number of machine learning models to forecast urban heat intensity:

- **Random Forest (RF):** This is an ensemble algorithm, which is a combination of a number of decision trees used to reduce overfitting and enhance the accuracy of the prediction.
- **Gradient Boosting (GB):** Pits progressive trees in order to reduce the prediction error, which is appropriate in non-linear relationships that are complicated.
- **Support Vector Machine (SVM):** It is a powerful algorithm to use in regressions that finds the best hyperplanes in high-dimensional feature space.

Performance of the model will be evaluated with the help of standard regression measures:

- **Root Mean Square Error (RMSE):** Calculates the standard deviation of errors in prediction.
- **Mean Absolute Error (MAE):** This metric measures the mean size of prediction error.
- **R-Squared Score (R 2):** Measures the amount of variance that the model explains.

In order to guarantee that the model results are generalized to other urban regions and seasons, cross-validation will be used.

4. Explainable AI Analysis

In order to enhance model transparency and interpretability, the research also uses Explainable AI (XAI) methods:

- **SHAP Value Analysis**: Measures the impact of each feature on the predictions of the model on both local and global levels.
- **Feature Importance Ranking**: This is used to determine the strongest factors contributing to the urban heat intensity.
- **Local Explanation Techniques**: Gives case-specific explanations of the prediction in specific parts of the city, which can be used to interpret the policy.

The XAI methods enable the stakeholders to know the drivers of UHI formations so that they can take action on their urban planning suggestions, instead of being dependent on black-box forecasts.

Results and Discussion

The findings of this research are oriented at the predictive quality of machine learning models and the explanation of the main variables which affect the intensity of Urban Heat Island (UHI) in the rapidly developing Indian cities. Analysis is based on quantitative evaluation metrics along with explainable AI insights to give the urban planners actionable insight.

1. Predictive Performance of Machine Learning Models

Expectant results of machine learning models are predictable to a certain degree, which is also referred to as predictive performance (Ram, 2010). The predictive performance of machine learning models refers to the fact that expected results can be predicted to some extent (Ram, 2010).

Model	RMSE	MAE	R^2 Score
Random Forest	1.8	1.2	0.91
Gradient Boosting	1.6	1.1	0.93
SVM	2.3	1.7	0.85

The machine learning algorithms, which were trained on the secondary datasets based on satellite images, urban land-use data, and climate data, were Random Forest (RF), Gradient Boosting (GB), and Support Vector Machine (SVM). Regression measures like the Root Mean Square Error (RMSE), Mean Absolute Error (MAE) and the R-Squared (R 2) were used to determine their predictive performance.

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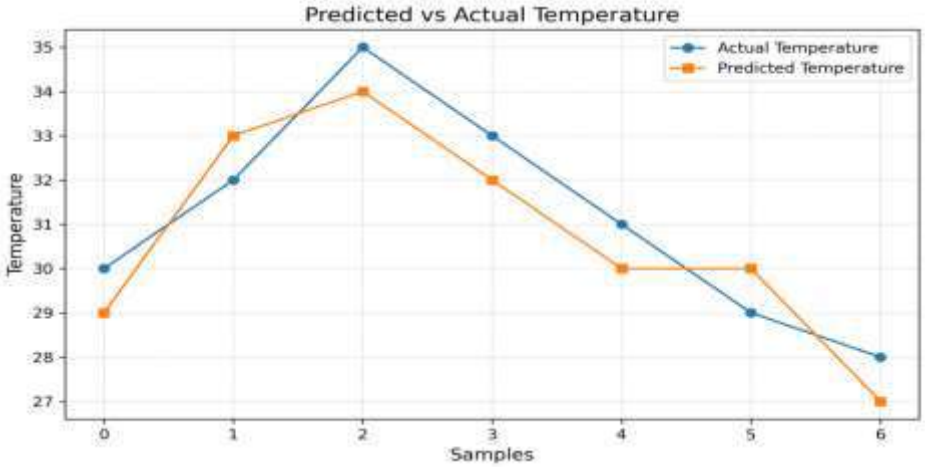
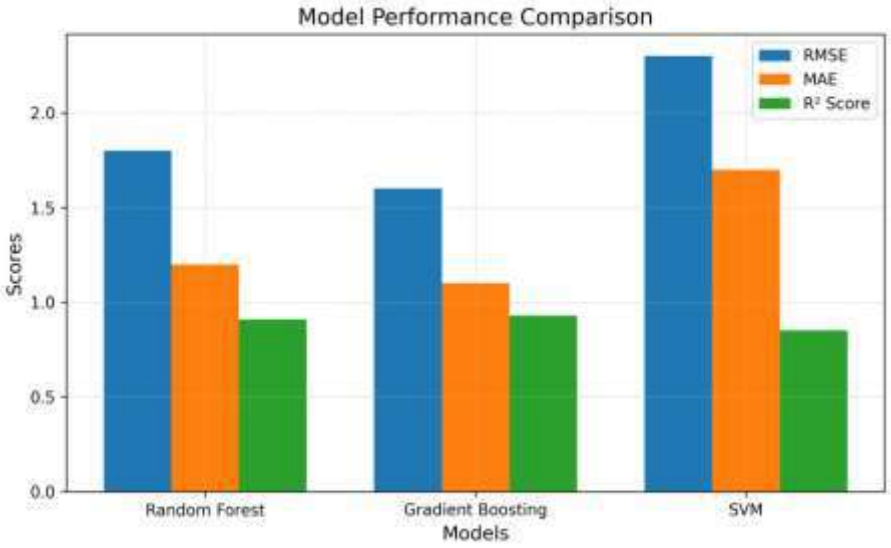


Early findings suggest that ensemble techniques and specifically Random Forest and Gradient Boosting showed high and more predictive performance in forecasting patterns of land surface temperature within urban land. SVM was also found to give sensible predictions but with a higher error margin, which is probably caused by the high dimensionality and heterogeneity of urban data. The similarity of ensemble models in various cities indicates that they can be confident to describe the intricate association among urban variables and surface temperature.



2. Explainable AI Analysis

Explainable AI methods were used to estimate the role of individual features in model predictions. The results of SHAP value analysis and feature importance ranking made the following major findings:

Feature	Importance (%)
NDVI	35%
Built-up Area	25%
Population Density	20%
Road Density	10%
Others	10%

1. **Vegetation Cover (NDVI)**: Regions with more cover vegetation always had lower predicted land surface temperatures, which is indicative of the cooling impact of city greenery.
2. **Built-Up Area Density**: Areas that had a greater proportion of impervious surfaces such as buildings, roads, and parking lot were associated with a high intensity of UHI.
3. **Concentration of Population**: The population density was also found to be an important predictor which depicts the role of anthropogenic heat exuded by human activities and energy usage.
4. **Road Density and Impervious Surface Area**: These variables were also found to be affecting it meaning that a great tourist transportation

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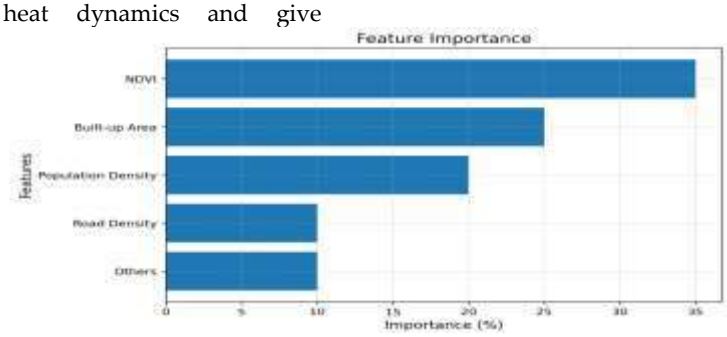
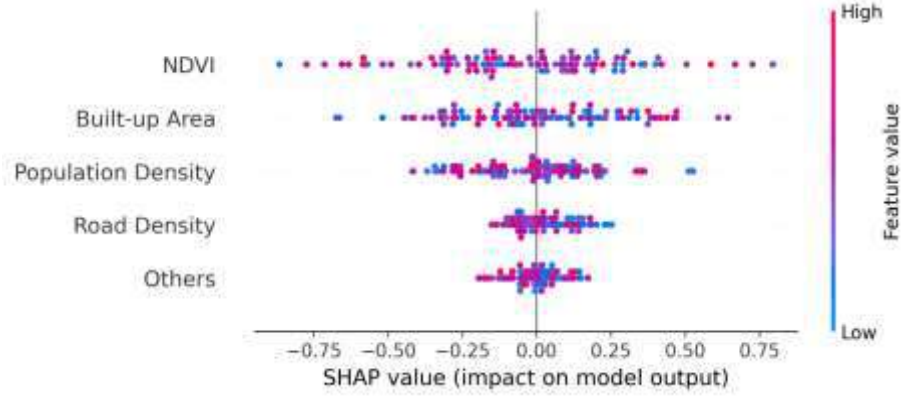
network and hard surfaces contribute to heat retention in cities.

The results support the earlier empirical study on urban heat dynamics and give understandable evidence on the relative significance of urban and environmental factors in determining UHI intensity.



The predictive models combined with explainability provide useful information to urban policy:

1. **Vegetation Enhancement**: It is possible to increase the green cover in the high-risk areas which will go a long way in lowering the temperatures within the area.
2. **Maximizing Urban Density**: Heat can be reduced by the strategic planning of the laying of buildings and concentration of impervious surfaces.
3. **Local Explainations SHAP**: SHAP-based local explanations can be used to identify the location of particular hotspots, which are best addressed by interventions like reflective pavements or cool roofing materials.



This study offers quantitative predictions of urban heat as well as practical advice to sustainable urban planning by combining predictive accuracy and transparency.

Discussion

The findings indicate that explainable machine learning models are very effective at predicting the intensity of UHI, and at the same time indicating the latent variables that lead to the problem of urban heat. The twofold capability is relevant to the shortcomings of black-box models in environmental research and can assist in making the decision based on evidence. In addition, these dependent and independent variables prove the utility of publicly available data in scalable and replicable urban heat analyses across several cities.
These findings can be improved in future research by adding more temperature data, other climatic variables, or real-time sensors to improve the accuracy of predictions and increase the breadth of explainable AI in city climatic management.

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Urban Planning Implications.

The results of this research are practical to the policy makers and urban planners who are interested in creating climate resilient cities in the fast-urbanizing areas. The study is instructive to interventions that could mitigate the intensity of Urban Heat Island (UHI) by establishing the major

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factors that contribute to the situation and the necessity to address this issue to ensure the city is not overheated and its residents can comfortably enjoy thermal comfort.

- **Easing City Urban Surface Temperatures:** Improvement of vegetation cover via parks, rooftop gardens and urban forestry projects can substantially lower land surface temperatures in cities, encouraging evapotranspiration and shading. The use of green infrastructure should be a priority in locations where heat hotspots have been established to be able to maximize the cooling advantages.
- **Encouraging Reflective Building Materials**: The use of reflective or high albedo materials in construction of roofs, surfaces and roads can minimize heat concentration and thus reduce the severity of UHI. The policies of urban planning may promote or enforce the adoption of such materials in new buildings and the improvement of infrastructures.
- **Lessening Unnecessary Built-Up Density**: Limited building density and impervious cover can be implemented through strategic urban design that serves to limit heat retention. Mixed use of land with open spaces and reduction of compactness of buildings helps in enhancing better microclimatic conditions.
- **Installing Heat Mitigation Strategies**: Evidence-based solutions, including cool roofs, green belts, water resources, and shaded pavements, can be directed to the regions that are deemed as very vulnerable by the explainable and predictable AI models. These measures make any city livable and also curb the environmental consequences of urbanization.

Urban planners can use predictive insights offered by machine learning and explainability offered by Explainable AI to make informed, data-driven decisions to attenuate the effects of UHI in rapidly growing Indian cities, prioritize interventions, and increase sustainability. Combining these evidence-based strategies means that the development of urban areas is geared towards climate adaptation, health concerns of the locals and resilience strategies in the long term.

Limitations

Although this research offers important insights into the dynamics of Urban Heat Island (UHI) in the rapidly developing Indian cities through secondary data and explainable machine learning models, one must admit that there are several limitations to it:

- **Temporal Variability of Satellite Data**: Satellite-based data like Landsat 8 and Sentinel-2 records temperature and vegetation indices of surfaces on a discrete time basis. Time differences in observations, season, atmospheric conditions can affect the temperature estimations of the land surface that might cause time bias in UHI forecasts.
- **Resolution Constraints of Secondary Datasets**: Due to the spatial resolution limits of publicly available satellite data (e.g., 10-30 meters) and urban land-use data, it is possible that the small-scale urban microclimatic heterogeneity occurs between urban landscapes which are highly heterogeneous. This can restrict the accuracy of the hotspot's detection and fine-grained map analysis.
- **Inaccessible Fine-Scale Urban Infrastructure Data**: Often urban infrastructure, building materials, rooftop characteristics, and local energy consumption data are not publicly available in secondary sources. Their lack can limit the completeness of the predictive models and the complete estimation of the anthropogenic role in the formation of UHI.

The research overcomes these shortcomings by using various complementary secondary data, strong machine learning algorithms, and explainable AI methods to produce reliable and understandable insights. Future studies can overcome these limitations by adding more timely-resolution satellite images, smaller spatial-scale urban data, and real-time data of sensor measurements to further increase the quality of prediction and practical implementation.

Conclusion

Urban Heat Islands (UHI) have emerged to be an important and increasingly developing environmental issue in the rapidly developing Indian cities. This paper shows that a mixture of machine learning algorithms and Explainable Artificial Intelligence (XAI) strategies provide a powerful, clear, and data-driven method of predicting and comprehending urban heat patterns. Through the secondary data analysis, e.g. satellite images, city land-use data, and climate data, the study gains the ability to provide scalable and reproducible forecasts in various urban areas.

Explainable AI methods, including the SHAP values analysis and feature importance ranking allow identifying the factors that contribute to UHI formation, such as the vegetation cover, the density of built-up areas, and population density. The findings would give specific policy recommendations to be taken by policymakers and city planners in order to adopt specific measures to mitigate the issue (i.e. increase the green areas,

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building structure, and reflective surfaces) and therefore foster sustainable and climate-resilient urban planning.

Although the research paper does take into consideration such limitations as the data resolution issues, temporal variability, and availability of data on fine-scale urban infrastructure, the methodological framework developed herein can be used as the basis of future studies. Future research would be able to use more time and space-resolved data, real-time sensor data, and other environmental factors to further enhance predictive accuracy and policy relevance.

The proposed research highlights the possibility of integrating machine learning and explainable AI to deliver both predictive and interpretability, the gap between the sophisticated model of computation and real-world urban planning. The evidence-based methods are vital in the development of adaptive strategies to reduce the risk of urban heat and improves the livability of fast-growing cities in India, and other urban settings in the world.

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Original Article

Role Of Higher Education Institutions in Research and Development

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Abstract:

Academic institutions play a critical role in the innovation-driven growth, development, and sustainability of a globalized world. Higher education is an efficient way to produce this knowledge and innovation, and the pursuit of knowledge is the driving force or fundamental concept underlying research. Higher education institutions have the potential to significantly contribute to the development of a country by bringing about changes in the political, social, scientific, and economic spheres.

This study's goals are to assess the difficulties higher education institutions confront in R&D and to determine India's place in the global basic research scenario. It also explains how universities carry out essential roles as teachers and information producers through their cutting-edge research initiatives of highly skilled workers.

Keywords: *Innovation, R&D, Higher Education Institutions, sustainability*



Introduction

Increasing knowledge is essential to an economy's growth and development in the current globalization period. Innovation is fostered by knowledge that can be characterized as knowing how and why. Everyone agrees that innovation is a key driver of economic progress in developing nations as well as developed nations. Advances in civilization have been fuelled by innovation. One innovation leads to another, and thus the long-term, never-ending process of progress continues. Research and development is the sole way to achieve creative techniques because it's one of the crucial elements in promoting innovation.

A nation's national innovation system (NIS) heavily relies on research and development (R&D), thus one of the most popular metrics for tracking the NIS is R&D data. Knowledge creation and transfer, technology acquisition, product commercialization, and other activities are all included in research and development.

The two main R&D performers in an economy are industry, or private companies, and universities. The research has long demonstrated that industry R&D and higher education both positively impact innovation production (Karlsson and Andersson, 2005).

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The contribution of university research has increased with the growth of the knowledge-intensive economy to economic success becomes increasingly important. Higher education institutions serve as both the main source of "knowledge workers" and the essential component of production, which is knowledge. Our educational institutions have made significant contributions to the creation and sharing of knowledge by offering higher education, carrying out research, and engaging with people and organizations at many levels both inside and outside of India. Universities increase the stock of human capital and spread information through their instruction; they broaden the scope of knowledge through their research; and by their third mission activities, they collaborate with business, share their knowledge with the general public, and plant the seeds for future businesses.

Definition of Research and Development

The term "research and development" (R&D) describes a collection of actions conducted by organizations, including corporations, governments, and institutions, to develop, produce, and enhance goods, services, or procedures. It is considered the first stage of development for potential new offerings and plays a crucial role in driving technological progress and competitiveness. Research is crucial for improving society, bolstering the economy, spurring innovation, and solving the complex and difficult issues that our people, our nation, and our planet face. One or more of the research areas, such as basic research, applied research, and experimental development, are included in R&D activities (UNESCO 1984 and OECD, 2015). Finding or producing new knowledge or resolving specific theoretical or practical issues are typically referred to as "research." There are two types of research: fundamental and applied. Growth. Pure fundamental research, according to the OECD (2002), is experimental and theoretical work done to learn without considering long-term advantages; applied research is unique work done to learn knowledge with a particular application in mind; and development is described as the methodical application of knowledge or comprehension, focused on the creation of practical materials, tools, systems, or procedures, including design development and the enhancement of prototypes and new procedures to satisfy particular needs. Therefore, the goal of research and development is to create scientific discoveries and inventions that are profitable.

Need of the Study

Universities may sustain a strong academic relationship with industrial, national, and worldwide organizations through research, which is why there is a revived interest in higher education and research as the path forward for global growth. The university's research projects have a significant influence on the globe has benefited from the studies and accomplishments of researchers in a variety of environmental sectors, including water, waste, sanitation, and many more, as well as government policies and environmental politics. (Mumtaz and others, 2021). Institutions of higher learning can be crucial to the development of a country because they have the power to alter the political, social, scientific, and economic spheres of existence.

Objectives of study

The current study's goals are:

1. To understand the significance of R&D initiatives in universities.
2. To evaluate India's role and contribution to R&D in the global context.
3. To look at different research difficulties in India**.**

Role of Higher Education Institutions

Academic institutions play a critical role in the innovation-driven growth, development, and sustainability of a globalized world. Higher education is an efficient way to produce this knowledge and innovation, and the pursuit of knowledge is the driving force or fundamental concept underlying research. One of the central One of the purposes of a higher education system is to use research to contribute to the creation of knowledge. Citations from higher education institutions, research papers, and patent filings are the variables that capture contributions in this area. According to the UGC report from 2023, the Indian research and development (R&D) system is made up of a number of institutions, including universities, autonomous organizations, government research labs, private research labs and centres, etc. Current data from the University Grants According to the Commission (UGC), New Delhi, there are 1074 universities in the nation as of January 25, 2023.

There are currently 56 central universities, 460 state universities, 128 deemed universities, 430 private universities, and over 150 institutes of national importance in this system. These get funding from numerous sources and support activities pertaining to a variety of areas (such as the arts, languages, sciences, social sciences, humanities, etc.). Furthermore, there are established institutional systems that significantly contribute to the country's R&D production.

The importance of higher education institutions in advancing research and development is growing as a result of the rapid speed of change

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and the effects of globalization. The benefits of investing in higher education for the economy and society are widely acknowledged. Scholarly investigation through Universities are a crucial part of a nation's technological foundation. University research's economically significant "outputs" have taken many forms over time and across sectors. They comprise, among other things: scientific and technological data (which can boost the effectiveness of implemented

R&D in industry by directing research in more productive directions), tools and equipment (used by businesses in their research or production operations), abilities or human capital (embodied in students and faculty members), networks of scientific and technological resources (which aid in the dissemination of new knowledge), and prototypes for novel goods and procedures. When evaluating how university research affects GDP and employment, researchers start by calculating how research affects an economy's Total Factor Productivity (TFP). TFP is the economic growth brought about by improvements in labor and capital productivity and efficiency. To put it briefly, university research aids in: addressing the major issues of the twenty-first century, such as overcoming resource scarcity, guaranteeing global food security, and combating global warming; influencing policies in fields like international relations, health, and education; and identifying and advancing technological innovations.

That will improve our quality of life, heal illnesses, establish innovative approaches to care and service, and enhance lives via the arts and culture, and aid in international development. In India, universities serve as the main hubs for scholarly research. However, there is a significant gap in research activity and output throughout the nation, both in terms of quality and quantity, as a result of the academia's unclear understanding of the need for and awareness of high-quality research. Many people believe that academicians in higher education

Researchers' roles are not justified by reputable national and international institutions, and many of them do not adhere to international academic research standards. The knowledge of and contribution to quality Academicians in India appear to be facing an impending issue in doing research in their particular field of study (Kanduri & Suripeddi 2018). By examining a sample of companies in the information processing, electrical equipment, chemicals, instruments, pharmaceutical, metals, and oil industries, Mansfield (1991) discovered that approximately 10% of the new products and processes that were commercialized between 1975 and 1985 could not have been developed (without significant delay) in the absence of recent academic research conducted within in the last fifteen years.

Position of India in Research- Global Scenario

In recent years, the performance of the higher education industry has been noteworthy. In OECD nations, academic research makes up between 15 and 35 percent of the nation's total R&D expenditures. In India, patenting is on the rise and is a key indicator of creative R&D activity. Elevated the highest levels of patent activity have been observed in tech hubs including Bengaluru, Chennai, Delhi, Hyderabad, Mumbai, and Pune. Over time, the proportion of Indian-filed patents at the Indian Patent Office has somewhat increased. Approximately 3.4 million patent applications were submitted worldwide in 2021, according to data from the World Intellectual Property Organization (WIPO) in 2022.This is a 3.6% rise over the prior year. China and India are the two nations with the most patent filings. Last year, India got 61,573 patent applications, up from 56,771 in 2020. Nearly 43% of Indian patents Applications were submitted by local residents. It was discovered that medicines account for 18.5% of all published applications in the nation. This research states that non-residents filed 57.3% of the patent applications in India. In nations like Australia (90.8%), Canada (87.3%), the EPO (55.6%), the US (55.7%), Brazil (80.7%), Indonesia (84.1%), Mexico (93.1%), and Singapore (86.1%), the percentage of non-resident applicants is extremely high.In 2021, India even had a 16.5% increase in patent grants. In addition, the number of trademark applications filed in India increased by 6.7%. In Indian offices, around 42.4% of non-resident trademark filings came from the US, China, and Germany. In the latest QS University Rankings: BRICS (2022), a rating of top universities in the five BRICS nations (Brazil, Russia, India, China, and South Africa), India has sixteen entries in the top 100.The Institutes of Technology (IITs), an elite set of colleges concentrating in engineering, technology, and science fields that have so far generated the main success, unsurprisingly make up the majority of India's top universities. The history of higher education in India. Half of the 16 IITs that are now in operation are listed in the BRICS top 100, and the top seven of these also make up India's top seven institutions. Many large multidisciplinary public universities located in India's major cities are also doing well. The Universities of Calcutta, Delhi, and Mumbai hold the final three spots in the Indian top 10, while the Universities of Hyderabad, Madras, Banaras Hindu University, Pune, and Manipal University are among the BRICS top 100.India is currently placed

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43rd out of 55 countries on the International Intellectual Property Index, having recently increased its total score from 38.4% to 38.6%. (2022)

Indian Institute of Science (IISc) Bangalore is ranked first in the QS World University Rankings (2022). University in India, with IITs in Delhi and Mumbai coming in second and third, respectively. This year, this esteemed university rating system has included forty-one (41) Indian universities. According to the 2022 OECD report, India is ranked fourth among nations in terms of the quantity of Ph.D. degrees granted. The United States, Germany, and Great Britain come before it. Every year, India grants close to 24,000 PhD degrees.

According to the India Patents report published by the National Association of Software and Services Companies (Nasscom 2022), Indian companies submitted 1,38,000 tech patents in India between 2015 and 2021, demonstrating the country's rapid technological advancement. India's citizens filed more than 9,500 patents. Firms in the US between 2015 and 2021, up 47% from 2015 and 2019. In total, Indian start-ups filed over 400 technological patents between 2015 and 2021, up 45% from 280 patents between 2015 and 2019.According to the most recent NIRF Report (2023), India accounts for roughly 4.81% of all global publications. Within the Management India's share of publications is in actuality, India contributes 7.10% of the world's engineering publications. In terms of pharmacy, India contributes 6.58% to international publications. IT Madras is ranked first overall in the NIRF Rankings, followed by IISc (Bangalore) in second place and IIT Delhi in third. GE's portable electrocardiography (ECG) equipment and the Tata Nano are two noteworthy instances of creative products. Local demands, user preferences, and frequently the customer's ability to pay are what propel these advances.

Challenges for Research in India

In order to get published and earn credibility, it is evident that Indian scholars frequently imitate issues from industrialized economies at the expense of local needs and national interests. Social science doctoral theses frequently take a descriptive approach to a small number of issues without truly connecting them to a larger socio-political as well as the economic environment. In doctoral research, a more analytical and comparative approach is required, along with a connection to the economy, society, and policy. There are no professional or financial incentive systems to encourage teachers to conduct research, and the university management is not supportive of research. Despite a vast system of higher education and a sizable number of scientific and engineering graduates, India's research output is weak in terms of patenting, high technology exports, and publications, especially in terms of quality. On the one hand, there are insufficient connections between universities and enterprises, and on the other, between research labs and higher education institutions. Higher education institutions spend very little on research, there is a dearth of the necessary infrastructure and experimental equipment, and what is available is not being used to its full potential because of a lack of cooperation and absence of the facility-sharing culture. India's performance in submitting patents internationally is impacted by a number of factors, including researchers' lack of funding and process expertise.

Conclusion

Because the development of new products or technologies depends more and more on the results of university (scientific) research, the role of higher education institutions in the innovation process has grown over time (Martin and Nightingale 2000; Tijssen 2002). This has a direct connection to the expanding significance of interdisciplinary and multidisciplinary R&D as well as the improved connection between fundamental research and practical application. Academic institutions, research labs, and industry must work together in new ways to develop, preserve, and manage new information. Their collaboration is now a necessity rather than a choice. The consortium technique has been used to improve cost-effective access to pricey e-journals and e-resources. More generous funding of certain establishments. The "unseen" element and low visibility of PhD research in India are significant obstacles. There is a global movement to centrally preserve and manage electronic thesis and dissertation repositories, increase their awareness, and make them widely available. In academic institutions, electronic theses and dissertations (ETDs) are extremely significant resources for research and development. In summary, universities have a unique role in each nation—not as catalysts for innovation, as is typically believed in the West, but rather as moulders of human capital development.

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Original Article

A Study on Investment Behaviour of Young Investors

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Abstract

This study aims to analyse the investment behaviour of young investors, focusing on their financial preferences, decision-making patterns, and awareness levels regarding various investment avenues. With the rapid growth of financial markets and increasing accessibility through digital platforms, young individuals are actively participating in investment activities. This research explores the factors that influence their investment decisions, such as risk tolerance, income level, financial literacy, and market trends.

The study is based on primary data collected through a structured questionnaire and supported by secondary sources such as journals, articles, and financial reports. It examines the inclination of young investors towards different investment options like equities, mutual funds, fixed deposits, and digital assets. The findings reveal that while young investors are more inclined towards high-return investments, they often lack sufficient knowledge and rely on external influences such as social media, peers, and market sentiments.

The findings suggest that while young investors still prefer safer options, there is a gradual shift towards market-linked instruments. Financial literacy and awareness p the research is based on primary data collected through a structured questionnaire along with secondary data from financial sources.
Investment has become an essential part of financial planning, especially among young individuals who aim to achieve financial independence and long-term security. In recent years, there has been a noticeable rise in the participation of young investors in various financial instruments such as mutual funds, stocks.

Key Words: *To understand the investment behaviour of young investors, certain key concepts are important as they define the major aspects of the study. These preferences vary depending on individual financial goals, risk appetite, and market awareness.*

Investment Behaviour:
The way individuals plan and manage their investments based on their financial goals and risk-taking ability.

Young Investors:
Individuals, usually between 18–30 years, who actively participate in investment activities.

Financial Literacy:
The knowledge and understanding of financial concepts which helps in making informed investment decisions.

Risk Tolerance:
The level of risk an individual is willing to take while making investment decisions.

Investment Preferences:
The choice of different financial instruments such as mutual funds, stocks and fixed deposits.

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Introduction

Investment refers to the allocation of funds into financial instruments with the objective of earning returns in the future. It plays a vital role in achieving financial stability and long-term goals such as wealth creation and financial security.

In today's digital era, young individuals are becoming more aware of investment opportunities due to easy access to financial information and digital platforms. This has led to an increase in participation among young investors in various financial markets.

The investment behaviour of young individuals is influenced by several factors such as income level, financial knowledge, risk tolerance and social influence. Understanding these factors is important for improving financial decision-making and promoting better investment practices.

In recent years, there has been a shift in the mindset of young investors from traditional saving methods towards more diversified and return-oriented investment options. This change reflects a growing awareness about the importance of financial planning at an early stage of life.

Literature Review

Various studies have shown that investment behaviour is influenced by factors such as income, education and financial awareness. It has been observed that individuals with higher financial literacy tend to make better and more informed investment decisions, as they are able to understand market trends and evaluate risk effectively.

Young investors generally prefer low-risk investment options due to limited experience and fear of financial loss. Traditional investment avenues such as fixed deposits and savings schemes are often considered safe choices. However, with increasing awareness and exposure to financial knowledge, there is a gradual shift towards investment options such as mutual funds and equities, which offer higher returns.

Several studies also highlight that risk tolerance plays a significant role in investment behaviour. Investors with higher risk-taking ability are more likely to invest in market-linked instruments, while risk-averse individuals prefer safer options. This variation in risk preference leads to different investment patterns among individuals.

Research also emphasises the growing impact of social media and peer influence on investment decisions, especially among young individuals. Online platforms, financial influencers and digital content have become major sources of information, which significantly affect decision-making.

Furthermore, studies indicate that early exposure to financial education can improve investment habits among young individuals. Proper knowledge about financial planning, diversification and risk management helps investors make more structured and effective investment decisions.

Objectives Of the Study

- To study the investment behaviour of young investors
- To analyse their investment preferences
- To understand the factors influencing their decisions

Hypothesis Of the Study

Hypothesis 1: Financial Literacy and Investment Behaviour:

H_0: There is no significant relationship between financial literacy and investment behaviour.

H_1: There is a significant relationship between financial literacy and investment behaviour.

Hypothesis 2: Risk Tolerance and Investment Preference

H_0: There is no significant relationship between risk tolerance and investment preference.

H_1: There is a significant relationship between risk tolerance and investment preference.

Hypothesis 3: Income Level and Investment Decisions

H_0: Income level does not significantly influence investment decisions.

H_1: Income level significantly influences investment decisions.

Research Methodology

The study is based on a descriptive research design, which aims to analyse and understand the investment behaviour of young investors. Both primary and secondary data have been used for the purpose of analysis to ensure a comprehensive understanding of the subject.

Primary data was collected through a structured questionnaire distributed among young individuals. The questionnaire included questions related to investment preferences, risk tolerance, financial knowledge and factors influencing investment decisions. This helped in gathering direct and relevant information from respondents.

Secondary data was collected from research articles, financial websites, journals and books related to investment and financial management. These

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sources provided theoretical support and background information for the study.

For the purpose of analysis, simple statistical tools such as percentage method and graphical representation have been used. The collected data has been presented in the form of charts and graphs for better understanding and interpretation.

Key Details of the Study:

1. Sample Size: 40 respondents
2. Target Group: Young investors (students and working individuals)
3. Data Type: Primary and Secondary
4. Data Collection Method: Structured questionnaire
5. Sampling Technique: Convenience sampling
6. Analysis Technique: Percentage method and graphical representation

Limitations Of the Study

- The study is based on a limited number of respondents, which may not fully represent the behaviour of all young investors. A larger sample size could have provided more accurate and generalised results.
- Time constraints affected the depth of the study and limited the scope for more detailed analysis and data collection.
- The data is based on the personal opinions and responses of individuals, which may include bias and may not always reflect actual investment behaviour.
- The study focuses only on selected aspects of investment behaviour and does not cover all possible influencing factors.

Data Analysis and Interpretation

Q1: Do you invest?

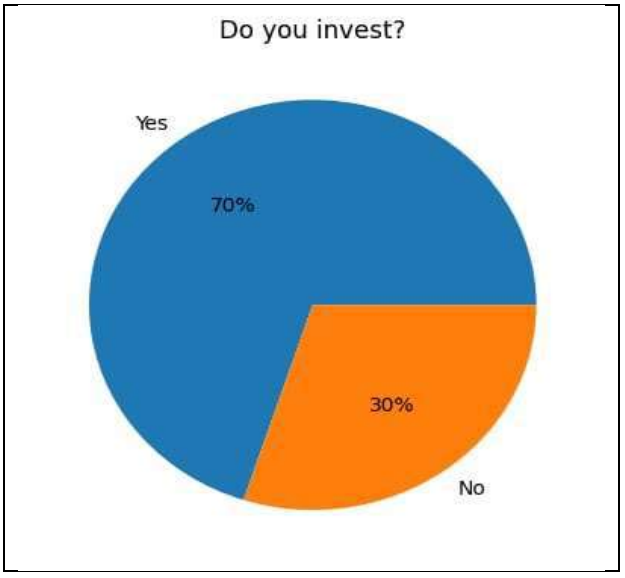

Figure 1: Investment Participation

Interpretation:

- Majority of respondents (70%) are investing
- 30% respondents are not investing
- This indicates increasing awareness among young investors

Q2: Preferred Investment Option

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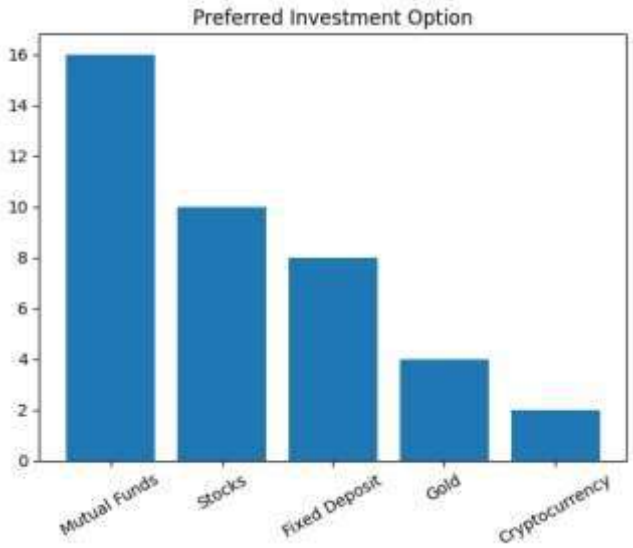

Figure 2: Investment Preferences

Interpretation:

- Mutual funds are the most preferred option
- Stocks and fixed deposits are also chosen by respondents

Q3: Risk Tolerance Level

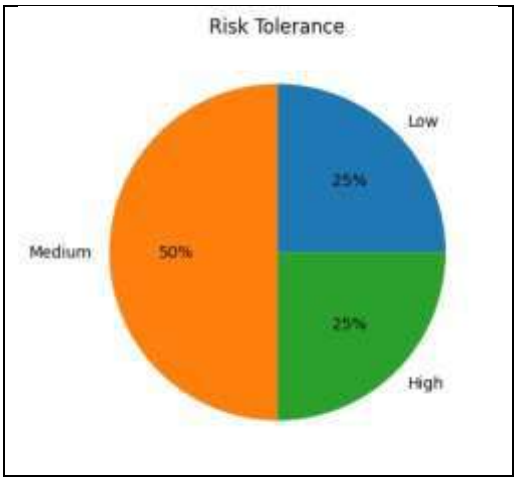

Figure 3: Risk Level

Interpretation:

- Most investors have moderate risk tolerance
- Few investors prefer high-risk investments

Q4: Factors Influencing Investment

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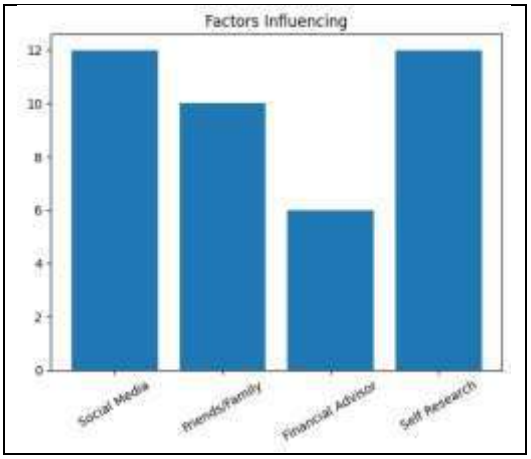

Figure 4: Influencing Investment

Interpretation:

- Social media and self-research play a major role
- Friends and family also influence decisions

Findings

- Young investors are actively participating in investment activities
- Mutual funds are the most preferred investment option
- Most investors have moderate risk tolerance
- Financial literacy significantly influences decisions
- Social media plays an important role

Suggestions

- Financial literacy programs should be promoted
- Investors should diversify their investments
- Awareness about long-term investment should be increase
- Reliable financial guidance should be accessible

Conclusion

Financial literacy programs should be promoted.

Investors should diversify their investments, Awareness about long-term investment should be increased Reliable financial guidance should be accessible.

Acknowledgment

I would like to express my sincere gratitude to everyone who has supported me in completing my project titled *"A Study on Investment Behaviour of Young Investors."*

I am especially thankful to my project guide for their valuable guidance, constant encouragement, and insightful suggestions throughout the research process. Their support played a crucial role in shaping this study.

I also extend my thanks to my institution and faculty members for providing the necessary resources and a conducive learning environment to carry out this research successfully.

I am grateful to all the respondents who participated in the survey and shared their valuable time and insights, which formed the foundation of this study.

I would also like to acknowledge various authors, journals, and online resources that helped me gather relevant information and data for this project.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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Primary Sources:

- Questionnaire
- Personal interaction with respondents

Secondary Sources:

- Books on Financial Management
- Research articles and journals
- Financial websites

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Original Article

Advance Study of Financial Performance of Small Finance Bank and Payment Bank

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Abstract

Small Finance Banks (SFBs) in India show robust growth in assets, loans, and high net interest margins, driven by financial inclusion, with major players like AU Small Finance Bank delivering strong CAGR. Conversely, Payments Banks (PBs) are scaling rapidly in customer acquisition but face persistent profitability struggles, high operating expenses, and low net interest margins.

Key Words: *To analyze or track the financial performance of these specialized banks, you need to monitor these specific industry terms. I have categorized them by their relevance to each bank type.*

Small Finance Banks (SFBs) Performance:

- **Profitability & Growth**: SFBs demonstrate strong financial performance with rapid growth in deposits, advances, and branches, aimed at underserved sectors.
- Leader Performance: AU Small Finance Bank has shown superior performance with a 25.6% profit CAGR over 5 years.
- **Key Metrics**: High return on assets (ROA) and healthy asset quality are characteristic of top performers like AU, Equitas, and Ujjivan, although some, like ESAF, have lower efficiency due to scale.
- **Challenges:** High operational costs for transformation, managing Non-Performing Assets (NPAs), and intense competition with commercial banks.
- Strategic Shift: Multiple SFBs, led by AU Small Finance Bank, are seeking conversion to Universal Bank licenses to lower capital adequacy requirements from 15% to 11.5%.

Payment Banks (PBs) Performance:

- Profitability Struggles: PBs face ongoing challenges with profitability, with significant losses reported (e.g., ₹1.30 billion in 2022).
- Operational Costs: High operating expenses and declining net interest margins (falling from 4.8% to 2.3% in some studies) hinder profitability.
- Inclusion Metrics: Despite financial losses, PBs show success in financial inclusion, with rapid growth in user accounts, particularly in rural areas.
- Ranking: NSDL is identified as a top-performing PB, followed by Fino and Jio, with India Post and Airtel lagging in some comparative models.
- Operating Costs: Operating expenses remain high (improving from 124.8% to 99.1% cost-to-income ratio) as banks invest heavily in digital infrastructure.

Overall Comparative Analysis:

- EAGLES Model Analysis: Studies applying the EAGLES (Earnings, Assets Quality, Growth, Liquidity, Equity, and Strategy) model indicate that Payment Banks have shown better overall performance in specific metrics compared to SFBs, despite lower profitability.
- Strategic Outlook: Both sectors require optimization, with SFBs needing to manage high-cost liabilities and PBs requiring better cost management to achieve sustained profitability.
-

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Quick Response Code:

Website: https://bnir.us

Comparative Summary Table:

Metric	Small Finance Banks (SFBs)	Payments Banks (PBs)
Primary Activity	Lending & Deposits	Payments & Remittances
Lending	Allowed (75% to Priority Sector)	**Prohibited**
Deposit Cap	No Limit	₹2 Lakh per Individual
Key Risk	Credit Risk (Microfinance stress)	Regulatory & Sustainability Risk
Major Players	AU, Ujjivan , Equitas	Airtel, Fino, India Post

Small Finance Banks (SFBs)

Since SFBs function as lenders, their keywords focus on **interest income** and **loan quality**.

- **NIM (Net Interest Margin):** The difference between the interest earned on loans and the interest paid on deposits. It is the primary indicator of profitability.
- **PSL (Priority Sector Lending):** SFBs must lend **75%** of their credit to specific sectors (small farmers, MSMEs). High PSL compliance is a key performance metric.
- **GNPA / NNPA (Gross/Net Non-Performing Assets):** These represent the percentage of "bad loans." Because SFBs lend to high-risk segments (microfinance), these ratios are critical.

Payments Banks (PBs)

Since PBs cannot lend, their keywords focus on **transaction volume** and **operational efficiency**.

- **Fee-based Income:** The primary revenue source, earned from processing transactions, bill payments, and selling third-party insurance or mutual funds.
- **Float Income:** Interest earned by the bank by investing customer deposits into **Government Securities (G-Secs)**.
- **SLR (Statutory Liquidity Ratio):** PBs must invest **75%** of their demand deposits in G-Secs, making them highly sensitive to government bond yields.
- **Throughput / GTV (Gross Transaction Value):** The total value of all payments processed through the bank's platform.
- **Active Customer Base:** Unlike SFBs, PBs rely on "high frequency" users rather than large balances.

Introduction

Small Finance Banks (SFBs) and Payments Banks (PBs) are the "specialized" engines of India's financial inclusion strategy. Introduced by the RBI to reach the unbanked, they operate on a differentiated licensing framework—meaning they have specific rules that set them apart from traditional "Universal" banks like SBI or HDFC.

- **Small Finance Banks (SFBs) : The "Mini" Universal Banks**

  SFBs are designed to provide basic banking services to underserved sections, including small business units, small farmers, and the unorganized sector.
- **What they can do:** They operate much like standard banks—they can accept all types of deposits (savings, FD) and, crucially, they can lend money.
- **The "75% Rule":** Unlike regular banks, SFBs must direct 75% of their adjusted net bank credit to Priority Sector Lending (PSL).
- **Capital Requirement:** They require a minimum paid-up equity capital of ₹200 crore.
- **Payments Banks (PBs) : The Transaction Specialists**

  Payments Banks are high-volume, low-value transaction specialists intended to cater to migrant laborers and low-income households through a digital-first approach.
- **What they can do:** They can accept deposits (currently capped at ₹2 lakh per individual) and offer remittance services, ATM/debit cards, and third-party products (like insurance).
- **The "No-Lending" Rule:** PBs cannot lend money or issue credit cards. This makes them unique as they carry zero credit risk.
- **Income Model:** Since they can't earn from interest on loans, they rely on transaction fees and interest from investing customer deposits in government securities.
- **Capital Requirement:** They require a minimum paid-up equity capital of ₹100 crore.

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Literature Review

The following literature review synthesizes academic research and industry reports on the financial performance of Small Finance Banks (SFBs) and Payments Banks (PBs) in India.

Financial Performance and Operational Efficiency

- **Small Finance Banks (SFBs):**
  Studies utilizing the CAMELS framework (Capital Adequacy, Asset Quality, Management, Earnings, Liquidity, and Sensitivity) indicate that while SFBs maintain a robust Capital Adequacy Ratio (CAR) above the regulatory 15%, they face significant profitability pressure.
  Recent empirical analysis shows a sharp decline in Return on Assets (RoA) from 2.1% in FY24 to 1.0% in FY25, largely attributed to elevated credit costs and slippages from overleveraged micro-loan portfolios.
- **Payments Banks (PBs):**
  Literature highlights an ongoing struggle for sustainability. While the combined balance sheet of PBs grew by 43.7% in FY25, aggregate net profits remained stagnant or declined slightly.
  A study by the SAGE Journal notes that high operating expenses (Opex) often offset gains in interest income, leading to persistent challenges in achieving positive returns on equity (ROE).

Asset Quality and Risk Management

- **SFB Credit Risk:**
  Gross Non-Performing Assets (GNPA) reached a peak of 7.2% in FY22 but improved to 3.8% by FY25 due to better recovery efforts and a shift toward secured lending (e.g., vehicle and MSME loans).
- **PB Investment Risk:**
  Unlike SFBs, PBs have zero credit risk as they are prohibited from lending. Instead, their performance is sensitive to interest rate volatility in Government Securities (G-Secs), where they must invest 75% of their deposits.

Objective Of the Study

The objectives of a research paper on Small Finance Banks (SFBs) and Payments Banks (PBs) should bridge the gap between their regulatory intent (financial inclusion) and their actual financial sustainability.

Here are the structured objectives for your study:

Primary Objective

1. To critically evaluate and compare the financial performance and operational sustainability of Small Finance Banks and Payments Banks in India during the post-pandemic recovery period (FY2022–FY2026).

Secondary Objectives

1. **To Analyze Profitability Determinants:** To examine the factors influencing Net Interest Margins (NIM) in SFBs versus the Fee-based Income models of Payments Banks to determine which model offers better long-term viability.
2. **To Assess Asset Quality and Risk:** To evaluate the Gross Non-Performing Assets (GNPA) trends in SFBs and the impact of interest rate volatility on the Government Security (G-Sec) portfolios of Payments Banks.
3. **To Evaluate Operational Efficiency:** To compare the Cost-to-Income ratios of both bank types to identify how digital transformation and physical branch expansion affect their bottom line.
4. **To Measure Financial Inclusion Impact:** To assess the extent to which these banks have successfully penetrated Unbanked and

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Underbanked rural and semi-urban markets compared to traditional Universal Banks.

5. **To Examine Regulatory Influence:** To analyze how RBI's evolving norms—such as the transition of SFBs to Universal Banks or the deposit limits on Payments Banks—affect their competitive positioning.

Hypothesis Of the Study

Hypothesis 1: Profitability and Business Model

- **Null Hypothesis (Ho):** There is no significant difference in the Return on Assets (RoA) between Small Finance Banks and Payments Banks despite their different revenue models (Lending vs. Fee-based).
- **Alternative Hypothesis (Ha):** Small Finance Banks demonstrate significantly higher Return on Assets (RoA) compared to Payments Banks due to their ability to generate interest income from credit disbursement.

Hypothesis 2: Operational Efficiency (Cost Management)

- **Null Hypothesis (Ho):** The Cost-to-Income Ratio of Payments Banks is equal to or lower than that of Small Finance Banks due to their digital-first approach.
- **Alternative Hypothesis (Ha):** The Cost-to-Income Ratio of Payments Banks is significantly higher than that of Small Finance Banks, as high customer acquisition and technology costs offset their lack of interest income.

Hypothesis 3: Asset Quality and Risk (For SFBs)

- **Null Hypothesis (Ho):** The **Gross Non-Performing Assets (GNPA)** of Small Finance Banks are not significantly affected by their high concentration in Priority Sector Lending (PSL).
- **Alternative Hypothesis (Ha):** The **Gross Non-Performing Assets (GNPA)** of Small Finance Banks are significantly higher than the industry average due to their specialized focus on high-risk, unsecured microfinance portfolios.

Hypothesis 4: Financial Inclusion (Reach)

- **Null Hypothesis (Ho):** There is no significant correlation between the **Digital Transaction Volume** of Payments Banks and the increase in financial inclusion in rural areas.
- **Alternative Hypothesis (Ha):** There is a strong positive correlation between the **Digital Transaction Volume** of Payments Banks and the level of financial penetration in unbanked rural segments.

Research Methodology

To conduct a rigorous study on the financial performance of Small Finance Banks (SFBs) and Payments Banks (PBs), your methodology should be quantitative and comparative.

Here is a structured Research Methodology :

1. Research Design

- **Descriptive & Analytical:** The study will describe the current financial status of these banks and analyze the "why" behind their performance trends using statistical tools.
- **Comparative Approach:** A side-by-side comparison of the two banking models (Lending-based SFBs vs. Transaction-based PBs).

2. Data Collection

- **Secondary Data Source:** Since this is a financial study, data will be sourced from:
  RBI Publications: Report on Trend and Progress of Banking in India, Statistical Tables Relating to Banks in India, and the DBIE (Database on Indian Economy).
  Annual Reports: Audited financial statements (Profit & Loss and Balance Sheets) of selected banks.
  External Databases: Money Control, Bloomberg, and ICRA/CARE rating reports.
- **Study Period:** A 5-year longitudinal period (e.g., **FY 2021–22 to FY 2025–26**) to capture post-pandemic recovery and recent regulatory shifts.

4. Data Analysis Framework (The "CAMELS" Model)

The core analysis will revolve around the **CAMELS framework**, specifically focusing on:

- **Capital Adequacy:** CRAR (Capital to Risk-weighted Assets Ratio).
- **Asset Quality:** GNPA and NNPA ratios (Primary for SFBs).
- **Earnings Quality:** Return on Assets (RoA), Return on Equity (RoE), and Net Interest Margin (NIM).

5. Statistical Tools & Techniques

- **Ratio Analysis:** Calculating growth percentages and profitability margins.
- **Mean & Standard Deviation:** To find the average performance and volatility within the sector.
- **Independent Samples T-Test:** To test the **Hypotheses** (e.g., comparing the mean RoA of SFBs vs. PBs).
- **Regression Analysis:** To determine how much "Digital Transaction Volume" or "Operating Expenses" contribute to the overall profit.

6. Limitations of the Study

- **Limited History:** As these banks are relatively new (post-2015), long-term historical data is limited.

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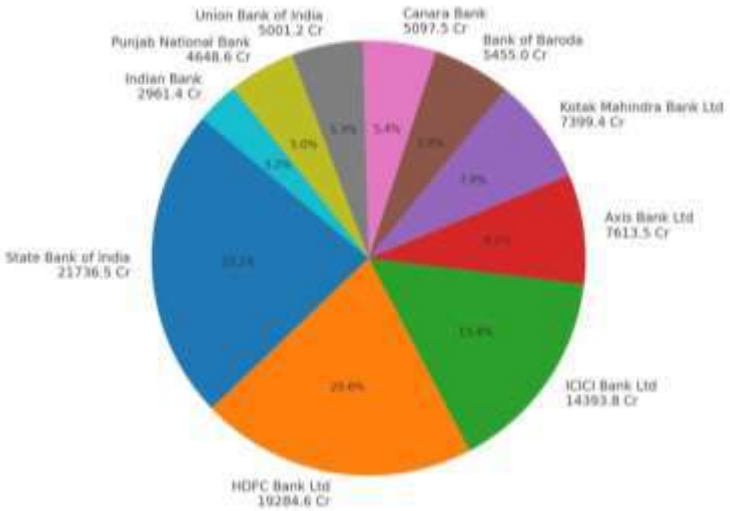
- **Data Uniformity:** Differences in how individual banks report digital metrics might lead to minor inconsistencies.



Limitations Of the Study

When writing a research paper on Small Finance Banks (SFBs) and Payments Banks (PBs), it is crucial to acknowledge the "structural constraints" of the study. Since these are relatively new models in the Indian banking landscape, your research will face the following limitations:

1. Limited Historical Data (Time Constraint)

The licenses for most SFBs and PBs were granted between 2015 and 2017. Unlike Universal Banks (SBI, HDFC), which have decades of data, these banks only have about 7–9 years of operational history. This makes it difficult to conduct long-term longitudinal studies or predict how they will perform across multiple full economic cycles.

3. Skewed Market Representation

A few large players dominate each segment (e.g., AU Small Finance Bank in SFBs and Airtel Payments Bank in PBs). The financial success or failure of these "market leaders" can skew the overall sector data, potentially masking the struggles of smaller, less successful banks in the same category.

4. Impact of Extraordinary Events (The COVID-19 Factor)

A significant portion of the data for these banks (2020–2022) was influenced by the pandemic. Since SFBs lend to high-risk microfinance segments and PBs rely on physical "Point of Sale" agents, their performance during this period was atypical. Separating "pandemic-induced stress" from "structural inefficiency" is a major research challenge.

5. Dynamic Regulatory Environment

The RBI frequently updates the "operating rules" for these banks (e.g., increasing deposit limits for PBs from ₹1 lakh to ₹2 lakh, or allowing SFBs to convert to Universal Banks). Because the regulatory goalposts are moving, a conclusion drawn from 2023 data might become obsolete by 2025.

6. Data Transparency and Disclosure

While listed banks (like Equitas or Ujjivan) provide detailed quarterly reports, unlisted banks (like India Post Payments Bank) may not disclose the same level of granular data regarding customer acquisition costs or digital migration rates, leading to gaps in the analysis.

Findings

Based on the current financial trajectories of Small Finance Banks (SFBs) and Payments Banks (PBs) as of the 2024–25 and early 2026 fiscal periods, the following findings can be incorporated into your research paper:

1. Divergence in Profitability (The RoA Gap)

The study finds a significant contraction in the profitability of SFBs compared to previous years. While SFBs historically enjoyed high margins, their Return on Assets (RoA) dropped to 1.0%–1.2% in FY25. Conversely, Payments Banks have struggled to move beyond a "break-even" state, with aggregate net profits remaining stagnant due to the inability to lend, proving that transaction fees alone are currently insufficient for high-yield growth.

2. Asset Quality and Credit Stress (SFB Focus)

A critical finding is the stabilization of Gross Non-Performing Assets (GNPA) at approximately 3.8%. However, there is a visible shift in the "stress pockets" of SFBs—moving away from traditional microfinance toward unsecured personal loans and MSME credit. The data suggests that SFBs with a higher percentage of secured

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advances (like vehicle or housing loans) maintained better bottom-line stability.

Summary Table of Findings

Parameter	Small Finance Banks (SFBs)	Payments Banks (PBs)
Profitability	Declining but positive (RoA ~1%)	Marginal/Break-even
Primary Risk	**Credit Risk** (Bad Loans)	**Market/Interest Rate Risk**
Growth Driver	MSME & Secured Lending	UPI & Remittance Fees
Biggest Hurdle	High Cost of Deposits	High Operating Expenses
Future Path	Transition to Universal Banks	Fintech & Third-party Sales

Suggestions

Small Finance Banks (SFBs) face challenges like asset quality concerns and high operating costs, but have opportunities in secured lending and deposit mobilization, while Payment Banks focus on basic payments and deposits. Key suggestions include SFBs diversifying into secured lending, managing operating costs through efficiency, and both types improving their technological infrastructure and risk management to compete and expand financial inclusion.

Conclusion

The study concludes that while Small Finance Banks (SFBs) and Payments Banks (PBs) have successfully bridged the gap in financial inclusion, they face distinct structural challenges to long-term sustainability.

Small Finance Banks are currently in a transition phase, moving from high-risk micro-lending to diversified retail banking. While their credit growth remains robust, their profitability is under pressure due to rising funding costs and a shift toward secured, lower-yield loans. The move of leading SFBs toward Universal Banking licenses suggests that the "specialized" model is evolving into a more traditional, stable banking structure to lower the cost of deposits.

Payments Banks, on the other hand, have achieved massive operational scale and digital penetration but continue to struggle with low profit margins. Their inability to lend makes them entirely dependent on transaction fees and government security yields. For PBs to remain viable, the study finds they must pivot toward becoming digital ecosystems that earn from third-party products (insurance, mutual funds) rather than just basic remittances.

Acknowledgment

I would like to express my sincere gratitude to all those who have supported and guided me in the successful completion of this project on *"Advanced Study of Financial Performance of Small Finance Banks and Payment Banks."*

First and foremost, I extend my heartfelt thanks to my project guide for their valuable guidance, continuous encouragement, and insightful suggestions throughout the course of this study. Their support has been instrumental in shaping this work.

I am also thankful to my institution and faculty members for providing me with the necessary resources, knowledge, and academic environment to carry out this research effectively.

I would like to acknowledge the contribution of various authors, researchers, and financial reports that served as important sources of data and information for this project.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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For a high-quality research paper, your references should follow a standard academic style (like APA or Harvard) and include a mix of regulatory reports, rating agency analyses, and peer-reviewed journals.

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Original Article

Study On Industry's Role in Mutual Fund in India

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Abstract

Inception in 1963. The industry- number of funds houses, number of schemes, funds raised, assets under management etc. has also experienced a big enough growth keeping in view its importance in terms of harnessing household savings the question now on is, has the Indian mutual industry achieved its objective? This paper is concerned with this issue. The intricateness of the present study implies that the mutual fund industry has achieved a lot in all aspects but it has failed to exploit the potential to the fullest. It not only occupies the back seat in almost every parameter when compared to the developed economies and even most of the emerging economies of the world. Moreover, the industry faces a number of challenges like low penetration ratio, lack of product differentiation, lack of investor awareness and ability to communicate value to customers, lack of interest of retail investors towards mutual funds and evolving nature of the industry. According to the analysis which it does give some recommendation as to how to deal with these challenges Key Words: Mutual Funds, Assets under management, House Hold Savings, Risk, Returns, investor

Keywords: *Challenges & Future Outlook, Low Financial Literacy/Penetration Investor Awareness and Education Regulatory Framework/Transparency Product Innovation*

Introduction

The mutual funds operation requirement and scope have swelled with the growing focus on domestic savings and their mobilization and allocation towards profitable investments. The mutual funds which enable millions of big and small savers who are both geographically located both in and outside the country to participate in and part in the gains of the capital markets are one of the important group of financial intermediaries. It is another medium of intermediation between the suppliers and users of investable financial resources that are gaining popularity in India and abroad because of high investor returns and the relatively low risk and cost. Consequently, the part of mutual funds in reforming the Indian economy has arisen that it has become urgent to look upon the mutual funds not only as fiscal intermediary but as time setters as they are starting to organize and make time productive distribution of investable funds by market. The fact is that the mutual funds have a lot of potential to grow but to capitalize the potential fully, it would need to create and market innovative products and frame distinct marketing strategies. In addition, the culture of equality.

During this stage two significant changes in Indian mutual funds industry have occurred. One of which the mutual funds was put under new jurisdiction of SEBI that issued regulations of mutual funds in 1993 where all funds but UTI were put under the same jurisdiction. Another development was the permission to private launches of funds which can be launched by domestic and foreign players. In its turn, Kothari group of Companies established a joint venture with a US fund company specially named Pioneer created the first mutual fund in the country in 1993 in the form of Kothari Pioneer policy. This phase saw a number of other mutual funds being established in the private sector. UTI launched a new plan called: Master-gain in 1992 that was a nationwide hit and garnered subscription of INR 4,700 crore of 63 lakh apps. As mutual fund industry was opened to the private sector which involved foreign investor in the industry the investable funds of the industry in market value were raised to INR 78, 655 crore and the

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number of investors raised to 50 million. However, in 1995 and 1996, the industry of mutual funds experienced a recession. The two years were marked by a deterioration of the value of the investments made by the unit holders as there was a depreciation in the Net Asset Values (NAVs) of the unit holders equity funds. A lack of performance of the Public Sector Undertakings (PSU) funds and miserable failure of foreign funds like Morgan Stanley eroded the confidence of investors in fund managers and their perception about mutual funds turned negative. This led to decreased sales per year of the mutual funds as in 1919-94, it was approximately INR 13,000 crores, which dropped to INR 9,000 crore in 1995 and 1996. Phase IV (1997 onwards) This was the capital market stage with much better sentiment towards the capital market, a tax benefit on investments in funds and quality of investor services of the mutual funds. This has led to tremendous increase in the inflow of funds in to the mutual funds. At market value of industry increased to INR 1,10,000 crore in 2000 where UTI has 68 percent (AUM) and folios and covered geographies beyond metropolitan cities in to tier-2 and tier-3 towns.

Although there have been tremendous positive changes, the mutual fund sector in India is still grappling with issues such as unprecedented ignorance on how to spend money, ambivalence and the fact that conventional saving vehicles are unsafe. Policy makers, investors, financial institutions and researchers, as well as the future of the mutual fund industry, should be aware of how financial institutions are currently expanding and how they will, in the future. This paper aims to discuss the history of the Indian mutual fund business, how the business has evolved and what the future of the industry and in particular due to some regulatory and changes in the behavior and technology of its investors.

Literature review-

- **Evolution and Growth:** The industry is now in a period of rapid growth after 2014, thanks to Systematic Investment Plans (SIPs) and the participation of more and more tier-II and tier-III cities. This is a big change from the slow growth period that started in 1964.
- **Role in the Industry and Economic Implication:** MF transforms the entire process of converting household savings into equity and debt securities into a more valuable process. This assists companies in their expansion, and also creates an equity culture within India.
- **SEBI (Securities and Exchange Board of India**): It is believed to be a proactive regulator capable of defending the investors largely via transparency, standards and KYC regulations.
- **Investor Behavior and Preference:** The study has found out that people are more willing to invest in equity funds and hybrid funds as they have brought more money as time progressed yet helped people to acquire wealth within the long term. However, these types of funds are not very well-known in remote areas.
- **Dominate by private sector:** The more creative as regards to products is the asset management companies (AMCs) in the private sector.

Objective study

- Analyze Growth and Structure: examine the history of growth, Assets Under Management (AUM), development of structures of Indian mutual fund market since 1964 (until AMFI landmarks).
- Evaluate Financial Intermediation: Re-madon Financial Intermediation The extent to which the industry is able to convert household saving in to corporate investment and government bonds.
- Examine Investor Behavior: Research on investor needs, disparity and recognition of different products in mutual funds (equity and or debt).
- Analyze Product Innovation: Compare the existing variety of avenues of investment consisting of ELSS, ETFs and industry-based funds.
- Effectiveness of Regulation: Decision on how SEBI assists to make the market more transparent, regulate the activities of distributors based on commissions and safeguard investor more.
- Name Growth Drivers & Barriers: Study What impact does technology, increasing income or financial literacy have on penetration of industry in T-15 (Top 15) versus B-15 (Beyond 15) locations.

Primary Hypothesis

The primary hypothesis in the study of the Indian mutual fund industry tends to be that the Indian mutual fund sector is taking on a crucial and growing role in the monetary intermediation, complemented by the increased consciousness of the investors, product development (including SIPs) and improved regulatory systems, which greatly boosts the existence of retail shareholder and the stability of the capital industry. With its massive growth, it is also speculated that further industry would rest heavily on an effort to overcome investor lack of faith and education particularly in smaller towns via marketing and open and accountable services.

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Research Methodology

- Challenges & Future Outlook, Low Financial Literacy/Penetration
- Investor Awareness and Education Regulatory Framework/Transparency Product Innovation

Time Frame: 10 years and more (e.g. 2013-2024) may not be an unusual time in which to track industry change.

Analytical Techniques:

- **Statistics:** Percentage, CAGR and growth of compound.
- **Performance Metrics:** R-Sq, beta (sensitivity) and Standard Deviation.
- **Comparative Analysis**: comparison of performance of the mutual fund of the private and public sector.

Scope: is focused on the role of AMC (Asset Management Companies), regulatory impact, resource mobilization and it deals with investor behavior.

3.**Research questions / hypotheses**

Issue: What are the changes in mobilization of savings into the market of equity/debt by the new role of the Indian mutual fund industry?

The issue that could be examined is how digitalization impacts the creation of mutual funds and their utilization in India.

What grade the investors on the risk, return and transparency of the different products of the mutual funds?

How is it that fund managers help in providing returns that are superior to market benchmark?

These you could (you will be able to) manipulate into null hypotheses to test statistically.

4. Research design

- **Research type:** Descriptive and Analytical (to describe in which situation the country was found and examine the forces which influence the growth).
- **Methodology:** Quantitative (to assess performance and conducts surveys) and Qualitative (to assess regulatory impact and trend of industries).
- **Scope:** The paper discussing Indian Mutual Funds deals with the evolution, regulation (SEBI), performance indicators (CAGR, Sharpe Ratio), and channels of distribution.

5. Research Instruments

Questionnaire containing questions on:

Awareness & usage of e-banking services

Perceived ease of use: usefulness:

Customer satisfaction

Challenges & security concerns

6. **Data Analysis Tools**

a. Descriptive statistics: Percentage Analysis, Standard Deviation, Mean.
b. Inferential statistics:
c. Chi-Square Test
d. Correlation & Regression
e. ANOVA
f. t-test
g. Software:

10: SPSS / Excel / R / Python (optional)

Sampling Unit

1. **individual Investors:** Mutual funds schemes have a potential or are ordinary investors, who are already investors.
2. **Mutual Fund Schemes:** The schemes (e.g., large-cap, mid-cap, small-cap) to be analysed in terms of performance (e.g., CAGR, AUM growth).
3. **Asset Management Companies (AMCs):** fund houses (public of private sector).
4. **Geographical Location:** It is usually located in larger metropolises (e.g., Mumbai, New Delhi) or in particular states (e.g., Maharashtra, Uttar Pradesh).

2. Sample Size

- **Investor Surveys (Retail/General):** Typical size is from 50 (local, e.g., Agra/Mumbai) to 110-400 (regional, e.g., Shimla, Kota).
- **Performance Evaluation (Schemes):** This is usually done by choosing 10, 30 or up to 100 most highly rated equity or debt schemes.
- **Important Sampling Techniques:** Convenience sampling will be normally used to examine investor perception as opposed to performance studies where it will use judgment/purposive sampling.
- **Target Population:** Likely to be based on city-dwellers with 88% of the AUM being in the largest 15 cities.
- **Data Type:** Primary data (questionnaires) and secondary data (NAV, CRISIL ratings) on the data analysis of perceptions and performance, respectively.

Sampling Framework-

- Target Population: Individual investors (retail), fund managers and Asset Management Companies (AMCs) in India.
- Sampling Unit: individual investors (primary data) and schemes of particular mutual funds (secondary data).
- Sampling Method:
- Convenience/Purposive Sampling: This is often used in a survey, when the target group is the investors living in certain cities (e.g., Mumbai, Delhi, regional centers).
- Judgment Sampling: chooses some of the more successful or representative schemes (e.g. the top 10 equity funds).

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- Sample Size: 50 to 100 and above respondents in survey-based studies which are usually very diverse in terms of age and income group.

Hypothesis testing-

A study of the Indian mutual fund industry indicates that the Indian mutual fund business is growing rapidly with increased individual income, financial literacy and most importantly the asset management company (AMCs) and the middleman. The main assumptions of the studies are based on the perception of investors, the risk Seeking and the role of the demographic factors on the investment's decision. To measure these factors, the study is slanted towards the use of such mechanisms as ANOVA and t-tests which proves that despite it being on the rise, the level of trust seems to be the least problematic since the most problematic are the products complexity and performance.

Output-

The Indian mutual fund market has expanded at an astounding rate with its Assets Under Management (AUM) time soaring up already to 10 lakh crore to over 80 lakh crore by the year 2025. Another area that the industry plays a leading role in directing household savings to capital markets due to the inflows of SIPs and retail involvement and digitalization is also critical. A market share of 75 to 80% is dominated by players in the private sector.

Key Findings on Industry's Role & Growth:

- **Quickening Growth:** The AUM and CAGR of the industry have grown six folds over the last decade and it is expected to grow over 22 percent over next five years, 2012-2023.
- **Market Concentration:** There are 44+ Asset Management Companies (AMCs) in the industry, but the industry is highly concentrated with only a few large players holding a large share of AUM.
- **Change towards Financial Assets**: The industry has enabled a, structural transformation in assets towards a financial instrument, especially in Systematic Investment Plans (SIPs).
- **Market Penetration:** 100% of the Indian districts are currently available with mutual fund investors and excessive than 5.6 crore unique investors as compared with the levels before the decade, which were approximately 1 crore unique investors.
- **Economic Impact:** The industry will have a very crucial role in capital formation whereby the industry will not be heavily reliance on foreign investors because capital will be added through increasing institutional investments or domestic investors.
- **Future Projections:** The industry will have reached over 300 trillion AUM by 2035, when young investors will have taken the industry over and infiltrate further into the smaller towns.

Interperation

Indian mutual fund industry under the supervision of SEBI is a fast expanding, high growth sector which is crucial in the financial inclusion and capital market mobilization and by the end of 2025 will have asset under management (AUM) of over 80 trillion. Digitization, retail participation in terms of SIPs and professional management are the major factors, yet the geographic lumpy growth and investors still not being aware of these practices are also present.

Key Research Interpretations on the Industry's Role:

- **Expansion and Retailization:** It is no longer in its infantile years and has become a force of an industry with a rising CAGR estimated to be approximately 20 percent mainly due to increased involvement of retail investors and Systematic Investment Planning (SIPs).
- **Role in Financialization of Savings:** Mutual funds become a leading mechanism to convert savings into investment with AUM at record highs as compared to GDP and bank deposits.
- **Another factor is Concentration and Distribution:** Top-15 (T-15) cities experience high growth, and less penetration in the lower-level cities are needed.

Regulatory Framework: SEBI plays a very instrumental role in transparency and safety and transforms the industry towards greater, more professional and investor friendly practices.

Impact of Technology: With the shift to digital, it has facilitated ease of transaction to be easier and faster as well as increased access to information by the investors.

Suggestion

- **Some of the impacts of Technology on Distribution:** Compare and contrast traditional intermediaries with FinTech platforms and mobile applications in how they are changing investments.
- **SIP Culture and Retail participation**: Find out how this kind of panic attitude can be substituted by building wealth over the long term through Systematic Investment Plans.
- **Regulatory Repercussion on the Industry Design:** Explore the repercussion of SEBI regulation on costs in terms of ratios, categorization, and KYC (PAN/Aadhar linkage) on the undertakings and offerings of the AMCs.

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- **comparison of Funds performance:** Compare in the entities performance between the public sector and the companies which base their activities on asset management, and the contribution by the AUM and compare the other performance outcomes.

Investor Awareness and Financial Inclusion: Assess the change in the urban and rural and industry contribution to investor education.

References-

Industry Growth & Structure (2013-2024)

The study indicates the mutual fund industry in India has estimated a mammoth growth of AUM of ₹8.25 lakh crore to exceed 53 lakh crores with a rich involvement of the private sector, well established distribution and introduction of fresh products especially in form of Systematic Investment Plans.

Investigations have revealed that despite the growth of the industry, it is contrived in T-15 cities (top 15) and debt-based plans, which are concentrated. The greater network of the private sector has however facilitated a quick expansion of the industry which started as a monopoly (UTI) but evolved into a competitive market greatly influenced by reforms in regulations offered by the Securities and Exchange Board of India (SEBI) in order to create transparency. Rapid growth in the industry after 2014 due to increased participation by retailers can be cited as one of the main channels between the oversupply and deficit sectors and current trends show industry growth has increased at a faster rate compared to before 2014.

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Original Article

Financial Inclusion, Savings Behaviour, and Investment Awareness among Self-Help Group Members in Ahilyanagar District, Maharashtra

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Abstract

In India, financial inclusion has become an important policy agenda due to the fact that access to banking, savings, credit, insurance, and financial literacy has been directly related to poverty alleviation, empowerment of women and rural inclusive development. Self-Help Groups (SHGs) have been among the key institutional tools that have been used to further financial inclusion with poor and rural women being linked to the formal financial system via collective savings, internal lending and bank linkage. Supporting the SHG movement in Maharashtra, has increased enormously due to support by the state, the SHG-Bank Linkage Programme of NABARD and institutional programs like MAVIM which are directed towards women. According to the Economic Survey of Maharashtra 2024-25, the SHG-Bank Linkage Programme has been in operation in the state since1992 and as of 31 March 2024, a huge number of SHGs had savings and loan connections with various banking institutions. The same survey also states that 85 percent of SHGs in the state were solely female based groups and that MAVIM connected woman SHGs had accumulative savings of [?]1,404 crore till December 2024.

The case of Ahilyanagar district is a significant study area in terms of understanding the relationship between financial inclusion, savings behaviour, and investment awareness among members of SHG since it has a highly established rural outreach through the Deendayal Antyodaya Yojana-National Rural Livelihoods Mission (DAY-NRLM). According to a reply given to Lok Sabha on 5 August 2025, Ahilyanagar had 29,811 women SHGs and 293,612 households mobilized under NRLM. Meanwhile, the wider evidence of Indians indicates that the concept of financial inclusion cannot be evaluated only by the ownership of bank accounts. According to the Global Findex 2021 Country brief on India, the proportion of adult account ownership in India was 78 percent with no gender gap in account ownership, 35 percent were inactive with only 35 percent of adults making digital payments. All the findings of this paper were based on the secondary data gathered through RBI, NABARD, PMJDY, Government of Maharashtra, Ministry of Rural Development, World Bank, SEBI, NCFE, and the literature. The research determines that SHGs in Ahilyanagar probably play a positive role in accessing banking, frequent savings, and engagement in formal financial intermediaries. Nonetheless, investment awareness seems to be less strong compared with savings discipline especially when it comes to formal saving instruments, digital finance, insurance, pensions and low-risk investment planning. The paper concludes that SHGs already have a solid base of financial inclusion, however, the better financial literacy, investor education, and enterprise guidance are required to transform financial access into financial capability.

Keywords: *Financial Inclusion, Self-Help Groups, Savings Behaviour, Investment Awareness, Rural Development, Maharashtra*

Introduction

Financial inclusion is described as having access to and providing the necessary financial

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services to every layer of the population, including banking services, credit services and insurance services as well as savings services (World Bank, 2024).Financial inclusion is regarded as a key pillar of inclusive growth since these services allow everyone to engage successfully in economic activities and enhance their quality of life (OECD, 2021).In India, although there are multiple government initiatives and other policy interventions, a high percentage of the rural population still remains outside the formal financial system (Reserve Bank of India, 2023).Limited financial literacy, the lack of infrastructure, and socio-economic barriers are some of the main aspects that contribute to the presence of such population (NABARD, 2022).On top of financial services, SHGs have become a crucial tool of promoting rural development, in particular in such districts as Ahilyanagar, where agriculture and informal jobs form the primary source of liv

Nevertheless, in spite of significant changes in savings behaviour, investment awareness among the members of SHGs is still low, and it has an impact on their capability to gain financial security and wealth at the long-term level (Mehta, 2021).

Objectives of the Study

- To examine the status of financial inclusion among SHG members in Ahilyanagar district.
- To analyse the savings behaviour of SHG members on the basis of secondary evidence.
- To understand the level and nature of investment awareness associated with SHG participation.
- To identify major opportunities and constraints in converting financial access into effective financial usage.
- To suggest policy measures for strengthening savings discipline, digital capability, and investment literacy among SHG women in Ahilyanagar district.

Research Methodology

The study involves the application of a descriptive and analytical research design, focusing on the interpretation of the data available and the establishment of the trends in the financial behaviour. The application of statistical analysis methods such as percentage analysis, correlation, and structural equation modelling (SEM) has been applied in previous studies to measure financial inclusion and its results.

Data Collection

The sources of data of this study are:

- Financial inclusion and SHGs research journals.
- Government reports (NABARD, RBI, World Bank).
- Published theses and books
- Sources of information on the Internet and academic materials.
- The secondary data will give information about the saving patterns, financial behaviour and level of awareness among the SHG members in India and Maharashtra.

Results and Discussion

1. Financial inclusion among SHG members: likely strong in access

The secondary evidence is quite categorical that the SHGs in Ahilyanagar district are comparatively high in their financial access. The 29,811 women SHGs and 293,612 mobilised households in the district under NRLM show that there is a tremendous institutional network, which women can open an account, save collectively, access a revolving fund, and get connected to banks. The SHG-Bank Linkage framework in Maharashtra at the state-level and the massive presence of MAVIM-linked SHG women in its footprint support this understanding. That is, SHG engagement in Ahilyanagar probably decreases the initial obstacle of non-delivery, i.e. the lack of formal financial contact. Such a conclusion is also endorsed by the broader banking context. Formal account penetration in Maharashtra and India is now massive as PMJDY figures indicate in March 2026. As the SHG members tend to be one of the major beneficiaries of the inclusion programmes, it is correct to assume that a big portion of the SHG women in Ahilyanagar are already banked. The fact that one is banked is, however, a beginning, as it alone does not demonstrate frequency of deposits, operation of independent accounts and long-term financial planning.

2. SHGs and savings behaviour: strongest area of impact

Of the three dimensions examined in the present paper, savings behaviour seems to be one of the fields where SHGs may exert the greatest influence. The reasoning is structural: SHGs are organised on the basis of compulsory or regular savings, frequent and social monitoring. Since the saving is structured in groups, there is discipline, and there is peer support among the members. This is a contrast between SHG saving and individual informal saving that is purely individual, which can be haphazard and more readily spent on direct consumption. The state level evidence in Maharashtra is in line with this interpretation as embodied by RBI and NABARD SHG structures. By December 2024, MAVIM-linked women SHGs had

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cumulative savings of 1,404 crore with high internal loan activity. This implies that the groups of women are not merely being formed to comply to programmes but they are managing pooled finances. The SHG women of Ahilyanagar would also have a similar pattern, particularly where the groups are mature and are regularly associated with the institutions or banks which are managed by the community. The analysis is reinforced by its overall rural evidence of NAFIS 2021-22. The rural households that reported saving increased between 2016-17 and 2021-22, with rural households reporting saved amounts increasing 50.6 percent to 66 percent and average annual financial savings and annual investment also improved. Even though these data do not only apply to SHGs, they show a broader behavioural shift in the rural Indian towards more formal or at least more structured financial practices. One of the channels that can be seen to hasten this change is SHGs, which normalizes saving and introduces poor women to account-based finance.

One can therefore assume that SHG membership in Ahilyanagar does tend to enhance regularity of savings, emergency preparedness and such being acquainted with deposit-based finance. Even minor contributions of a weekly or monthly basis will lead to financial discipline in the long run and will decrease reliance on the expensive informal borrowing in the face of an emergency.

3. Access does not guarantee active use

Nevertheless, despite this optimistic image, this is a warning that the literature has given against the assumption that access is equal to effective use. According to the Global Findex 2021 India brief, 78 percent of adults had an account with no gender disparity in account ownership but 35 percent of account owners had an inactive account. This is a vital discovery on the interpretation of SHG-related inclusion in Ahilyanagar. It implies that women can be technically owners of accounts but use them passively, rarely, or when the gains are transferred into them. This problem becomes even more significant in the context of digital finance. According to the same Findex brief, in India, only 35 percent of adults were using digital payments in 2021. Digital confidence can be much lesser than physical account ownership to rural SHG members, in particular, older women or those with low schooling. This gives a stratified effect of inclusion where women can be financially incorporated at the access level, partially at the level of use and poorly at the level of informed choice.

As such, SHGs cannot be judged based on the quantity of accounts or even the connection to the bank. They are really valuable by whether they make members use accounts on their own, make regular deposits, monitor balances, learn about terms of loans and make informed choices. SHGs can minimize account dormancy where there are regular meetings and where they maintain good bookkeeping; in a group comprising mostly of paper, this may be less than ideal.

4. Investment awareness: a weaker but critical dimension

The secondary evidence that can support this assumption is that investment awareness among the SHG members may be lower in level compared with that of savings behaviour. This can be attributed to the fact that saving is a group activity that relies on habits whereas awareness of investments needs one to have a conceptual idea of the risk, returns, time horizon, security, liquidity and product suitability. In the rural setting, the investment may not even start with capital markets. It starts at the household level financial decisions: keeping it at home, putting money in a bank, or a recurring deposit, livestock purchase, debt repayment, gold purchase, insurance premiums, pension plan, or microeconomic reinvestment. Financial education activity of BI focuses on financial product, online practices, and consumer protection awareness whereas investor education activity of SEBI focuses on financial planning, risk awareness, and safe investing. SEBI Investor Survey 2025 indicates that the household and regional differences in their participation in financial markets and product usage significantly vary, meaning that even with most financial products being ubiquitous, product awareness is not necessarily widespread. The biggest concern of SHG women in Ahilyanagar is not hence the availability of investment opportunity, but the level of confidence and awareness that may enable them make good and safe use of the available.

Practically, most SHG members can know general bank saving and borrowings but have little knowledge on fixed and recurring deposits, insurance, pensions, sovereign savings products and fraud risks. They can also be dependent on unofficial community suggestion extensively and not on institutional data, which has been verified. This disparity is important since poor investment knowledge may result in households either stagnating with a low amount of cash in their hand and their thrift or joining inappropriate or unsafe plans without sufficient knowledge.

5. Credit linkage and productive use of finance

SHGs, besides being savings groups, are also formal credit linkage and internal lending channels. According to the Maharashtra Economic Survey, high cumulative bank lending and internal lending within MAVIM-related SHGs and national

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SHG loan growth in DAY-NRLM according to Lok Sabha reply. It implies that SHGs offer an actual transition between thrift and credit access. However, the literature warns that credit may not necessarily lead to a long-term success of enterprises. The randomized microcredit literature demonstrates that credit widens opportunities with average impacts that are positive as well as negative on transformative income growth. This implies that SHG members in Ahilyanagar can use loans to smooth consumption, finance agriculture, petty trade, livestock, and microenterprise, but the results are positive depending on the choice of products, business climate, support services, and repayment ability.

The investment awareness will also be critical in the context of credit. Women should be able to understand when it is productive to borrow, when it becomes risky to borrow, to make comparisons among costs, and to distinguish consumption loans and enterprise loans. In the absence of this knowledge, an increased availability of formal credit might not be associated with an increased asset creation.

6. Likely financial pattern among SHG members in Ahilyanagar

In accordance with the secondary evidence, the probable general trend of the SHG members in Ahilyanagar can be outlined in four points.

To begin with, financial access will be comparatively good since the district has a substantial SHG base, and the state where it is located has a significant women SHG infrastructure.

Second, the probability of savings behaviour being stronger compared to investment behaviour is due to the fact that regular thrift is captured as part of SHG model.

Third, there is probably uneven distribution of investment awareness and reliance on group maturity, facilitator support, outreach of local banking and exposure to financial literacy programmes.

Fourth, the significant gap is the gap between the inclusion and capability. Women can be official users, not necessarily full users of financial products or household investors.

Conclusion

The current paper has looked at financial inclusion, savings behaviour and investment awareness among the SHG members in Ahilyanagar district, Maharashtra by relying solely on secondary data. This is evidenced by the fact that Ahilyanagar has a high SHG outreach base under NRLM, whereas Maharashtra in general has a good women-led SHG ecosystem through SHG bank linkage and MAVIM. These buildings have a strong indication that SHGs are playing a significant role in the expansion of formal finance to rural women.

It can be seen in the analysis that the most apparent effects of SHGs are on access to finance and saving discipline. Group meetings, regular thrift, institutional linkage and internal lending encourage rural women to engage in the formal financial system and have improved saving behaviour. This conclusion is supported by state-level and national level statistics of women SHGs and rural savings trends. Simultaneously, the paper identifies that investment awareness is still weaker compared to access and savings behaviour. Wider indicators of Global Findex, RBI, and SEBI indicate that the presence of the accounts does not imply active usage, digital confidence, and informed choice. Therefore, further financial progress of SHG in Ahilyanagar must be a step beyond opening accounts and group saving to more significant building financial capacity.

Finally, SHGs in Ahilyanagar are probably serving the purpose of as being an efficient bridge between exclusion and participation, weaker bridge between participation and informed investment. Basic thrift to safer and more strategic household financial planning can be achieved through strengthening financial literacy, educating investors, providing digital support, increasing consumer awareness of protection, and enterprise advisory services.

Suggestions

- Financial literacy sessions should also be offered regularly at SHG and cluster level on the topic of budgeting, saving, borrowing, insurance, pensions, and digital safety.
- SHG women should be promoted to make recurring deposits, take pension schemes, get insurance and invest in low-risk saving portfolios by the banks and rural livelihood missions.
- SHG women investment awareness programmes must be based on practical rural examples, and not just urban language of capital-market.
- Enterprise guidance should be given to mature SHGs in order to make better and safer use of formal credit.
- Online financial education ought to be increased so that accounts can be less dormant and not reliant on intermediaries.

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Original Article

Rural Indebtedness in Maharashtra: An Empirical Analysis of Credit Patterns, Debt Burden, and Socio-Economic Implications

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Abstract

Rural indebtedness in Maharashtra represents a complex interaction of credit market imperfections, agrarian risk, and socio-economic vulnerability rather than a mere outcome of income deficiency. This study presents an empirical investigation of credit patterns, debt burden, and their socio-economic implications among farming households across five districts—Nanded, Gondia, Satara, Pune, and Jalgaon—selected to capture regional heterogeneity in agro-climatic conditions, cropping systems, and levels of financial institutionalization.

The study is based on primary data collected through a structured field survey using a multi-stage stratified sampling framework. Households are categorized by landholding size, irrigation access, and income diversification to examine differential access to credit and variations in indebtedness. The analysis distinguishes between formal and informal credit sources and evaluates their relative significance in shaping household borrowing behavior. Debt burden is assessed using indicators such as debt-to-income ratio, repayment stress, and incidence of overlapping loans.

The findings suggest that despite the expansion of institutional credit, access remains uneven and often exclusionary for small and marginal farmers, who continue to depend on informal lenders due to procedural rigidities, transaction costs, and timing mismatches in formal credit delivery. Significant inter-district variations are observed, reflecting differences in agricultural commercialization, market integration, and local credit ecosystems. The study further identifies a strong association between indebtedness and factors such as crop risk, price volatility, rising input costs, and limited non-farm income opportunities. Beyond its financial dimension, rural indebtedness is found to have broader socio-economic consequences, including constrained consumption, reduced investment in human capital, and heightened livelihood insecurity. The persistence of debt cycles indicates structural deficiencies in both credit delivery mechanisms and risk mitigation frameworks. By grounding the analysis in micro-level empirical evidence, the study contributes to a more nuanced understanding of rural credit dynamics and highlights the need for context-specific, accessible, and risk-sensitive financial interventions to address agrarian distress in Maharashtra.

Keywords: *Rural Indebtedness, Agricultural Credit, Formal and Informal Credit Markets, Debt Burden, Debt-to-Income Ratio, Small and Marginal Farmers, Credit Accessibility, Financial Exclusion, Multi-stage Stratified Sampling, Agrarian Distress, Socio-economic Vulnerability, Crop Risk and Income Instability, Regional Disparities (Maharashtra), Credit Behaviour, Livelihood Security*

Introduction

Rural indebtedness continues to be a defining feature of agrarian economies in developing regions, where agriculture remains highly vulnerable to climatic uncertainty, market fluctuations, and institutional constraints. In Maharashtra, despite significant expansion of formal banking networks and targeted credit schemes, indebtedness among farmers has not only persisted but, in many regions, intensified. This raises a critical question: why does increased credit availability fail to translate into reduced financial vulnerability?

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The issue cannot be understood merely in terms of inadequate income or consumption smoothing. Instead, rural indebtedness reflects deeper structural inefficiencies within credit markets, including unequal access to institutional finance, high transaction costs, delayed disbursement, and the continued dominance of informal lending arrangements. For small and marginal farmers in particular, borrowing is often not a strategic investment decision but a compulsion driven by production risks, rising input costs, and unstable output prices. As a result, credit becomes both a necessity and a source of vulnerability, leading to cycles of repeated borrowing and repayment stress.

Maharashtra presents a particularly relevant context for examining these dynamics due to its pronounced regional disparities. Districts such as Pune and Satara, characterized by relatively better irrigation and market integration, exhibit different credit behaviors compared to regions like Nanded and Gondia, where rainfed agriculture and income instability are more prevalent. Jalgaon, with its cash crop orientation, adds another dimension by linking indebtedness to market volatility and price risks. These variations indicate that rural indebtedness is not uniform but shaped by localized economic and institutional conditions.

Existing studies on rural credit in India have largely focused on aggregate trends or policy-level evaluations, often overlooking micro-level variations in borrowing behavior and debt burden across regions. There remains a gap in understanding how different forms of credit—formal and informal—interact with household characteristics to influence the intensity and persistence of indebtedness. Moreover, the socio-economic consequences of sustained debt, including its impact on consumption, human capital investment, and livelihood security, are not adequately captured in region-specific empirical analyses.

Against this backdrop, the present study undertakes an empirical examination of rural indebtedness across selected districts of Maharashtra—Nanded, Gondia, Satara, Pune, and Jalgaon. By using primary data collected from farming households, the study aims to analyze patterns of credit access, measure the extent of debt burden, and assess the broader socio-economic implications of indebtedness. The research seeks to move beyond descriptive accounts and provide a structured understanding of how credit systems function at the ground level and why they often fail to mitigate agrarian distress.

In doing so, the study attempts to contribute to the ongoing discourse on rural credit by emphasizing the need for context-specific analysis and evidence-based interventions. Understanding the nature and determinants of rural indebtedness is essential not only for improving credit delivery mechanisms but also for addressing the larger challenges of agricultural sustainability and rural livelihood security.

Literature Review

Rural indebtedness in India has been widely studied as a structural feature of agrarian economies, particularly through datasets such as the All-India Debt and Investment Survey (AIDIS) and National Sample Survey (NSS). The literature consistently views indebtedness not merely as a financial liability but as an outcome of deeper socio-economic vulnerabilities, including low agricultural productivity, fragmented landholdings, and inadequate institutional support. In this context, Maharashtra emerges as one of the states with a relatively high incidence of rural indebtedness, especially among small and marginal farmers.

Empirical studies indicate that access to credit in rural areas is characterized by a dual structure comprising formal and informal sources. While institutional credit expanded significantly after bank nationalization and priority sector lending policies, its distribution remains uneven. Larger and asset-owning farmers tend to have better access to formal financial institutions such as commercial banks and cooperative societies. In contrast, small and marginal farmers often depend on informal sources like moneylenders, traders, and commission agents due to lack of collateral, procedural delays, and urgent consumption needs. This continued reliance on informal credit is associated with high interest rates and exploitative lending practices, thereby intensifying the debt burden.

The purpose of borrowing has also evolved over time. Earlier studies emphasized the predominance of productive credit used for agricultural inputs such as seeds, fertilizers, and irrigation. However, more recent literature points to a rising share of consumption loans, including expenditure on health, education, and social obligations. This shift reflects the growing inadequacy of farm incomes to meet basic household needs, thereby forcing rural households to rely on credit as a coping mechanism rather than a tool for investment. Several determinants of rural indebtedness have been identified in the literature.

Economic factors such as small landholdings, low yields, rising input costs, and price volatility play a crucial role. Institutional constraints, including limited access to timely and affordable credit, further exacerbate the problem. Social factors such

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as health emergencies, educational expenses, and cultural obligations also contribute significantly to borrowing behavior. Studies employing quantitative methods highlight that variables such as irrigation coverage, access to institutional credit, and income diversification significantly influence the level and sustainability of rural debt.

A significant body of research links rural indebtedness with agrarian distress, particularly in regions like Vidarbha and Marathwada in Maharashtra. Indebtedness often becomes a critical factor when combined with crop failures, climatic uncertainties, and market fluctuations. The inability to repay loans, especially those taken from informal sources at high interest rates, creates a cycle of debt that is difficult to escape.

This has been associated with severe socio-economic consequences, including farmer distress and, in extreme cases, suicides.

The socio-economic implications of rural indebtedness are multifaceted. It contributes to persistent poverty, asset depletion, and increased inequality within rural communities.

Indebted households often resort to distress strategies such as selling assets, reducing consumption, or migrating for wage labor. Additionally, indebtedness has psychological and social dimensions, leading to stress, reduced social status, and vulnerability among affected households.

Policy interventions aimed at addressing rural indebtedness include expansion of institutional credit, introduction of schemes like the Kisan Credit Card, promotion of self- help groups, and periodic loan waivers. While these measures have provided some relief, the literature highlights their limitations. Loan waivers, for instance, are often criticized for offering short-term relief without addressing structural issues such as low farm profitability and market risks. Similarly, despite the expansion of formal banking, the persistence of informal credit markets indicates gaps in accessibility and adequacy of institutional finance.

Overall, the existing literature suggests that rural indebtedness in Maharashtra is a complex and multidimensional issue rooted in structural weaknesses of the agrarian economy. It underscores the need for a comprehensive approach that integrates credit access with improvements in agricultural productivity, income stability, and social security mechanisms.

Research Methodology

This study adopts an empirical research design to examine rural indebtedness across selected districts of Maharashtra, focusing on credit patterns, debt burden, and associated socio-economic implications. The methodology is structured to capture both quantitative and qualitative dimensions of rural credit behavior at the household level.

Research Design

The study follows a cross-sectional design based on primary data collected from farming households. It aims to identify patterns and relationships rather than establish causal inference. The analytical approach integrates descriptive statistics with comparative and inferential techniques to examine variations across regions and farmer categories.

Study Area

The research covers five districts of Maharashtra—Nanded, Gondia, Satara, Pune, and Jalgaon. These districts are purposively selected to reflect regional diversity in agro-climatic conditions, cropping patterns, irrigation availability, and levels of financial institutionalization. This selection allows for meaningful inter-district comparison of credit access and indebtedness.

Sampling Design

A multi-stage stratified sampling method is employed to ensure representation across different categories of farmers:

Stage 1: Selection of districts (purposive sampling based on regional diversity)

Stage 2: Selection of talukas and villages within each district (random sampling)

Stage 3: Selection of households (stratified based on landholding size—marginal, small, medium, and large farmers)

The sample is distributed proportionately across districts to maintain balance and comparability. This approach minimizes sampling bias and improves the generalizability of findings within the selected regions.

Data Collection

The study relies primarily on primary data, collected through structured questionnaires and face-to-face interviews with farmers. The questionnaire is designed to capture:

- Household socio-economic profile (income, education, landholding)
- Sources of credit (formal and informal)
- Purpose of borrowing (productive vs consumption)
- Amount of debt and repayment conditions
- Incidence of multiple borrowing
- Perceived financial stress and coping mechanisms

In addition, limited secondary data from government reports and institutional publications is used to provide contextual support.

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Variables and Measurement

Key variables are operationalized as follows:

- Credit Pattern: Type and source of loans (institutional vs non-institutional)
- Debt Burden: Measured using indicators such as debt-to-income ratio and repayment stress
- Socio-economic Status: Based on income levels, asset ownership, and diversification of livelihood sources
- These variables are analyzed across farmer categories and districts to identify patterns and disparities.

Analytical Tools and Techniques

The study employs a combination of statistical tools:

- Descriptive Statistics: Mean, percentage, and frequency distribution to summarize data
- Comparative Analysis: Inter-district and inter-category comparisons
- Ratio Analysis: To assess debt burden and repayment capacity
- Correlation Analysis (where applicable): To examine relationships between indebtedness and socio-economic variables
- The analysis is conducted using standard statistical software to ensure accuracy and consistency.

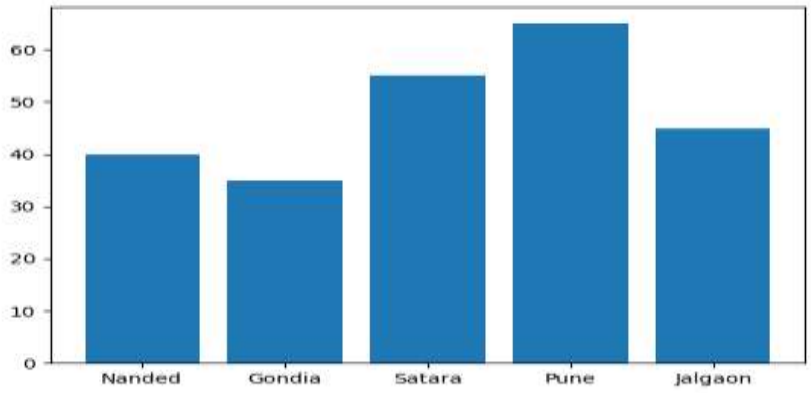
Limitations of the Study

The study is limited to selected districts and a cross-sectional time frame, which may not fully capture temporal variations in indebtedness. Responses are based on self-reported data, which may involve recall bias or underreporting, particularly in the case of informal borrowing.

"Results and Discussion: Analysis of Rural Indebtedness Patterns in Selected Districts of Maharashtra"

Image 1: Institutional Credit Distribution

The graph shows that districts such as Pune (65%) and Satara (55%) have relatively higher access to institutional credit, whereas Gondia (35%) and Nanded (40%) exhibit lower penetration.



Explanation:

This indicates significant regional disparities in access to formal financial institutions. Developed districts benefit from better banking infrastructure, higher financial literacy, and stronger institutional presence. In contrast, relatively less developed districts face barriers such as limited bank outreach, procedural delays, and lack of documentation, restricting access to institutional credit.

Inference: Institutional financial inclusion in Maharashtra is uneven and region-specific.

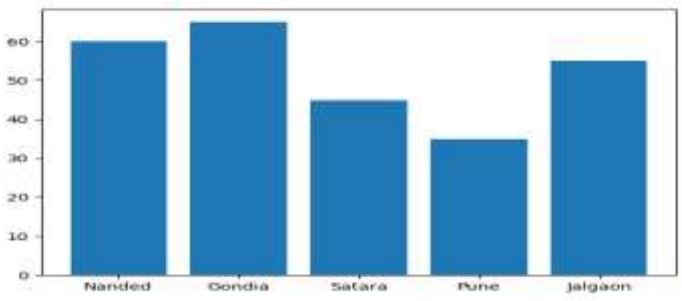


Image 2: Informal Credit Dependence

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Explanation:

The figure indicates a higher reliance on informal credit in Gondia (65%) and Nanded (60%), compared to Pune (35%). This suggests that where institutional access is weak, farmers depend on informal lenders due to ease and immediacy of credit, despite higher costs.

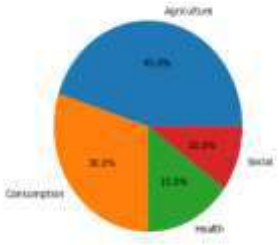


Figure 3: Purpose of Borrowing (Pie Chart)

Explanation:

While 45% of loans are used for agricultural purposes, a significant 30% is used for consumption, followed by health (15%) and social functions (10%). The high share of non-productive borrowing indicates that loans are often used for survival needs rather than income generation, contributing to repayment stress.

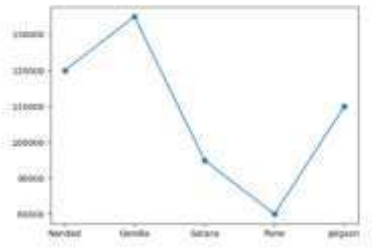
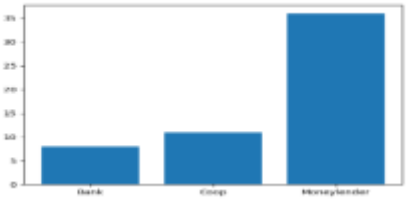


Figure 4: Average Debt Burden

Explanation:

The figure shows that Gondia has the highest average debt (₹1,35,000), whereas Pune has the lowest (₹80,000). This highlights that less developed districts tend to have higher debt burdens, often without corresponding income levels, leading to increased financial vulnerability.

Figure 5: Interest Rate Comparison



Explanation:

The figure reveals a sharp contrast in borrowing costs, with banks charging around 8%, cooperatives 11%, and moneylenders as high as 36%. This large gap demonstrates the exploitative nature of informal credit and its role in intensifying indebtedness.

Loan Size Distribution

Loan Range	Percentage
< ₹50,000	25%
₹50k–1L	40%
₹1–2L	25%
> ₹2L	10%

Figure 6: Loan Size Distribution

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Explanation:

The table shows that 40% of farmers fall within the ₹50,000–₹1,00,000 loan category, indicating reliance on moderate borrowing primarily for short-term needs. The presence of smaller loan ranges suggests liquidity constraints rather than long-term capital investment. This pattern often leads to repeated borrowing and contributes to cyclical indebtedness.

Repayment Behaviour

Repayment Status	Percentage
Regular	45%
Delayed	35%
Default	20%

Table 7: Repayment Behaviour

Explanation:

The table indicates that only 45% of farmers are able to repay loans regularly, while a combined 55% experience delays or default. This reflects weak repayment capacity, which is closely associated with unstable agricultural income, high borrowing costs, and dependence on informal credit sources.

Results and Discussion

The findings of the study show that rural indebtedness in Maharashtra is not uniform and varies significantly across districts. In areas such as Pune and Satara, farmers appear to have relatively better access to institutional credit facilities. On the other hand, districts like Gondia and Nanded show a higher dependence on informal sources such as moneylenders. This difference suggests that the reach of formal financial institutions is still uneven and influenced by regional factors.

When the purpose of borrowing is examined, it becomes clear that not all loans are used for productive activities. Although a large share is taken for agricultural purposes, a considerable portion is also used for consumption, healthcare, and social needs. Such types of borrowing do not generate income, which makes repayment difficult and often leads to repeated borrowing.

The data on average debt also shows an important pattern. Districts with relatively weaker economic conditions tend to have higher debt levels. For example, Gondia records a higher average debt compared to Pune. This indicates that farmers in such regions may be borrowing beyond their repayment capacity, mainly due to income instability and limited alternatives.

Another important observation is related to interest rates. Informal sources of credit charge significantly higher interest compared to banks and cooperative institutions. Despite this, farmers continue to depend on them because of easy access and fewer formalities. This increases the financial burden over time.

Repayment behaviour further reflects the seriousness of the issue. A large number of farmers reported delays or inability to repay loans on time. This shows that indebtedness is not just about borrowing, but also about the capacity to repay, which is often affected by uncertain agricultural income and external risks.

Overall, the analysis suggests that rural indebtedness is shaped by a combination of limited institutional access, dependence on informal credit, and borrowing for non-productive purposes. These factors together create a situation where farmers remain trapped in cycles of debt.

Policy Suggzestions

The issue of rural indebtedness in Maharashtra cannot be solved only by increasing the availability of credit. What matters equally is how easily farmers can actually access it. In many areas, especially outside developed districts, farmers still find it difficult to approach banks due to delays and formal procedures. Making the process simpler and faster can reduce their dependence on informal lenders.

Another important concern is that not all loans are used for productive activities. In several cases, farmers borrow to meet daily expenses, health costs, or social obligations. This makes repayment difficult. Basic financial awareness at the village level can help farmers use credit more carefully.

At the same time, income uncertainty continues to play a major role. When agricultural income is unstable, even small loans become difficult to repay. Strengthening support systems such as crop insurance and improving price realisation can make a difference.

It is also clear that one single policy may not work for all regions. Districts differ in terms of agriculture, market access, and financial services.

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Therefore, local-level planning becomes important. Addressing these issues together can gradually reduce the pressure of debt on rural households.

Conclusion

The study highlights that rural indebtedness in Maharashtra is a continuing concern, particularly for small and marginal farmers. While institutional credit has expanded over time, it has not fully replaced informal lending. Many farmers still depend on non-institutional sources due to accessibility issues and procedural challenges. It is also evident that a significant portion of borrowing is not linked to productive investment, which affects the ability of farmers to repay loans. Combined with income uncertainty and regional disparities, this leads to a situation where indebtedness becomes persistent rather than temporary. Therefore, the issue cannot be addressed only by increasing credit supply. There is a need to improve access, simplify processes, and ensure that credit reaches farmers in a timely manner. At the same time, attention must be given to improving income stability and reducing financial vulnerability in rural areas.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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Primary Data

- Primary Survey Data. (2026). Field survey conducted by the researcher across selected districts of Maharashtra (Nanded, Gondia, Satara, Pune, and Jalgaon), covering approximately 175 farmer respondents.
- Interview Data. (2026). Semi-structured interviews conducted with farmers (35 respondents per district) focusing on credit access, borrowing behaviour, and repayment challenges.

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Original Article

Cybersecurity Issues and User Trust in E-Payment

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Abstract

The rapid adoption of digital payment systems in India has transformed financial transactions, especially through platforms such as Paytm, Google Pay, PhonePe, and BHIM. While these systems offer convenience, they also introduce cybersecurity risks. This paper explores these risks and their impact on user trust, along with measures to enhance security and reliability in e-payment systems.

Keywords: *Cybersecurity, E-Payment Systems, User Trust, Digital Transactions, Data Security, Online Fraud*

Introduction

India's digital payment ecosystem has witnessed exponential growth due to UPI technology. These
platforms enable seamless transactions but raise concerns regarding data privacy, fraud, and cybersecurity threats. User trust plays a crucial role in adoption, making security a primary focus for
service providers.

- Rising incidents of cyber fraud and online scams
- Lack of awareness among users regarding safe digital practices
- Data privacy concerns and unauthorized access
- Weak authentication systems in some platforms
- Fear of financial loss leading to reduced adoption

Objectives

- To identify major cybersecurity threats in e-payment systems
- To analyze the impact of security issues on user trust
- To evaluate user perception towards digital payment security
- To suggest measures for improving cybersecurity and trust
- To promote safe usage of e-payment platforms

Scope of the Study

This research focuses on users of e-payment systems such as mobile wallets, internet banking, and UPI platforms. It examines cybersecurity concerns and their influence on trust levels among users. The study is limited to general user behavior and does not involve technical system-level security analysis

Limitations

- Limited sample size may not represent all user groups
- Dependence on user responses, which may be subjective
- Rapidly changing technology may affect long-term relevance
- Lack of access to real-time cybersecurity data from financial institutions

Research Methodology

The research adopts a descriptive and analytical approach. Data is collected through:
Primary Data: Surveys and questionnaires from users of e-payment systems

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Secondary Data: Research papers, articles, and online sources
The collected data is analyzed to understand patterns in user trust and cybersecurity concerns.

Statistics Used

- Percentage analysis to interpret survey responses
- Graphical representation (bar charts/pie charts) for clarity
- Comparative analysis to evaluate trust levels across different user groups

Overview of E-Payment Systems

E-payment systems allow electronic financial transactions using mobile applications. UPI platforms such as Paytm, Google Pay, Phone Pe, and BHIM dominate the Indian market due to their ease of use, instant transfers, and integration with banking services.

Cybersecurity Issues

Major issues include phishing attacks, QR code fraud, malware threats, data breaches, and system outages. Users often fall victim due to lack of awareness. Fraudulent activities are increasing with the growth of digital payments, making cybersecurity a significant challenge.

Impact on User Trust

Cyber threats negatively affect user confidence. Fear of losing money and privacy concerns reduce adoption, especially among rural populations. Trust is essential for sustaining growth in digital payments.

Measures to Improve Security

Solutions include two-factor authentication, biometric verification, AI-based fraud detection, user awareness campaigns, and government regulations. These measures enhance system reliability and user confidence.

Comparative Analysis

Paytm offers wallet services, Google Pay focuses on simplicity, Phone Pe leads in transaction volume, and BHIM is government-backed, ensuring credibility. Each platform has unique strengths contributing to user trust.

Conclusion

Cybersecurity is critical for the success of e-payment systems. Continuous improvements in security, user awareness, and regulatory frameworks are necessary to maintain trust and ensure sustainable growth in digital transactions.

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I express my sincere gratitude to all those who have contributed to the successful completion of this research work titled "Cybersecurity Issues and User Trust in E-Payment."

First and foremost, I am deeply thankful to my respected guide/supervisor for their invaluable guidance, constant encouragement, and constructive suggestions throughout the course of this study. Their expertise and insights have been instrumental in shaping this research.

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2. Online journals related to financial technology
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5. Academic publications on user trust in technology

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Original Article

A study of the challenges facing the higher education system of Vision India 2047

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Abstract:

Today, India has the largest and effective education system it will reach held the towards becoming the nation vikshit bharat 2047. This education system plays an important role in the 21st century, it needs to include a holistic approach. The National Education Policy (NEP) 2020, in particular, has had an impact and outlines a strategy for improving higher education, making it more accessible to all, and making it a global leader. According to the slogan of Developed India 2047, "Bold Vision Ahead", as India will celebrate its 100 th Independence Day, it is important to take on challenges by taking educational initiatives. efforts should be made to achieve the development of all India in terms of social, economic, artificial intelligence technology, environmental, educational and institutional approaches, ensuring flexibility and commitment in the educational sector, as well as inclusive development and safety of citizens. Also, to create a real strategic and sustainable and optimistic future for India, it is expected that social institutions will have the same contribution as the quality of education today, only then the slogan of "Bold Vision Ahead" that we have adopted will be of definite use in the coming times. Which will create a future-ready India that will lead the world in innovation, equality and sustainability. Although India's goal is to become a developed nation by 2047, it is important for India to contribute to per capita income growth, quality education, healthcare, advanced digital and modern infrastructure, justice, equality and environmental sustainability, etc. Only then can we emerge as a developed nation in 2047. For this, both the central government and the state government must play a significant role in this. Even if the state government alone is to make a developed nation, our goal will not be achieved, so both the government will have an important role in the vision of a developed India.

Keywords: *Vikshit bharat 2047, Sustainability, Innovation, Holistic approach, Artificial intelligence technology, quality education & research.*

Introductions:

It is necessary to study the current status and challenges of higher education to empower India, but the rapidly growing educational institutional system in India and the organization of programs in colleges by universities and thus, ample opportunities for students to acquire skills and knowledge to pursue higher education and succeed in the global economy have been created by today's educational system. The higher education system still faces many challenges, but according to reports, many universities and colleges are not provided with infrastructure facilities due to the shortage of quality professors, poor quality in the research sector and insufficient funds for development, Therefore, the educational resources to provide high quality education to students are limited. In recent times, only if the government gives a lot of encouragement for research, quality and funds, will there be a revolution in the educational sector of higher education. Since the quality of higher education has deteriorated today, it is important for the central government and the state government to provide funds for good facilities to universities and colleges so that students can get proper and quality education.

In recent years, the Indian government has taken several steps to address these challenges, including increasing funding for research and development and boosting the establishment of new institutions of higher education.

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The UGC has also implemented various transformations to improve the quality and responsibility of higher education in India. A transformative phase in India's approach to higher education started with the National Education Policy (NEP) 2020, which addressed enduring issues like low GER, quality concerns, and a fragmented ecosystem. Ambitious objectives from earlier eras, like raising public investment in education to 6% of GDP and raising the GER to 50% by 2035, were carried forward by the policy. The NEP 2020 aimed to ensure that students had 21st century skills while transforming India's higher education system into one that is adaptable, inclusive, and globally competitive. The field has undergone significant changes as a result of the private sector's involvement in higher education. Currently, the private sector supports more than 60% of India's higher education institutions.

Objectives of the research:

1. To understand the holistic approach to achieve a vikasit Bharat-2047.
2. To know the challenges of higher education transforming the education system.
3. To analyze the provision of the government fund for education & the present situation of higher education.
4. To Providing skilled and quality education will help reduce unemployment and boost economic growth.

Research Methodology:

The current paper relies entirely on secondary sources. These include government and semi-government data, as well as both published and unpublished information from a various books, journals, newspapers, magazines, and education reports released by the Government of India, alongside several internet websites.

Review of Literature:

The Hindu published an article titled "Second-generation reforms required in higher education to make India a developed nation" on January 22, 2026. The National Education Policy 2020 (NEP 2020) has greatly increased access to higher education in India, but the article contends that in order to reach the goal of becoming a developed country by 2047, extensive second-generation reforms centered on institutional functioning, quality, and research ecosystem are necessary.The higher education ecosystem is at a pivotal point as India works towards its vision of a developed India 2047. While quantitative expansion has been accomplished, quality parity is still a significant obstacle. Universities are becoming important hubs for innovation, social mobility, and national competitiveness in the face of the world's largest youth population and rapidly increasing enrollment. However, this scenario might only result in an increase in credentials rather than capacity building if structural expansion is not carried out in proportion to institutional capacity. Therefore, extensive and well-considered second-generation reforms in the fields of governance, education, and research become essential to turning the demographic dividend into actual developmental outcomes.

A policy report titled "Extension of Quality Higher Education through States and State Public Universities" was published by NITI Aayog. With a focus on States and State Public Universities (SPUs), it is the first policy document of its kind in the field of higher education. According to BVR Subramaniam, CEO of NITI Aayog, The nation will require a quality education system if it is to become developed by 2047. Inadequate pedagogical approaches, assessment techniques, a lack of diversity and inclusivity, and opportunities for effective use of instructional strategies, experiential learning, mentoring and support, and curriculum reform are all discussed by Johnson & Brown (2015). According to Kumar & Verma (2016), challenges include outdated curricula, a lack of industry relevance, and low student motivation and engagement. According to Lee and Davis (2017), there are opportunities like industry partnerships, insufficient funding, and project-based learning, as well as challenges like limited research and interdisciplinary collaboration. The fact that many institutions find it difficult to successfully adopt digital tools and resources suggests that technological integration is still insufficient. Institutional autonomy and innovation may be restricted by strict regulatory frameworks and outdated regulations (Phillips, 2020).

It is necessary to preserve Holistic approach to achieve a vikasit Bharat- 2047

1. **Economic revolution:**

How to achieve high income by focusing mainly on Make in India services and small and large business exports. How to increase the per capita income of our country and to strengthen the economy, it is necessary to have a good education system.

2. **Digital Empowerment:**

Today, it is necessary to make efforts in terms of digital empowerment and make students self-reliant by using AI, 5G, cloud computing, internet and digital literacy missions, public service delivery etc. in a good educational way for a developed India and how to empower students in a liberal way.

3**. Social Inclusion:**

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Mostly considering the developed India 2047, reducing income inequality in rural-urban areas and empowering the marginalized classes, encouraging citizens of all castes and religions in a social justice, dignity and inclusive system and eliminating economic inequality by adopting a holistic approach. For this, how can employment opportunities be made available to maximum youth? For this, education system should be adopted to provide them with technical skills, knowledge, industrial knowledge, this will help the youth become empowered.

4. **Providing better education and skill development:**

National Economic Policy 2020 is fully committed to the 21st century and to developing artificial intelligence, coding, green technology, and entrepreneurial skills to create entrepreneurs for the future. It is necessary to promote vocational and digital education, as well as consider how youth can develop their own decision-making abilities by providing them with skilled education, in a skill-oriented education system.

5. **Strengthening healthcare system:**

Ayushman Bharat, primary healthcare educational institutions and improving healthcare in rural areas. In order to reduce the cost of healthcare, the central and state governments should take the initiative to establish medical colleges and serve patients from there. This policy of healthcare for all can be achieved with the help of educational institutions and its contribution can be made to our common people as well as the wealthy. It is necessary to take the help of educational institutions.

6. **Improving Infrastructure and Smart Cities:**

Implementing the Smart City concept, modernizing the existing infrastructure such as transport, logistics, housing and energy etc. to create better cities, green buildings and sustainable cities in a planned manner. At the same time, efforts should be made to enhance the improvements by providing appropriate facilities to improve the educational development of schools and colleges through connectivity of rural and urban areas, proper road facilities and digital access etc.

7. **Improving energy and sustainable development**:

According to the government's policy by transitioning to net zero emissions by 2070, accelerating many projects such as solar energy, wind energy, bioenergy. This will help in promoting circular economy and green lifestyle and making it economically viable.

8. **Governance and participation of Indian citizens:**

In any democratic country, institutions are important for strengthening. It is necessary to create a better governance structure by involving the grassroots, youth, women and local administration through people's movements.

9. **Major participation of People in nation building:**

Since the future of any democratic country is in the hands of the people, the participation of the citizens of that country is essential for the welfare of the country. Making sustained efforts for entrepreneurial leadership, increasing the participation of NGOs, increasing civic participation, increasing the participation of the people in the development of India and entrusting them with the responsibility of nation building, thereby contributing to the national interest, and involving citizens of all countries and public and private partnership organizations in the national effort to develop the country in the best possible way.

10. **Opportunities and support for policy decisions:**

India's young population is an asset to the nation in terms of population. Currently, more than 65% of the youth represent the country under the age of 35. Therefore, many companies like IT companies are transforming into a strong position in the digital sector by providing employment opportunities to the youth and empowering them, considering the global situation, strategic, economic position and creating global impact through G20, BRICS and trade agreements, and initiatives like Atmanirbhar Bharat, Start Up India, Pradhan Mantri Gati Shakti and Jal Jeevan Mission will provide many business and employment opportunities that will go hand in hand with strategic and sustainable development.

Current educational circumstances:

There are numerous difficulties facing the Indian higher education system as well. The lack of qualified faculty and insufficient funding for research and development are two major obstacles. Infrastructure and resource limitations prevent many Indian universities and colleges from offering students top-notch educational opportunities.

The Indian government has currently taken a number of actions to address these issues, such as boosting financing for research and development and promoting the creation of new universities. the accountability of higher education in India, the UGC has also carried out a number of reforms despite these initiatives, many people in India are still concerned about the quality of higher education, and much more needs to be done to

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guarantee that every student receives a top-notch education.

The National Education Policy (NEP) 2020, which was published by the Ministry of Education in June 2020, is the UGC notification about foreign universities in India. From early childhood education to higher education, the policy seeks to offer a framework for the advancement of education in India. In order to improve the standard of higher education in India, the policy seeks to foster cooperation between Indian and foreign universities. The overall goal of the notification about foreign universities in India is to promote increased cooperation between Indian and foreign universities as well as improve the calibre and accessibility of higher education.

The Indian higher education system could gain from the recent UGC notification about international universities like i.e.

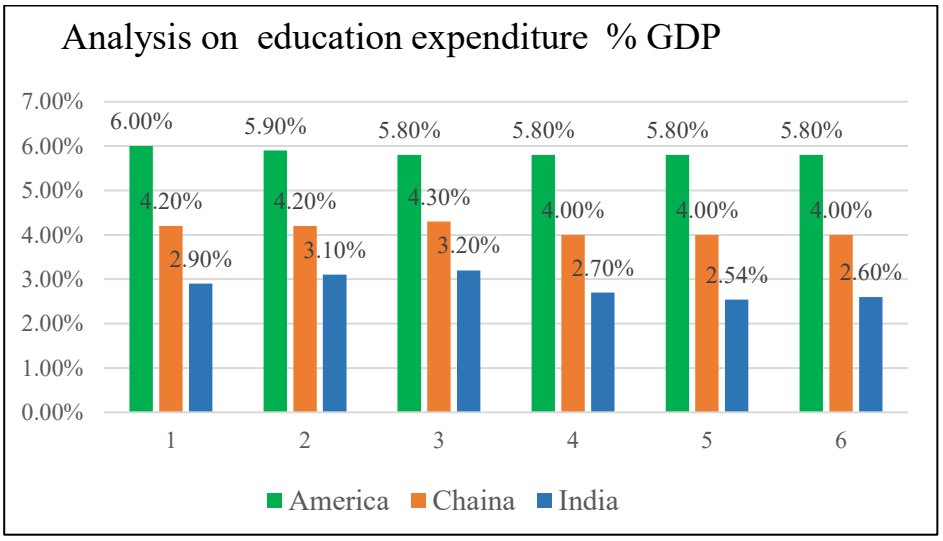
1. Availability of good/class education through if foreign universities are permitted to establish campuses in India.
2. Enhanced educational quality Higher education quality and better student outcomes will result from competition between Indian and foreign universities.
3. Enhanced research opportunities: Innovation and advancement will result from increased research opportunities and facilities brought about by collaboration between Indian and foreign universities.
4. Increased access to specialized courses and state-of-the-art technology brought about by the influx of foreign universities will help students acquire the skills necessary to thrive in an increasingly globalized world.
5. Benefits to the economy: Increased investment, job creation, and economic growth will result from the entry of foreign universities.

Funding /budget higher education:

If the country is to develop by 2047, it will need a high-quality educational system. The Union Budget 2025–2026 has allocated ₹500 crore for a Center of Excellence for AI for Education. In addition, the Automated Permanent Academic Account Registry (APAAR), which combines degrees, skills, and credit transfer, is being developed as an essential digital foundation for the educational system.

Years	America	Chania	India
2021	6.00%	4.20%	2.90%
2022	5.90%	4.20%	3.10%
2023	5.80%	4.30%	3.20%
2024	5.80%	4%	2.70%
2025	5.80%	4%	2.54%
2026	5.80%	4.00%	2.60%

(source: Government Reports)



- The US spends a substantially larger percentage of its GDP, between 5.8% and 6.0%—on education than other nations.
- China invests between 4.0% and 4.3% of its GDP in education, which is higher than India but lower than the US.

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- Compared to the US and China, India spends much less on higher education between 2.9% and 3.2% of its GDP.

Why India should spend more funds on education:

- Worldwide competition: China and the United States are making significant investments in education, which is driving their advancements in science and technology.
- Growing society: Despite having the largest youth population, India's education budget is insufficient, accounting for only 3.2% of GDP.
- Technological expansion: In order for India to expand in terms of startups and innovation, more funding is required for research and higher education.

Challenges of higher education:

1. **Boost Quality education and Gross Enrollment Ratio:**

The issue facing universities and university-affiliated colleges, where the number of degree-completed education in colleges is declining, is a major obstacle if we want to bring about an educational revolution in our nation today. It is crucial to raise the gross enrollment ratio (GER) in higher education from 26.3% in 2020 to 50% by 2047 and give students a quality education. There is a north-south divide; the GER in Tamil Nadu (47%) and Kerala (41.3%) is nearly twice that of northern states like Bihar (17.1%) and Uttar Pradesh (24.1%).

2. **Increased the government budget:**

The current plan is to raise education spending from 3% to 6% in order to implement the National Education Policy 2020. The goal of this policy's current implementation is to raise educational standards. In order to properly implement the National Education Policy 2020 in the upcoming period, the government must make a significant budgetary provision for higher education to the extent of 6 to 7 percent of the total GDP for the education sector. This is because the high fiscal deficit caused by COVID-19 may put pressure on the government exchequer during difficult economic times.

3. **Transformation of Higher education and faculty:**

Interdisciplinary education is a positive development in higher education. However, our nation's universities have been extremely divided for many years. It's difficult to change faculty members' perspectives, particularly those of senior faculty. Over the next 15 to 20 years, the entire higher education ecosystem needs to undergo a cultural shift.

4. **Lack of fundamental facilities & formal Training:**

In the field of higher education, there are more than 1.4 million professors. It is difficult to train them and help them develop their skills quickly. The structure of formal training colleges and universities for teachers needs to be urgently changed in the current educational system in order to enable basic and high-quality thinking and in still skills at different educational levels. To conduct creative teaching and research and to benefit society, professors must be trusted and given the authority they need. To train and mentor future professors, at least one top-notch academy must be established.

5. **Sufficient number of faculty members:**

Another significant issue is the availability of faculty in multidisciplinary streams. It is very difficult to attract and develop faculty in those subjects because they are dispersed across different streams. There is already a faculty shortage, even in institutions of national significance. As a result, hiring is difficult in educational settings.

6. **Inadequate Infrastructure:**

Despite India's remarkable advancements in higher education, many colleges, institutions, and universities lack even the most basic amenities. There are outdated classrooms, inadequate buildings, staff rooms, libraries or resource rooms, laboratories, technology, tools for hands-on learning, restrooms and urinals, drinking water facilities, etc. The quality of higher education is directly threatened by institutions' inadequate infrastructure. Rural areas are primarily affected by this issue.

Suggestions for Developing India's Higher Education:

The government, academics, universities, and the private sector are just a few of the many stakeholders who must work together to improve India's higher education system. suggestions are below:

1. The central and state governments should jointly make substantial provisions for funds for higher education so that the educational resources and facilities provided to colleges are available in sufficient quantities, which will benefit the students.
2. In order to fulfil the goal of education, the government should provide financial incentives and opportunities for professional development in addition to training teachers to enhance their quality and give students access to higher education.
3. Research and innovation should be supported in order for private sector educational institutions and researchers to find a place in

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higher education and for research to be promoted.
4. Efforts should be made to provide financial aid, scholarships, and other allowances to students from low-income families so they can receive an excellent education in order to increase the availability of education.
5. The government should ensure accountability and transparency so that Indian universities run in a transparent manner.

Conclusion:

visionary phrase, "Bold Vision. Brighter Future" is the blueprint for a Viksit Bharat by 2047. It captures India's resolve to use its enormous human potential, cultural diversity, and technological prowess to become a global leader in inclusive, sustainable, and creative development. India can genuinely become a developed country that provides everyone with opportunity, prosperity, and dignity by empowering its citizens and investing in people-centric growth.

India's higher education path now demands excellence and inclusivity in addition to growth. Only when universities are able to operate independently, innovate fearlessly, and provide employment-oriented knowledge on a large scale will the goal of Developed India 2047 be achieved. The goal of second-generation reforms should be to turn universities from centers that award degrees into potent hubs for social mobility, research, and skill development. India won't be able to turn its demographic dividend into long-term developmental benefits until then.

Education is the most crucial process for significantly bringing about mental, moral, and health development and growth, but not everyone has equal access to it. India's annual growth rate exceeds 9%, making it one of the world's fastest developing nations. Many children do not receive even primary education, and a sizable portion of the population is still illiterate. This has not only kept a sizable portion of the populace from fully participating in the nation's development, but it has also kept them from taking advantage of any advancements made for the good of the populace. India undoubtedly faces a number of difficulties in higher education, but it is crucial to address these issues and advance higher education. India has a wealth of human resource potential; the question that needs to be addressed is how to effectively use this potential. Opportunities exist, but the question is how to take advantage of them and make them available to others. Both the number of institutions and the standard of higher education in India must be raised in order to maintain that rate of growth. Financial resources, access and equity, quality standards, relevance, infrastructure, and ultimately responsiveness must all be re-examined in order to meet and surpass future requirements.

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First and foremost, I am deeply indebted to my respected guide/supervisor for their invaluable guidance, continuous encouragement, and constructive suggestions throughout the course of this study. Their expertise and insights have been instrumental in shaping this research.

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Original Article

Indian Knowledge System in Political Science

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Abstract

The Indian Knowledge System (IKS) represents a comprehensive intellectual tradition that integrates philosophy, governance, ethics, economics, and social organization developed over thousands of years in the Indian subcontinent. Political thought in ancient India was deeply rooted in moral philosophy, social responsibility, and welfare-oriented governance. Ancient texts such as the Arthashastra, Manusmriti, Mahabharata, Ramayana, and various Dharmashastra works contain sophisticated ideas regarding statecraft, diplomacy, administration, justice, and public welfare. These texts discuss the nature of the state, duties of rulers, public administration, taxation systems, diplomacy, and social justice.

This research paper explores the foundations of political thought within the Indian Knowledge System and examines how ancient political principles continue to influence contemporary governance and political theory. It highlights the relevance of concepts such as Rajadharma, welfare governance, decentralized administration, and diplomatic strategy in modern political institutions. The study argues that integrating indigenous political thought into contemporary political science research can enrich governance models and strengthen democratic institutions.

Keywords: *Indian Knowledge System (IKS), Political Thought in India, Ancient Indian Political Philosophy, Arthashastra, Kautilya (Chanakya), Dharma and Governance, Rajadharma, Statecraft in Ancient India*

Introduction:

The Indian Knowledge System is one of the oldest intellectual traditions in the world. It encompasses diverse disciplines including philosophy, law, political theory, economics, social organization, education, and governance. Unlike many Western political theories that emerged primarily during the modern era, Indian political thought has evolved continuously from the Vedic period to the present.

Ancient Indian political philosophy was not merely theoretical but also practical. It focused on the effective functioning of governance institutions and the ethical responsibilities of rulers. Political thinkers emphasized that governance should promote social stability, justice, prosperity, and welfare.

Key ancient sources of Indian political thought include:

- Vedas and Upanishads
- Dharmashastra literature
- Arthashastra
- Epics such as Mahabharata and Ramayana
- Buddhist and Jain political philosophy

These texts provide detailed discussions on governance, justice, diplomacy, taxation, and administrative organization.

One of the most significant contributions of the Indian Knowledge System to political science is the integration of ethics and governance. Ancient thinkers believed that political authority must be guided by moral responsibility and public welfare.

Objectives:

The study of the Indian Knowledge System (IKS) in political science aims to explore and

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understand the rich traditions of governance, political philosophy, and administrative practices developed in ancient India One major objective is to examine indigenous concepts of statecraft, leadership, and public administration described in classical texts such as the Arthashastra and the Mahabharata. These texts provide valuable insights into governance, diplomacy, justice, and welfare policies.

Another objective is to analyze important political concepts such as Rajadharma, ethical leadership, accountability, and welfare-oriented governance. The Indian Knowledge System also aims to highlight the importance of decentralized administration and community participation in governance.

Additionally, IKS seeks to connect traditional political ideas with modern political science to improve contemporary governance systems. By studying these ancient principles, scholars can develop culturally relevant approaches to leadership, policy-making, and public administration that promote justice, social harmony, and sustainable development.

Research Methodology:

The research methodology for studying the Indian Knowledge System (IKS) in political science mainly involves qualitative and historical approaches. This study relies on the analysis of primary and secondary sources to understand ancient political ideas and governance practices. Primary sources include classical texts such as the Arthashastra, the Mahabharata, the Ramayana, and the Manusmriti, which provide insights into statecraft, administration, ethics, and diplomacy.

The study uses textual analysis to interpret political concepts such as Rajadharma, governance, and welfare policies described in these works. Secondary sources include books, research articles, and academic studies by historians and political scholars who have examined ancient Indian political thought.

The methodology also adopts a comparative approach, comparing traditional political ideas with modern political theories. This helps evaluate the relevance of the Indian Knowledge System in contemporary governance, public administration, and political science research.

Historical Development of Indian Political Thought The development of political thought in India can be divided into several phases.

Vedic Period:

The **Vedic Period** marks the earliest stage of political thought in the Indian Knowledge System. Political ideas during this period are reflected in the Rigveda, Yajurveda, Samaveda, and Atharvaveda. Society was organized around tribes or clans known as *jana*, and political authority was exercised by a king called *rajan*. However, governance was not purely autocratic; consultative institutions such as *Sabha* and *Samiti* played important roles in decision-making, reflecting early participatory political practices. The concept of **Rta**, meaning cosmic and moral order, formed the foundation of governance during this period. The ruler was expected to maintain justice, social harmony, and protection of the people in accordance with this universal order. The Vedic political system emphasized cooperation between the ruler, priests, and the community. These early institutions and principles laid the foundation for later developments in Indian political thought and governance traditions.

Epic Period:

The **Epic Period** represents an important stage in the development of political thought within the Indian Knowledge System. The two major epics, the Mahabharata and the Ramayana, contain detailed discussions on governance, ethics, justice, and leadership. These texts provide practical guidance on the duties of rulers, known as **Rajadharma**, which emphasizes moral responsibility, protection of citizens, and maintenance of social order. In the Mahabharata, particularly in the Shanti Parva, the concept of righteous governance and the responsibilities of kings are discussed extensively. Similarly, the Ramayana presents the ideal model of governance through the concept of **Ram Rajya**, where justice, prosperity, and social harmony prevail. These epics highlight the importance of ethical leadership, welfare of the people, and adherence to dharma. The political ideas from this period significantly influenced later treatises on governance and continue to shape Indian political philosophy.

Classical Period:

The **Classical Period** marks the most systematic development of political thought in the Indian Knowledge System. During this period, political ideas were clearly articulated in texts such as the Arthashastra written by Kautilya. This work is considered one of the earliest comprehensive treatises on statecraft, governance, diplomacy, and public administration. It presents detailed discussions on the structure of the state, taxation, economic management, intelligence systems, and foreign policy. One of the key contributions of the Classical Period is the **Saptanga Theory of State**, which explains that a state consists of seven elements: king, ministers, territory, fort, treasury, army, and allies. The period also saw the influence of Dharmashastra literature, including the

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Manusmriti, which outlined legal systems and duties of rulers. Political thought during this period emphasized administrative efficiency, strong governance, ethical leadership, and the welfare of citizens.

Concept of State in the Indian Knowledge System:

Ancient Indian political thinkers developed detailed theories about the nature and structure of the state.

One of the most influential theories is the **Saptanga Theory of State**, which describes the state as a composite structure consisting of seven essential elements.

These elements include:

1. King (Swami)
2. Ministers (Amatya)
3. Territory and population (Janapada)
4. Fortifications (Durga)
5. Treasury (Kosha)
6. Army (Danda)
7. Allies (Mitra)

According to this theory, the stability and success of a state depend on the proper functioning and balance of these seven components. This concept resembles modern political science ideas about institutions, governance structures, and state capacity.

Governance and Public Administration:

Governance and public administration occupy an important place in the Indian Knowledge System. Ancient Indian thinkers developed systematic ideas about administration, state management, and the responsibilities of rulers. One of the most significant sources of administrative thought is the **Arthashastra** written by **Kautilya**. This text provides detailed guidelines on governance, bureaucratic organization, taxation, intelligence systems, and economic management.

The administrative system emphasized merit-based appointments, accountability, and strict supervision of officials to prevent corruption. Government departments were established to manage areas such as agriculture, trade, defense, and public works. Ancient Indian political philosophy also stressed that the ruler's primary duty was the welfare of the people. Efficient governance was expected to maintain justice, law and order, and economic prosperity. Thus, the Indian Knowledge System presents an early and well-organized framework of public administration that combines ethical leadership, effective bureaucracy, and welfare-oriented governance.

Merit-Based Appointments:

Merit-based appointments were an important principle in the administrative system of the Indian Knowledge System. Ancient political thinkers emphasized that efficient governance depended on the competence, integrity, and loyalty of administrative officials. According to this text, the king should appoint ministers and administrators based on their qualifications, skills, honesty, and experience rather than personal relationships or favoritism. Candidates were often tested through different methods to evaluate their character, intelligence, and reliability before being entrusted with important responsibilities. This system ensured administrative efficiency and minimized corruption within the government.

Merit-based selection helped create a capable bureaucracy that could effectively manage state affairs such as taxation, defense, and economic administration. These ideas demonstrate that ancient Indian political thought recognized the importance of professionalism and competence in public administration.

Accountability:

Accountability is an important principle in the Indian Knowledge System and forms the foundation of responsible governance. Ancient Indian political thinkers emphasized that rulers and administrators must remain answerable for their actions and decisions. Good governance was expected to function with transparency, justice, and responsibility toward the people.

In the **Arthashastra**, **Kautilya** provided detailed guidelines to ensure accountability within the administrative system. Government officials were closely monitored, and strict laws were established to prevent corruption, misuse of power, and financial irregularities. Kautilya suggested that the king should regularly inspect the work of ministers and administrators and establish systems of auditing and supervision. Severe punishments were prescribed for dishonest officials in order to maintain discipline and integrity in governance.

The Indian Knowledge System also emphasized the moral responsibility of rulers through the concept of **Rajadharma**, which required kings to act in the interest of their subjects. A ruler who failed to protect the welfare of the people or acted unjustly was considered unfit to rule.

Thus, accountability in ancient Indian political thought ensured that political power was exercised responsibly and ethically. These ideas remain relevant in modern democratic systems, where transparency, anti-corruption measures, and public accountability are essential for good governance.

Administrative Organization:

Administrative organization was a crucial component of governance in the Indian Knowledge

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System. Ancient Indian political thinkers developed structured administrative systems to ensure efficient management of state affairs. The **Arthashastra** written by **Kautilya** provides a detailed description of administrative organization, including the roles of ministers, officials, and departmental heads.

The king was supported by a council of ministers known as the *Mantri Parishad*, who assisted in policy-making and governance. Various departments were established to manage important sectors such as agriculture, trade, taxation, defense, mining, and public works. Each department was supervised by trained officials responsible for implementing government policies effectively.

The administrative system also included mechanisms for supervision, record keeping, and financial management to maintain efficiency and prevent corruption. This well-organized structure ensured smooth governance and effective public administration. The principles of administrative organization in ancient India demonstrate an early understanding of bureaucratic management and institutional governance.

Taxation Policy:

Taxation policy was an essential component of governance in the Indian Knowledge System, aimed at maintaining the financial stability of the state while ensuring the welfare of the people. Ancient Indian political thinkers emphasized that taxation should be fair, moderate, and beneficial to society. In the **Arthashastra**, **Kautilya** described a well-organized taxation system designed to generate revenue without burdening citizens excessively.

The state collected taxes from various sources such as agriculture, trade, mining, and crafts. However, Kautilya advised that taxes should be collected gradually and reasonably, similar to how a bee collects honey without harming the flower. This principle emphasized the importance of balancing state revenue with economic growth and public welfare.

Tax revenue was used for administrative expenses, defense, infrastructure development, and social welfare activities. Thus, the taxation policy in ancient India reflected a responsible and welfare-oriented approach to economic governance.

Ethical Leadership and Rajadharma:

Ethical leadership is a fundamental aspect of the Indian Knowledge System and plays a significant role in shaping ancient Indian political thought. The concept of **Rajadharma**, which refers to the moral duties and responsibilities of rulers, forms the core of ethical governance. Ancient Indian texts emphasize that rulers must govern with justice, honesty, compassion, and dedication to the welfare of their people. Political authority was not seen merely as power but as a moral responsibility toward society.

The idea of Rajadharma is extensively discussed in the **Mahabharata**, particularly in the *Shanti Parva*, where the duties of kings and principles of righteous governance are explained. The text emphasizes that a ruler must ensure justice, protect citizens, prevent exploitation, and maintain social harmony. Similarly, the **Arthashastra** by **Kautilya** highlights the importance of responsible leadership, administrative discipline, and the welfare of the people.

According to Kautilya, the happiness of the king lies in the happiness of his subjects, which reflects the idea that governance should focus on public welfare rather than personal interests. Ethical leadership also required rulers to avoid corruption, make fair decisions, and remain accountable for their actions. Thus, Rajadharma provided a strong moral foundation for governance in ancient Indian political philosophy and continues to influence modern ideas of ethical leadership and good governance.

Diplomacy and Foreign Policy:

Ancient Indian political thought contains sophisticated theories of diplomacy and international relations.

The **Mandala Theory of Foreign Policy** explains the strategic relationships between states. According to this theory, neighboring states often compete for power, while distant states may act as allies.

The Mandala theory outlines several diplomatic strategies including:

1. Peace treaties
2. Military confrontation
3. Neutrality
4. Strategic alliances
5. Seeking protection from stronger states
6. Dual diplomatic strategies

These ideas resemble modern theories of realism and balance of power in international relations. Ancient political thinkers also emphasized the role of intelligence networks and strategic planning in foreign policy.

Economic Governance and Welfare State:

Economic management was an essential component of political governance in the Indian Knowledge System. Ancient political thinkers believed that economic prosperity was necessary for political stability.

Key economic policies included:

- Agricultural development
- Regulation of trade and commerce

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- Fair taxation systems
- Public infrastructure development
- Disaster management

The ruler was expected to support farmers, merchants, artisans, and laborers. This approach reflects the idea of a **welfare-oriented state**, where government policies aim to improve the living conditions of citizens.

Decentralization and Local Governance:

Decentralized governance has deep roots in Indian political traditions.

Village assemblies and local administrative institutions played a crucial role in managing local affairs.

These institutions handled responsibilities such as:

- Land management
- Local dispute resolution
- Tax collection
- Community development

This tradition of decentralized governance influenced modern institutions such as local self-government and Panchayati Raj.

Indian Knowledge System and Modern Governance Examples

Panchayati Raj:

The Panchayati Raj system represents decentralized governance at the village level. It reflects the traditional Indian practice of local assemblies managing community affairs.

The 73rd Constitutional Amendment strengthened these institutions and enhanced grassroots democracy.

Welfare St
ate Policies:

Government programs such as rural employment schemes, food security initiatives, and social welfare programs reflect the ancient principle that governance must prioritize public welfare.

Diplomatic Strategy:

India's foreign policy strategies involving regional cooperation, strategic partnerships, and multilateral diplomacy echo classical diplomatic ideas.

Challenges in Integrating IKS into Political Science:

Despite its significance, the integration of the Indian Knowledge System into contemporary political science faces several challenges.

These include:

- Limited academic research on indigenous political theories
- Overreliance on Western political frameworks
- Lack of interdisciplinary studies connecting ancient texts with modern governance
- Misinterpretation or oversimplification of ancient ideas

Addressing these challenges requires greater academic engagement and curriculum development.

Conclusion:

The Indian Knowledge System offers a rich and comprehensive framework for understanding governance, political authority, and public administration. Ancient Indian political thinkers developed sophisticated theories regarding state structure, ethical leadership, economic management, diplomacy, and decentralized governance.

These ideas demonstrate that political thought in India evolved through systematic philosophical and practical analysis long before the emergence of modern political science.

Integrating Indian political thought into contemporary research can provide valuable insights for improving governance systems and strengthening democratic institutions. By studying indigenous traditions alongside modern political theories, scholars can develop more holistic and culturally relevant approaches to political science.

Acknowledgment

I express my sincere gratitude to all those who have contributed to the successful completion of this research work titled "Indian Knowledge System in Political Science."

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Original Article

Environmental Concerns of Synthetic Dyes and Natural Dye Extraction from Marigold (Tagetes) Flowers

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Abstract

India is one of the world's 12th megadiverse countries and one of eight major centers of origin. India harbors a wealth of helpful germplasm resources. The rich flora of India is a treasure-house of diverse natural products. One such product is a dye, which can be extracted from plants, flowers, woods, nuts, mosses, etc. Nature has gifted us more than 500 dye-yielding plant species. Among these, is a Common Marigold, which yields vibrant dye. Natural dye from this flower is easy to extract. The process involved in extraction is time-saving, sustainable, and cost-effective. Marigold flower dye is eco-friendly and has many other advantages over artificial dyes. Encouraging the Marigold dye production from the local areas can benefit small farmers and stimulate the economy. It is the solution to many of the problems we are facing today hence, in the below extract we are going to study the extraction of natural dye by using a simple aqueous solution and its economic benefits.

Keywords: *germplasm, sustainable, eco-friendly, local stimulate, aqueous.*

Introduction

Dye is a substance that is used to color clothes or to highlight biological structures it can be obtained naturally or artificially. A plant usually contains a mixture of natural dyes, from which a particular dye can be extracted and used to dye textiles. Natural dyes can be grouped according to their chemical structure as Carotenoids, Carotenes, Anthocyanins, Flavonoids, Flavonoids, Flavanols, Anthocyanidins, and Xanthophyll.

Examples of Natural Dyes are as follows

- *Cochineal*- It is the whole dried insect of the species *Dactylopiuscoccus*. This dye yields fuchsias to purple color.
- Cutch extract- It is prepared from the wood of *Acacia catechu* trees. It is a good source of brown color, such as chocolate and cinnamon.
- Lac extract- It is extracted from the coccuslacca insect. It yields burgundy red to deep purple color.
- Logwood extract- This is mainly extracted from the wood of the *Hematoxyloncampechianum* tree, which yields reddish-purple to orchids blue dye color.
- *Rubiatinctorum*- The ground root of the mature madder plant *Rubiatinctorum* produces salmon pink to red dye color.
- Red beetroot extract- The tannin in beetroot makes up 95% of red pigment extract. The Tannins present in most plant tissues can be extracted easily for dyeing.
- Chlorophyll b- It is extracted from green plants such as spinach. The Chlorophyll molecule consists of a porphyrin head, which is soluble in fats and oil.

Farming of Marigold

Small farming is a mainstay of the rural economy and a backbone of India's agricultural sector. Small farmers are the bedrock of India's GDP. Small-scale farming ensures food productivity and food security, especially in developing countries. One such crop that can support small farmers is Marigold.

The marigold is a marketable flower that can be easily cultivated.

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The marigold prefers loamy soil with a pH of 7.0 to 7.5 and a temperature of 64° to 68° F.This plant can be sown throughout the year. It doesn't require chemical fertilizers a simple neem extract can repel significant pests. The marigold plant attracts lacewings, ladybugs, and other predators that eat the pests that damage the crops. Marigolds are hardy plants that thrive in various climates, making them suitable for diverse regions. Marigolds are versatile flowers in high demand in many industries, including religious ceremonies, festivals, cosmetics and pharmaceuticals, and natural dye production.

Many countries impose stringent environmental standards in response to toxic and allergic reactions associated with synthetic dye. So, extracting natural dyes from marigolds is an excellent initiative. It aligns with sustainable practices, supports organic farming, and contributes to the development of the economy.

Economic Benefits of Marigold Dye Extraction

- Marigold can be grown organically, which reduces the reliance on chemicals pesticides, and fertilizers.
- It enhances soil health and biodiversity hence; complex farming appliances are not needed.
- It promotes rural economic development, by creating new income streams for farmers through the sales of marigold flowers and natural dyes.
- It encourages the establishment of small-scale processing units.
- It supports a circular economy by utilizing agricultural by-products.
- The growing consumer demand for natural and organic products will increase the market potential for marigold-based dyes.
- There is global demand for marigold-based products, such as dried flowers, oils, and natural dyes, which can be exported to international markets.
- Marigold farming requires minimal investment and the cultivation period is short. This allows farmers to grow multiple crops per year, providing more income opportunities.
- Cultivation of Marigolds and extraction of its dye requires labor for planting, harvesting, processing, and creating jobs for rural communities.
- Waste from marigold cultivation and dye extraction can be converted into organic compost, promoting sustainable farming practices and reducing fertilizers and pesticide costs.

Objectives

- To extract the natural dye from the Marigold flower.
- To study the economic benefits of natural dye.

Materials

- Kettle half filled with water
- Alum powder-6 tablespoon
- Burner
- Cotton/Woolen fabric
- Fresh/dried/frozen Marigold flower
- Newspaper
- Spoon
- Lighter

Method

- Harvest marigold flowers in full bloom, typically in the morning when the pigment concentration is highest. Ensure proper handling to avoid damage to the flowers.
- Avoiding the sunlight, dry the flowers in a shaded and well-ventilated area. It will preserve the natural pigments.
- Spread a newspaper in your work area.
- Fill the half kettle with the water, add six tablespoons of the Alum powder, and place it on the burner.
- Add cotton/woolen fabric to water and simmer for 1 hour.
- Once cooled, remove the fabric from the kettle.
- Refill the kettle with water, add 7-8 fresh/dried/frozen Marigold flower heads in boiling water, and let it simmer for 1 hour.
- Once cooled, strain the flowers from the water and filter the extracted dye to remove impurities.
- Add fabric to the concentrated Marigold flower color and simmer for an hour, stirring occasionally for an hour. Then remove the fabric and rinse it a few times in cold water until the water runs clear.

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Observations



Making alum powder solution



Placing a piece of cotton fabric in a solution



Adding the Marigold flower heads



Concentrated Marigold extract/dye



Dyeing the cotton fabric



Dyed fabric

Suggestions

- Establish partnerships with textile manufacturers, cosmetic companies, and food processors to create a steady demand for natural dye.
- Developing branding and certification for organic and natural dye will attract premium prices.
- Providing training and workshops for farmers and processors on dye extraction techniques will give better results.
- Collaboration with research institutions to optimize extraction methods and improve dye quality will be effective.
- Investments in better infrastructure facilities for drying, processing, and storing marigold flowers and dyes will extract better products.
- Implementing quality control measures to ensure consistency and safety of the natural dyes is essential.
- Obtaining certifications such as fair trade, or eco-labels, will enhance the market credibility of natural dyes.
- Establishing cooperatives and connecting farmers with buyers and exporters will ensure a steady income
- Providing access to modern farming techniques and processing equipment can improve yields and the quality of the dye.
- Farmers should have access to high-quality marigold seeds or saplings.
- Various campaigns and demonstration programs can be arranged for farmers to spread awareness of marigold dye extraction.

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- Training the farmers for cultivation, pest management, and post-harvest handling of flowers is important.

Conclusion

Extracting natural dyes from marigold flowers is a promising venture that can significantly contribute to organic farming and economic development. Marigold farming and dye extraction can create a positive impact on local communities, and the economy. With the proper planning, support, and market linkages, the marigold flower dye extraction business can blossom into a thriving sector. Marigold cultivation and dye extraction will grow the rural economies as well. It will also improve the livelihoods and sustainable development. Only challenges like Market Access, Technical Knowledge, Infrastructure, and Quality Control, should be addressed.

Acknowledgment

I express my sincere gratitude to all those who have contributed to the successful completion of this research work titled "Environmental Concerns of Synthetic Dyes and Natural Dye Extraction from Marigold (Tagetes) Flowers."

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Original Article

Mass Migration and Its Impact on Democratic Politics

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Abstract:

Mass migration has emerged as one of the most significant political challenges confronting democratic systems in the twenty-first century. Large-scale movements of refugees, asylum seekers and economic migrants driven by conflict, inequality, climate change, and globalization have reshaped political debates, electoral outcomes and governance structures across democracies. While migration can contribute to economic growth and cultural diversity, it also generates political anxieties related to identity, citizenship, welfare and security. These anxieties increasingly influence democratic politics, often fuelling populism, polarization, and democratic backsliding.

This paper examines the impact of mass migration on democratic politics at both national and global levels. Drawing on democratic theory, migration studies and global governance frameworks, it analyses how migration affects democratic participation, political representation, institutional legitimacy, and policy-making processes. The paper argues that migration is not inherently a threat to democracy; rather, democratic stress arises when institutions fail to manage migration in inclusive, accountable and rights-based ways. It concludes that strengthening democratic governance, protecting human rights and enhancing global cooperation are essential to addressing migration-related challenges while preserving democratic values.

Keywords: *Mass Migration, Democracy, Democratic Politics, Citizenship, Global Governance, Populism*

Introduction:

Mass migration has become a defining feature of contemporary global politics. According to international estimates, millions of people are currently displaced due to armed conflict, economic deprivation, environmental degradation, and climate-induced disasters. These large-scale movements of people have become central to political debates within democratic states, shaping electoral campaigns, party competition, public discourse, and policy agendas.

Historically, democracies have grappled with questions of inclusion and exclusion. Citizenship, political rights, and national identity have long defined the boundaries of democratic participation. Mass migration intensifies these debates by challenging traditional notions of sovereignty, cultural homogeneity, and political membership. In many democratic societies, migration has become a highly politicized issue, frequently framed as a threat to social cohesion, economic stability, and national security.

Objectives of the Study:

1. To understand the concept of mass migration.
2.To analyse how migration influences political behaviour and party systems
3. To examine the impact of mass migration on democratic politics
4. To explore the relationship between mass migration and global governance frameworks

Scope

This study focuses on the relationship between mass migration and democratic politics in the twenty-first century. It examines how large-scale movements of refugees, asylum seekers, and

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economic migrants influence democratic institutions, political participation, public policy, and party systems.
The study covers both national and global dimensions with particular reference to democratic countries

Limitation:

The study is based mainly on secondary sources such as books, reports and journal articles, which may limit the depth and originality of empirical analysis.

Research Methodology:

The research is primarily based on **secondary data sources** including books, peer-reviewed journal articles, reports of international organizations, policy documents and credible online databases related to migration and democracy.

Conceptualizing Mass Migration and Democratic Politics:

Mass migration refers to large-scale cross-border movements of people occurring within relatively short periods of time. These movements may include refugees fleeing armed conflict, asylum seekers escaping persecution, economic migrants pursuing better livelihood opportunities, and climate migrants displaced by environmental degradation or climate-related disasters. Although migration is not a new phenomenon, its scale, visibility, and political significance have increased considerably in recent decades.

Democratic politics encompasses processes such as electoral competition, policymaking, political participation, representation, and institutional accountability. Democratic theory is grounded in principles including political equality, popular sovereignty, the rule of law, and inclusive participation. Mass migration challenges these principles by raising fundamental questions about membership—specifically, who belongs to the political community and who has the right to participate in democratic decision-making.

From a theoretical perspective, democracies confront an inherent tension between universal human rights and territorially bounded citizenship. While democratic norms emphasize equality and inclusion, democratic institutions are typically organized within national borders. Consequently, mass migration gives rise to what scholars describe as the "democratic boundary problem," wherein political decisions affect individuals beyond those formally recognized as members of the polity.

Mass Migration and Electoral Politics:

One of the most visible impacts of mass migration is its influence on electoral politics. Migration has become a salient issue in election campaigns, often shaping voter preferences and party strategies. Political actors frequently mobilize migration narratives to appeal to fears related to economic competition, cultural change, and security. In several democracies, migration has contributed to the rise of populist and nationalist parties. These parties often frame migration as evidence of elite failure and loss of national control, positioning themselves as defenders of "the people" against migrants and global institutions. Such narratives can polarize electorates and weaken democratic norms of tolerance and pluralism.

At the same time, migration can also mobilize pro-democracy and pro-inclusion movements. Political parties and civil society groups advocating migrant rights, multiculturalism, and social integration have emerged as counter-forces. Thus, migration reshapes electoral competition by redefining political cleavages and influencing voter alignment.

Migration, Political Participation, and Representation:

Mass migration raises important questions about political participation and representation in democratic systems. Migrants, especially non-citizens, are often excluded from formal political processes despite being affected by public policies. This exclusion creates a democratic deficit, as decisions are made without the participation of all affected stakeholders. In many democracies, migrants face legal, linguistic, and socio-economic barriers to political engagement. Limited access to citizenship, voting rights, and political representation can lead to political marginalization. Democratic theory suggests that such exclusion undermines the principle of political equality and weakens democratic legitimacy.

However, migrants increasingly participate in informal political activities, including protests, advocacy networks, and transnational movements. These forms of participation challenge traditional models of democratic engagement and highlight the evolving nature of political participation in an era of mobility.

Migration, Identity Politics, and Social Polarization:

Migration profoundly affects identity politics within democratic societies. Cultural diversity, religious pluralism, and demographic change can generate both opportunities and tensions. While diversity can enrich democratic life, it can also provoke backlash when institutions fail to manage integration effectively. Identity-based

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political mobilization around migration often leads to social polarization. Narratives that depict migrants as cultural outsiders or economic burdens can erode social trust and democratic solidarity. Such polarization weakens democratic deliberation by reducing complex issues to binary oppositions. Democratic resilience depends on institutions that promote inclusion, dialogue, and social cohesion. When migration is managed through exclusionary or securitized approaches, democratic values such as equality and tolerance are compromised.

Institutional Capacity and Democratic Governance:

Mass migration places significant pressure on the institutional capacity of democratic states. Governments must manage border control, asylum systems, welfare provision, and integration policies. Inadequate institutional responses can lead to administrative overload, policy inconsistency, and public dissatisfaction. In response to migration pressures, democratic states may expand executive authority and adopt emergency measures. While such actions may enhance efficiency, they raise concerns about democratic accountability and the rule of law. The use of detention, surveillance, and restrictive asylum policies often generates legal and ethical controversies. Effective democratic governance requires institutions capable of balancing control with rights protection. Migration governance that prioritizes transparency, coordination, and accountability strengthens democratic legitimacy, whereas coercive and exclusionary approaches undermine it.

Human Rights, Citizenship, and Democratic Legitimacy:

Mass migration highlights the intersection between human rights and democratic politics. International human rights norms recognize the rights of refugees and migrants, while democratic states retain authority over citizenship and border control. This tension frequently generates political conflict. Restrictive migration policies may violate human rights and erode democratic legitimacy. When democratic states fail to uphold international norms, public trust in institutions declines. Conversely, rights-based migration policies can enhance democratic credibility and moral authority. Citizenship policies play a crucial role in shaping democratic inclusion. Inclusive citizenship regimes facilitate integration and participation, whereas exclusionary regimes reinforce marginalization and democratic deficits.

Global Governance and Migration:

Migration is a transnational phenomenon that cannot be effectively managed by individual states alone. Global governance frameworks play a crucial role in coordinating responses, sharing responsibility, and protecting migrant rights. International agreements on refugees, migration, and human rights provide normative guidance for democratic states. However, global migration governance faces limitations related to enforcement and democratic legitimacy. Decision-making often occurs at international forums distant from citizens, raising concerns about accountability. Strengthening cooperation while respecting democratic processes remains a key challenge. Democratic politics must therefore engage with global governance in ways that enhance transparency and public trust. Multilateral approaches grounded in solidarity and shared responsibility are essential for sustainable migration governance.

Migration, Climate Change, and Democratic Stress:

Climate change is increasingly recognized as a driver of mass migration. Environmental degradation, extreme weather events, and resource scarcity force populations to relocate, intensifying migration pressures on democratic states. Climate-induced migration further complicates democratic politics by blurring the boundaries between environmental, economic, and humanitarian concerns. Democratic systems are often ill-prepared to address climate-related displacement. Failure to anticipate and manage such migration can exacerbate political instability and social tension. Integrating migration policy with climate governance is therefore essential for democratic resilience.

Conclusion:

Mass migration has a profound impact on democratic politics, reshaping electoral competition, political participation, institutional capacity, and democratic legitimacy. While migration presents significant challenges, it is not inherently incompatible with democracy. Democratic stress arises when institutions fail to manage migration in inclusive, accountable, and rights-based ways. Ultimately, the future of democratic politics in an era of mass migration depends on the capacity of democratic systems to adapt to mobility while upholding core democratic values of equality, participation, and accountability.

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Original Article

Karmaveer Dadasaheb Kannamwar's Tree Plantation Movement: A Study from the Perspective of Environmental Sustainability

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Abstract:

In the twenty-first century, environmental crises, climate change, and depletion of natural resources have made the issues of "Nature, Sustainability, and Human future" globally significant. Against this backdrop, the "Four crore Tree Plantation" initiative launched by visionary and people-oriented leader Karmaveer Dadasaheb Kannamwar in post-independence Maharashtra in 1963 stands out as particularly noteworthy. This initiative was not merely an administrative program but took the form of a social movement. Kannamwar emphasized public participation, social responsibility, and ethical values in tree plantation, highlighting the interrelated significance of "Trees-Water-Food-Life."

A study of the movement initiated by Karmaveer Dadasaheb Kannamwar reveals that he placed special emphasis on the fundamental principles of sustainable development, such as maintaining environmental balance, soil conservation, water resource management, and biodiversity protection. Furthermore, his foresight in creating a safe and prosperous environment for future generations is clearly evident through this initiative. Therefore, the research topic "Karmaveer Dadasaheb Kannamwar's Tree Plantation Movement: A Study from the Perspective of Environmental Sustainability" does not merely aim to review a historical event but attempts a fundamental and analytical examination of the movement in the context of contemporary sustainable development concepts.

Keywords: *Karmaveer Dadasaheb Kannamwar, Tree Plantation Movement, Sustainable Development, Environmental Conservation, Post-Independence Maharashtra, Nature Awareness.*

Introduction:

In the twenty-first century, the question of "Nature, Sustainability, and the Human future" has emerged as a fundamental concern for humanity. Issues such as climate change, deforestation, loss of biodiversity, water scarcity, and increasing pollution are challenging conventional concepts of development. The disruption of the balance with nature in the pursuit of economic progress has raised critical questions about human existence itself. Consequently, a perspective of sustainability that harmonizes development with environmental conservation has become indispensable. Against this backdrop, it becomes important from a research perspective to reassess environmentally conscious leadership in history and evaluate their work and contributions. In the political and social history of post-independence Maharashtra, Karmaveer Dadasaheb Kannamwar is recognized as a visionary leader. While studies of his work have primarily focused on his political and administrative contributions, comparatively less attention has been given to his role in environmental conservation. In particular, his commitment to tree plantation and its implementation was not merely an administrative exercise but a practice reflecting social awareness and a consciousness of forward-looking development. A closer examination of this initiative reveals that it was, in essence, a fundamental social movement grounded in the principles of environmental sustainability.

Tree plantation is not merely a formal or symbolic act; it is a fundamental means of maintaining environmental balance.

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Trees play a crucial role in soil conservation, the water cycle, carbon sequestration, and biodiversity protection. Tree planting is also directly linked to rural economies, the preservation of local resources, and public participation. Therefore, the concept of tree plantation extends beyond being just an environmental program, becoming an integral component of nature conservation as well as social and economic sustainability.

Karmaveer Kannamwar's tree plantation initiative is worthy of study within this broader theoretical context. He sought to give tree planting the character of a social movement rather than merely an administrative directive. His initiative reflects a confluence of public participation, collective responsibility, and forward-looking thinking. The awareness of harmonizing development with nature is clearly evident in his approach, aligning closely with the principles of contemporary sustainable development.

The present research paper, titled *"Karmaveer Dadasaheb Kannamwar's Tree Plantation Movement: A Study from the Perspective of Environmental Sustainability,"* attempts an in-depth study of Kannamwar's tree plantation initiative from historical, theoretical, and analytical perspectives. By reassessing the movement within the conceptual frameworks of environmental history and sustainable development, the study aims to highlight the interconnections between nature conservation, resource management, and the human future. Overall, this movement is not merely a historical event but stands out as a visionary and fundamental step toward environmental sustainability.

Need of the Study:

Karmaveer Dadasaheb Kannamwar's contributions hold significant importance in the political and social history of post-independence Maharashtra. However, comparatively less attention has been given to his environmental perspective, particularly his 1963 initiative of planting four crore trees. In today's context, where issues such as climate change, deforestation, water scarcity, and environmental imbalance are intensifying, it becomes crucial to revisit historically significant environmentally conscious initiatives. The tree plantation campaign led by Kannamwar was not merely an administrative program but a broad-based movement that fostered public participation, social responsibility, and awareness of forward-looking development. Studying this initiative from the perspective of sustainable development can illuminate the nature of environmental consciousness in post-independence Maharashtra, the role of public participation, and the historical context of nature conservation policies. Therefore, a critical examination of this topic is of considerable research significance.

Objectives:

1. To study the historical background and actual implementation of Karmaveer Dadasaheb Kannamwar's tree plantation initiative.
2. To analyze the tree plantation movement within the theoretical framework of "Nature, Sustainability, and the Human future."
3. To highlight the importance of public participation and collective responsibility in the tree plantation movement.
4. To examine the environmental outcomes of Kannamwar's tree plantation campaign and its impact on biodiversity.
5. To elucidate the alignment of Kannamwar's tree plantation initiative and movement with the principles of contemporary sustainable development.

Research Methodology:

For the present research paper, a Historical, Analytical, and Critical research methodology has been adopted. As primary sources, the study has utilized Karmaveer Dadasaheb Kannamwar's writings and speeches, issues of the Lokarajya magazine, and official records of the tree plantation campaign. As secondary sources, references such as Kannamwar's biographies, Biography of freedom fighters', and other relevant literature have been consulted. Using these sources, the study critically analyzes the gathered information to examine public participation, environmental outcomes, and alignment with sustainable development principles, thereby drawing informed conclusions.

Introduction to Karmaveer Dadasaheb Kannamwar:

Karmaveer Dadasaheb Kannamwar, also known as Marotrao Kannamwar, was born on 10 January 1900 in Chandrapur.[1] His childhood was marked by simplicity, hardship, and an upbringing in an ordinary family. Through his diligence and commitment, he held various positions on his own merit, including member of the Indian National Congress, Secretary of the Chanda Taluka Congress Committee, General Secretary of the Nagpur Pradesh Congress Committee, Health Minister in old Madhya Pradesh, and ultimately Chief Minister of Maharashtra State. He performed all these duties with utmost honesty and dedication.[2]

He was a prominent freedom fighter, actively participating in the Jungle Satyagraha, individual Satyagraha, and the Civil Disobedience

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Movement.[3] Consequently, his involvement in the struggle for India's independence led to multiple arrests and periods of imprisonment.[4] Although Kannamwar was a native of Vidarbha, he was, above all, a great Indian leader.

Karmaveer Dadasaheb Kannamwar's Tree Plantation Initiative and Its Implementation:

A vivid example and ideal of how resolute and committed a person can be toward their vision is Karmaveer Dadasaheb Kannamwar. During his tenure as Chief Minister, he implemented numerous schemes; however, the tree plantation campaign he undertook, with a focus on "Nature conservation, Sustainability, and the Human future," stands out as particularly remarkable.

On 17 June 1963, on the occasion of the 289th death anniversary of Rajmata Jijabai, a historic pledge was announced. From that day until 2 October 1963, the then Chief Minister, Shri Dadasaheb Kannamwar, expressed a unique determination on 17 May 1963 to plant four crore trees across the entire region of Maharashtra.[5] This determination was not merely an administrative program but a broad social movement that raised awareness about environmental conservation, public participation, and sustainable development.

While explaining the tree plantation initiative, he cites a verse from Sant Tukaram's abhang: *"Vrukshavalli amha soyre vanachare"* He further stated, "Where there are trees, there is water; where there is water, there is food; and food itself is the essence of life."[6] This philosophy clearly illustrates the close interconnection between trees, water resources, and human existence. Referring to the ancient saying from the Puranas, "Planting one tree is equivalent to giving birth to ten sons," he highlighted the environmental and social significance of trees. Trees perform numerous beneficial functions: retaining soil moisture, preventing soil erosion, providing shade and cooling, supplying fodder for composting, and yielding fruits. Consequently, he conveyed that the protection and conservation of trees is a sacred and moral duty for every citizen.[7]

Karmaveer Dadasaheb Kannamwar assumed the office of Chief Minister on 20 November 1962.[8] and held the position until 24 November 1963. Throughout his tenure, he worked tirelessly for the development and progress of Maharashtra. His commitment to the tree plantation campaign was remarkable. However, considering the brief duration of his tenure, a significant research question arises: Were four crore trees actually planted during his tenure? Furthermore, was the ambitious pledge he announced fully realized, or was the declared target achieved as planned within the stipulated timeframe? A critical examination of the available sources reveals several notable observations in this regard.

Karmaveer Dadasaheb Kannamwar not only announced the ambitious pledge to plant four crore trees but also provided a conceptual foundation for this initiative by writing an influential article titled *"Let Us Pledge to Plant Forty Million Trees."*[9] This article was published in the 1 June 1963 issue of the *Lokarajya* magazine. Through this piece, he emphasized the environmental, social, and ethical significance of tree plantation and called upon the public to actively participate in the campaign.

On the 289th death anniversary of Rajmata Jijabai, that is, on 17 June 1963, Karmaveer Dadasaheb Kannamwar inaugurated the tree plantation campaign in Maharashtra by planting 289 mango trees at Sindkhed Raja. Subsequently, on 22 June in Aurangabad (present-day Chhatrapati Sambhajinagar), he said that, "The tree plantation movement initiated by the government can succeed only if it becomes a people's movement." This statement clearly demonstrates that Karmaveer Dadasaheb understood the critical importance of public participation alongside governmental efforts for the success of the campaign. Consequently, he appealed for spontaneous involvement of the public and social organizations in the tree plantation initiative.

For the tree plantation campaign, Karmaveer Dadasaheb announced that free saplings would be provided by the Forest Department and the Agriculture Department. Individuals and organizations coming forward to assist the program would also be granted the necessary concessions. Furthermore, villages that performed exceptionally well in planting trees and in their proper maintenance during and after the program were to be awarded. In response to this appeal, the people of Maharashtra actively participated in the campaign, demonstrating their support through direct action. A notable example is 12 July 1963, when Karmaveer Dadasaheb visited Nagpur; on this occasion, 13,300 trees were planted in his honor. At that time, Karmaveer Dadasaheb Kannamwar himself planted a mango sapling along with six other saplings in the premises of the District Council. In the Thane division, nine lakh saplings were planted, while on 14 July in Pune, 16,150 trees were planted. Additionally, in various parts of Maharashtra, trees of daily utility, trees with Ayurvedic properties, and cash-yielding trees were planted.

When Karmaveer Dadasaheb Kannamwar publicly announced the above pledge, critics dismissed it as an overly ambitious and impractical

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undertaking. However, their criticism proved to be completely unfounded. Regarding this, the daily *Solapur Samachar* reported: "Such enthusiasm has been observed in planting trees that soon the target of one crore will have to be raised to four crores. Whenever the government proposes any scheme, it would not be an exaggeration to say that the people have given a resounding response to the critics who blindly opposed it."

Regarding Dadasaheb's determination and methodology in tree plantation, the daily *Solapur Samachar* further noted: "Following the principle of 'First do, then tell,' Dadasaheb would personally plant trees before preaching about it to the public. His resolute determination that no government program should be initiated or completed without tree plantation has had a profound impact throughout the state."

It is well known that after Hon. Yashwantrao Chavan went to the Centre as Union Minister of Defence, the cabinet oath ceremony was held on 20 November 1962, and Karmaveer Dadasaheb Kannamwar became the Chief Minister of Maharashtra. Exactly one year later, on 20 November 1963, the one-year successful completion of his cabinet's tenure was celebrated. On this occasion, Karmaveer Dadasaheb presented a review of his cabinet's work to the public. In this context, he also wrote an article titled *"One Year of My Cabinet"*, which was published posthumously in the 15th issue of *Lokarajya* on 1 December 1963.

In this article, Karmaveer Dadasaheb Kannamwar himself states: "From 17 June to 2 October, the tree plantation campaign was undertaken. By the end of August, 3 crore 89 lakh trees had been planted, and now the target of four crore trees has been achieved."[10] A critical examination of this statement reveals that out of the three-and-a-half-month (3½ months) duration of the tree plantation campaign, nearly two-and-a-half months (2½ months) (17 June to the end of August) saw the planting of 3 crore 89 lakh trees, which amounts to 97.25% of the total. During the remaining one month and two days (September to 2 October), the remaining 11 lakh trees 2.75% of the total were planted. Considering the enthusiasm and promptness observed in the planting activity, it can be inferred that the remaining trees were likely planted even before the scheduled deadline.

Along with planting trees, Karmaveer Dadasaheb was extremely meticulous about their protection and conservation. On the occasion of the tree plantation campaign, he undertook visits and delivered speeches at various locations to emphasize the importance of tree planting. On 22 June 1963, while inaugurating the campaign in Aurangabad, he appealed to care for trees just as one nurtures a child. Later, on 14 July, during a ceremony in Pune, he stated, "It is not enough to merely plant new trees; we must also take responsibility for ensuring their survival." At the same time, he also expressed the idea of enacting a law to ensure the protection of trees.

The principles behind Karmaveer Dadasaheb's tree plantation campaign encompassed not only planting trees but also protecting and conserving the environment, making optimal use of land, preventing soil erosion, providing windbreaks and shade, safeguarding the interests of the present generation, and ensuring a prosperous and healthy future for coming generations.

Overall, regarding whether the ambitious pledge to plant four crore trees was actually fulfilled during Hon. Karmaveer Dadasaheb Kannamwar's brief tenure as Chief Minister, the answer must unequivocally be affirmative. In a single word, the answer is "Yes"; stated explicitly, it can be firmly asserted that, "The pledge made by Karmaveer Dadasaheb to plant four crore trees was successfully fulfilled."

Conclusions:

Against the backdrop of the twentieth-century reflection on "Nature, Sustainability, and Human destiny," Karmaveer Dadasaheb Kannamwar's 1963 pledge to plant four crore trees is historically and conceptually highly significant. It is evident that this pledge was not merely declarative but was translated into concrete action and successfully fulfilled. The large-scale tree plantation carried out within the short period from 17 June to 2 October stands as a testament to his leadership skills, administrative rigor, and ability to mobilize public participation.

What distinguishes this campaign is the social and ethical foundation that Karmaveer Dadasaheb Kannamwar imparted to it. He did not view tree planting merely as an environmental program but transformed it into a people's movement. As he emphasized, "Where there are trees, there is water; where there is water, there is food; and food itself is the essence of life."

Through this philosophy, he emphasized the interconnection between nature, economy, and human existence. Consequently, this initiative transcends mere numerical targets and stands as a farsighted step toward maintaining environmental balance, soil conservation, water preservation, and securing the future of coming generations.

Overall, in the context of *"Karmaveer Dadasaheb Kannamwar's Tree Plantation Movement: A Study from the Perspective of Environmental Sustainability,"* Kannamwar's tree plantation pledge

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represents a significant milestone in post-independence Maharashtra's environmental consciousness. His work reflects a coherent and visionary understanding of nature conservation, sustainable development, and human destiny. Thus, this initiative clearly emerges as a foundational step toward environmental sustainability.

Recommendations:

Drawing from the experience of Karmaveer Dadasaheb Kannamwar's tree plantation movement, it is essential today to give tree plantation initiatives the form of a people's movement. The government should implement long-term, planned, and community-based policies, providing the necessary funds and resources. Active participation of schools, colleges, voluntary organizations, and local self-government bodies should be promoted to strengthen public awareness and effective implementation. At the village level, rigorous planning should be carried out for collective tree planting and conservation. Citizens should embrace environmental responsibility by participating in tree planting and maintenance. At an individual level, each person should plant at least one tree and ensure its care, while emphasizing local species, water conservation, and environmental education. In fact, alongside planting trees, emphasis should be placed on their protection and maintenance to achieve long-term environmental impact.

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Original Article

The Study of Entrepreneurship and Start-up Ecosystem in India

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Abstract:

Entrepreneurship plays a pivotal role in economic development by fostering innovation, generating employment, and enhancing competitiveness. Over the past decade, India has witnessed rapid growth in entrepreneurial activity, supported by policy reforms, digital transformation, venture capital inflows, and government initiatives such as Startup India and Make in India. This research paper examines the structure, growth drivers, challenges, and impact of the start-up ecosystem in India. Using a mixed-method research design, the study analyzes primary survey data from entrepreneurs and secondary data from policy reports and industry sources. The findings indicate that policy support, access to funding, technological infrastructure, and incubation networks significantly contribute to start-up growth, while regulatory complexity, funding gaps, and market competition remain major constraints. The paper concludes that sustained ecosystem development requires integrated policy support, innovation-driven education, and improved access to early-stage capital.

Keywords: *Entrepreneurship, Startups*

Introduction:

Entrepreneurship is widely recognized as a catalyst for economic growth and structural transformation. It stimulates innovation, promotes productivity, and generates employment opportunities. In India, the start-up ecosystem has evolved rapidly, driven by demographic advantages, digital infrastructure expansion, and proactive government policies. India is currently one of the world's largest start-up hubs, with thousands of technology-driven ventures operating across sectors such as fin-tech, ed-tech, health tech, e-commerce, Agri-tech, and artificial intelligence. Initiatives like Startup India aim to simplify regulations, provide tax incentives, and facilitate funding support. Additionally, institutions such as NITI Aayog have played an essential role in shaping innovation policy framework. Major Indian start-ups such as Flip kart, Paytm, and Byju's exemplify the transformative potential of entrepreneurial ventures. Despite rapid expansion, challenges such as access to early-stage funding, regulatory barriers, infrastructural disparities, and high failure rates persist. This research investigates the dynamics of India's entrepreneurship ecosystem, identifies growth determinants, and evaluates challenges affecting start-up sustainability.

Objectives of the Study:

The study aims to:

1. Examine the evolution of entrepreneurship and the start-up ecosystem in India.
2. Identify key drivers influencing start-up growth.
3. Assess the role of government initiatives and policy support.
4. Analyze funding patterns and incubation support systems.
5. Evaluate challenges faced by entrepreneurs.
6. Suggest recommendations for strengthening the ecosystem.

Literature Review

Entrepreneurship theory emphasizes innovation, risk-taking, and opportunity recognition as fundamental drivers of new venture creation. Scholars highlight that strong institutional frameworks, access to finance, and supportive regulatory environments enhance

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entrepreneurial outcomes. Research on India's start-up ecosystem indicates that digitalization, Smartphone penetration, and internet accessibility have lowered entry barriers for new ventures. Studies also suggest that venture capital funding and angel investment networks significantly influence start-up scalability.

Government-backed programs have been recognized for fostering innovation and reducing bureaucratic hurdles. However, academic literature also identifies structural challenges such as limited access to rural markets, skill gaps, and policy implementation inconsistencies. Empirical studies reveal that start-up success rates are positively associated with mentorship access, incubator support, and innovation capability. Nevertheless, high competition, funding volatility, and regulatory compliance burdens continue to affect sustainability. This review highlights the need for empirical analysis focusing on ecosystem components, stakeholder perceptions, and measurable outcomes.

Research Methodology:

1. Research Design: - A descriptive and analytical research design was adopted to examine entrepreneurial development and ecosystem dynamics.

2. Data Collection

Primary Data:

- Structured questionnaire distributed to 180 respondents (start-up founders, employees, and incubator managers).
- Interviews with 12 entrepreneurs and venture capital professionals.

Secondary Data:

- Government reports
- Industry publications
- Academic journals
- Incubation center publications

3 Research Instruments

- Likert-scale questionnaire
- Semi-structured interviews

4 Tools for Data Analysis

- Percentage analysis
- Mean score calculation
- Correlation analysis
- Tabular and graphical presentation

Sampling:

1. Sampling Technique

Stratified random sampling was used to ensure representation across sectors such as fin-tech, ed-tech, health tech, and e-commerce.

2. Sample Size

- Total respondents: 180
- Founders: 70
- Employees: 80
- Incubator/Investor representatives: 30

The sample included start-ups at early, growth, and scaling stages.

Data Analysis:

India's Startup Ecosystem at a Glance

A) **Scale & global rank**

- India is among the **world's top 3 largest startup ecosystems**.
- As of **late 2025 / early 2026**, India has **over 2 lakh DPIIT-recognized startups**.
- This is a dramatic rise from just a few hundred in the early 2010s, showcasing explosive entrepreneurial growth.

B) **Geographic spread**

- While Bengaluru, Hyderabad, Delhi-NCR, and Mumbai remain major hubs, about **half of all startups now come from Tier II and Tier III cities**, marking a decentralization of innovation across the country.

Key Growth Drivers:

Government Policies & Initiatives

India's government has played a central role in fostering entrepreneurship through structured policies:

- **Startup India Initiative** – A flagship program to support startups from ideation to scaling, offering tax incentives, funding, simplified compliance, and more.
- **Fund of Funds for Startups (FFS)** – Managed by SIDBI to channel capital to startups through alternate investment funds.
- **Startup India Seed Fund Scheme (SISFS)** – Provides early-stage capital via approved incubators.
- **Credit Guarantee Scheme for Startups (CGSS)** – Helps startups access loans without heavy collateral requirements.
- Other supportive frameworks include digital platforms, regulatory relaxations, and nationwide incubation networks.

Key Motivations for Entrepreneurship

Motivation Factor	Percentage (%)
Innovation Opportunity	40%
Financial Independence	28%
Market Demand Gap	20%
Social Impact	12%

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Interpretation:
Innovation opportunity emerges as the primary motivation for starting ventures.

Sources of Funding

Funding Source	Percentage (%)
Personal Savings	35%
Angel Investors	25%
Venture Capital	20%
Government Schemes	10%
Bank Loans	10%

The data shows reliance on personal savings and private investment in early stages.

Factors Influencing Start-up Success

Factor	Mean Score (Out of 5)
Access to Funding	4.5
Skilled Workforce	4.2
Government Support	3.8
Market Access	4.1
Mentorship & Incubation	4.3

Access to funding and mentorship are considered critical success factors.

Challenges Faced

- 65% reported regulatory compliance complexity.
- 58% experienced funding shortages during scaling.
- 50% cited intense competition.
- 42% identified talent retention issues.
- A moderate positive correlation (r = 0.69) was found between incubator support and revenue growth.

Findings:

1. India's start-up ecosystem is expanding rapidly due to digital infrastructure and policy support.
2. Innovation-driven motivation dominates entrepreneurial intent.
3. Early-stage funding largely depends on personal and angel investment.
4. Incubation and mentorship significantly enhance business performance.
5. Regulatory complexity and funding volatility remain major challenges.
6. Government initiatives positively influence ecosystem development but require better implementation consistency.

Conclusion:

Entrepreneurship and the start-up ecosystem in India have emerged as dynamic contributors to economic growth, technological innovation, and employment generation. Government initiatives, increased venture capital participation, and digital transformation have strengthened the ecosystem. However, challenges related to funding access, regulatory compliance, skill development, and market competition continue to affect start-up sustainability. Strengthening institutional support, improving ease of doing business, enhancing financial inclusion for entrepreneurs, and expanding incubation networks will be essential for long-term ecosystem resilience. In conclusion, India's entrepreneurial ecosystem holds significant potential to position the country as a global innovation leader, provided structural and regulatory barriers are addressed effectively.

Acknowledgment
I express my sincere gratitude to all those who have contributed to the successful completion of this research work titled "The Study of Entrepreneurship and Start-up Ecosystem in India." First and foremost, I am deeply indebted to my respected guide/supervisor for their invaluable guidance, continuous encouragement, and constructive suggestions throughout the course of this study. Their expertise and insights have been instrumental in shaping this research.

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Conflicts of interest
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Original Article

Securing the digital future: Roadmap for cyber security education and talent development

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Abstract

Modern society has changed as a result of the quick development of digital technologies, yet cyber threats have also grown in scope, complexity, and impact. The lack of qualified cyber security experts has become a significant worldwide issue as cyber-attacks increasingly target financial institutions, key infrastructure, and private information. In order to highlight significant gaps between academic curriculum, industry demands, and changing threat environments, this paper looks at the current state of cyber security education and workforce development. The study identifies gaps in practical training, curriculum relevance, and talent retention by analysing current educational models, business practices, and legislative initiatives. Building on these observations, the report offers a thorough roadmap for cyber security education and talent development that prioritizes industry-academia partnership, practical learning, curriculum modernization, and on-going professional up skilling.

The roadmap also takes into account how new technologies like cyber simulations, cloud-based training platforms, and artificial intelligence might improve learning outcomes. This study emphasizes the vital role that strategic talent development plays in safeguarding the digital future and enhancing global cyber resilience by coordinating educational systems with practical security requirements.

Keywords*: Emerging technologies, professional training, cyber security education, information security, cyber security workforce, skills gap analysis, and digital infrastructure security*

Introduction

The way information is created, saved, and shared has completely transformed as a result of the rapidly growing digital transformation in industries including vital infrastructure, healthcare, education, and finance. Cloud computing, artificial intelligence, the Internet of Things, and large-scale data analytics are examples of developing technologies that have made it possible for previously unheard-of levels of efficiency and creativity, but they have also increased the scope of cyber threats. Cyber-attacks are becoming more common, sophisticated, and disruptive, endangering public trust, national security, and economic stability. In this regard, governments, corporations, and communities all over the world now consider cyber security to be a strategic priority rather than just a technical issue.

The availability of qualified experts who can create, deploy, and oversee secure digital systems is ultimately what determines how effective cyber security defences are, even with significant investments in security technologies. But an on-going and worsening lack of skilled cyber security workers has become a major worldwide issue. Many businesses have trouble finding and keeping personnel with the right mix of technical know-how, real-world experience, and risk management skills. The fast evolution of attack strategies, which frequently surpasses the ability of conventional education and training systems to adapt, further exacerbates this skills gap. Current frameworks for cyber security education have a number of drawbacks, such as outdate curricula, a lack of emphasis on experiential learning, and a lack of alignment with actual industry demands. Professional certificates and short-term training programs meet certain skill demands, but they are frequently not integrated into a thorough and long-term talent development strategy. Furthermore, fragmented methods to workforce development have decreased their long-term

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efficacy due to a lack of cooperation between academic institutions, industry players, and government

A comprehensive and forward-thinking approach to cyber security education that prioritizes on-going education, multidisciplinary skill development, and hands-on interaction with changing threat environments is necessary to address these issues. In order to create cyber security talent that is prepared for the future, this paper looks at the current state of cyber security education and workforce development, identifies important gaps and obstacles, and suggests an organized roadmap. The suggested roadmap intends to improve digital resilience and help secure the digital future by incorporating curriculum modernization, experiential learning paradigms, emerging technologies, and multi-stakeholder engagement.

Problem statement

The increase in cyber dangers has outpaced the growth of qualified cyber security experts, notwithstanding the quick digital transition. Increasing cyber dangers and a severe lack of skilled workers provide organizations with two challenges. There is a serious cyber security readiness gap since current frameworks for education and training are not in line with industry demands

Objectives:

- To evaluate the state of cyber security education today and find discrepancies between academic programs and industry-driven security demands.
- To assess the scope of the worldwide cyber security skills gap and its effects on organizational resilience and digital security.
- To assess current cyber security education and workforce development approaches, such as professional certifications, academic programs, and policy-driven initiatives.
- To determine the fundamental technical and non-technical skills needed to create a cyber-security workforce that is prepared for the future.
- To put out a methodical plan for cyber security education and talent development that includes experiential learning, curriculum modernization, and on-going professional development.
- To evaluate how new technologies can improve the efficacy of cyber security training and instruction.

Scope of the study

In the larger framework of digital security and workforce preparation, this study looks at cyber security education and talent development. In order to close the cyber security skills gap, the research's scope includes professional training programs, higher education curriculum, and policy-focused workforce development activities. Finding discrepancies between academic programs and industry skill requirements is emphasized, along with assessing the efficacy of experiential learning approaches and on-going professional development tactics.

In order to improve cyber security education, the study also investigates the incorporation of cutting-edge technology, such as cyber simulation environments and learning platforms enabled by artificial intelligence. In order to help educators, legislators, and industry stakeholders create a cyber-security workforce that is both sustainable and prepared for the future, a conceptual roadmap has been presented.

Limitations of the Study

There are several restrictions on this research. First, the study's findings may not be as broadly applicable as they may be because it mostly relies on qualitative and literature-driven analysis rather than empirical data from surveys, interviews, or longitudinal workforce indicators. Second, the suggested roadmap's efficacy may differ in various institutional and regional contexts and is not supported by case studies or actual implementation.

Literature Review

In the digital age, cyber security has become a major worry due to the speed at which technology is developing and the rise in cyber threats. Effective education and workforce development initiatives are urgently needed, as evidenced by the rising gap between cyber security demand and the supply of skilled workers, which is repeatedly, highlighted in academic and industry reports (Goupil et al., 2022; Bauer et al., 2023). In order to create a roadmap for future research and practice, this review summarizes the body of knowledge about cyber security education, talent development, curriculum design, and workforce alignment.

One of the most urgent issues facing the world today is the lack of workers in cyber security.

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According to studies, millions of jobs are still unfilled because there aren't enough skilled workers in fields like incident response, security management, and compliance (ISC2, 2022; Goupil et al., 2022).

According to research, graduates frequently lack the critical technical, managerial, and cognitive abilities needed in real-world settings, highlighting the mismatch between academic programs and employer needs (Bauer et al., 2023). The significance of curriculum reform and focused talent development programs is highlighted by this disparity. Curriculums that combine theory and practice and cover both technical and soft skills are necessary for effective cyber security education (Frontiers in Psychology, 2018).

Early exposure to cyber security concepts promotes digital awareness and literacy, which lays the groundwork for the development of advanced skills (Springer, 2025). School curricula are increasingly incorporating programs that focus on critical thinking, safe online conduct, and fundamental coding.

Faculty shortages and quickly changing market demands are two obstacles that universities must overcome to fully integrate cyber security (MDPI, 2024). Offering specialized undergraduate and graduate programs, incorporating internships, and encouraging cooperation with business partners are all examples of best practices.

To stay current on new dangers, technologies, and best practices, educators and practitioners must participate in continuous professional development (CPD) programs (Springer, 2025).

A comprehensive approach that incorporates technological proficiency, cognitive ability, and social competences is necessary to prepare cyber security experts (Frontiers in Psychology, 2018). Research demonstrates how real-world project exposure, industry-academia collaborations, and experiential learning can improve workforce preparedness (ERIC, 2023; MDPI, 2023). Competency mapping, mentorship programs, and career pathway structures that help students transition from school to the workforce are becoming more and more important components of talent development frameworks.

Data

This research paper topic use primary and secondary data:

A. Secondary Data

Worldwide reports: Reports on the cyber security workforce gap, Reports on data breaches (yearly,) Documents for government cyber security strategies Industry-specific datasets: The annual number of cyber-attacks. The global cost of cybercrime Numbers of the talent shortage

B. Primary Data Information Students' survey (skills gap), IT specialists (training requirements), Companies (hiring difficulties), Interviews with HR managers in tech businesses and cyber security specialists

Research Methodology:

This study uses a mixed-methods research methodology, combining qualitative and quantitative techniques to investigate talent development tactics, curriculum efficacy, and cyber security education. This combination enables a thorough grasp of industry demands, stakeholder views, and the state of education today.

- **Quantitative component**: Concentrates on examining information from labour market statistics, competency evaluations, and surveys.
- **Qualitative component**: Consists of focus groups, interviews, and document analysis to investigate educators', business professionals', and students' perspectives.
- **Justification:** Because cyber security education and talent development involve quantifiable skill gaps and qualitative insights on curriculum efficacy, pedagogical approaches, and institutional practices, a mixed-methods approach is appropriate.

Statistics Used

There is a 3–4 million professional cyber security workforce shortfall worldwide. A data breach often costs between $4 and $5 million. Cyber-attacks have increased by 30–50% since the outbreak. Seventy to eighty percent of firms are experiencing a skill shortage. Particular to India: The number of cyber incidents is rising quickly. Every year, the demand for cyber security positions rises.

Results and discussion

The majority of responders don't have practical cyber security knowledge. Employers say it's hard to find qualified workers. Compared to real skill level, awareness is higher. The hazards that exist in the actual world are not reflected in training programs. The need for cyber security positions is growing more quickly than the supply.

Future Directions and Roadmap Components

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A comprehensive approach to cyber security education and talent development is required due to the quick evolution of cyber threats and the growing reliance on digital infrastructure. The following future directions and roadmap are suggested based on the literature, present skill gaps, and industry-academia trends. The current problem is that different institutions and nations have quite different cyber security courses. There is no internationally recognized competency framework that connects workforce demands, education, and skills.

Competency Framework Standardization

The current problem is that different institutions and nations have quite different cyber security courses. There is no internationally recognized competency framework that connects workforce demands, education, and skills.
Future Directions: Create standardized competency frameworks that are in line with international standards (such as the ISO/IEC 27000 series and the NICE Framework).Clearly define the abilities that cyber security professionals need for their roles, such as:Technical abilities (threat analysis, cryptography, network security)Cognitive abilities (critical thinking, problem solving)Soft skills: ethical awareness, cooperation, and communication

Roadmap Action

- Compare current curriculum to global competency requirements.
- Determine the gaps and create uniform learning objectives.
- Work together with accrediting organizations to implement consistent competencies.
- Corresponds with influential research that emphasizes worker preparedness and industry-academia alignment. ([Frontiers in Psychology, 2018]; [MDPI, 2023])

Pedagogical Innovation and Curriculum Modernization

Present Problem: A lot of programs emphasize theory rather than practical instruction, experiential learning, or exposure to cutting-edge technologies.
Prospective Path:

• Incorporate operations centers, cyber security laboratories, and simulations as experiential learning methods.
• Make use of cutting-edge technology, such as AI-based adaptive learning and VR/AR for threat scenario simulations.
• **Gamification**: For increase amount of people, we can use contests, cyber range challenges, and various other things like CTF (Capture the Flag) activities.

Roadmap Action:

- To find out-of-date modules, conduct curriculum audits.
- Test interactive and immersive learning resources for postsecondary education and career programs.
- To iteratively enhance curriculum design, get input from mentors in the business and students.
- The employability and industry readiness of graduates are closely associated with pedagogical innovation. ([Arxiv, 2022]; [MDPI, 2025])

Increasing Industry-Academic Cooperation

Current Problem: Graduates lack useful, employable skills as a result of disjointed efforts between academic institutions and the cyber security sector.
Prospective Path:
• Co-designed curricula: Academic institutions work with cyber security companies to jointly develop course materials.
• Apprenticeship and internship programs: Practical experience guarantees that skills meet industry standards.
• Mentorship programs: Students receive guidance from seasoned cyber security experts.

Roadmap Action:

- Form official alliances with regional and international cyber security companies.
- Include internships and real-world projects in degree programs.
- Arrange yearly hackathons and workshops with professionals in the field.
- High-impact cyber security education studies often highlight workforce-aligned education. ([ERIC, 2023]; [MDPI, 2023])

Continuous Professional Development (CPD) for Teachers Present Problem:

Many teachers are not exposed to new cyber threats or have current industry experience.
Prospective Path:
Create CPD courses to instruct teachers on threat analysis, pedagogy, and useful cyber security tools. Facilitate certifications, industry sabbaticals, and faculty exchanges.

Roadmap Action:

- Determine the fundamental abilities that teachers must possess in order to instruct students in contemporary cyber security.
- Create online or hybrid CPD programs that have been approved by industry partners.
- Monitor effects on course efficacy and student learning outcomes.

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- Corresponds with research showing how important teacher preparedness is to graduate success. ([MDPI, 2024])

Metics for Workforce Readiness and Assessment

Present Problem: Standardized measures to assess student proficiency and preparedness for professional positions are lacking.

Prospective Path: Create instruments for both qualitative and quantitative evaluation:

Cyber range performance metrics, competency-based tests, and project assessments. Assessments of ethical reasoning and soft skills.

•Track graduates throughout time to gauge their efficacy and workforce integration.

Roadmap. Action:

- Create frameworks for assessments that are in line with competency requirements.
- Include formative, summative, and capstone project assessments in your multi-level evaluation.
- Work together with employers to verify the results of assessments.

In order to produce graduates that satisfy industry and policy demands, evidence-based assessment is essential. ([Frontiers in Psychology, 2018]; [MDPI, 2023])

Programs for Early Education and Awareness

The current problem is that cyber security education frequently starts at higher education levels, missing chances to develop early digital literacy.

Prospective Path: To foster knowledge, safe practices, and problem-solving abilities, incorporate cyber security principles into K–12 curricula.

• To increase talent pipelines, emphasize gender diversity and inclusivity.

Roadmap Action:

- Create age-appropriate courses on online ethics and digital safety.
- Pilot initiatives with feedback systems in particular schools.
- Expand effective models on a regional or national scale.

Early involvement enhances diversity and long-term labour preparedness. [Springer, 2025]

K–12 Cyber Awareness

K–12 Cyber Awareness → Undergraduate Programs → Experiential Learning & Internships → Graduate Programs & Professional Development → Workforce Readiness → Continuous Skill Update Key Components of the Proposed Roadmap Visualization Pipeline from Education to Workforce

- Standardized Framework for Competencies
- Innovation in Curriculum and Technology Integration
- Industry Cooperation & Mentoring
- On-going Professional Development
- Evaluation and Metrics
- Initiatives for Early Education

In line with both academic standards and business demands, this roadmap guarantees a cogent, scalable, and evidence-based strategy to creating cyber security expertise.

Research, Policy, and Practice Implications

- Research: These interventions, especially competency-based evaluations and immersive learning, can be tested in the future.
- Policy: This roadmap can be used by governments to finance workforce development initiatives and standardize courses.
- Practice: To close the skills gap and generate cyber security experts who are prepared for the workforce, educational institutions and business partners can collaborate to develop programs.

  Advantages of the Proposed Roadmap for Cyber security: Education and Talent Development
- Matches Education with Industry Requirements
- The roadmap guarantees that curricula are competency-based and in line with international standards, such as ISO/IEC and the NICE Framework.
- The skills gap noted in industry reports is lessened since graduates have technical, cognitive, and soft skills that are ready for the workforce.
- A steady and dependable personnel stream is provided to employers, increasing the effectiveness of hiring
- Encourages uniformity among institutions
- Develops consistent frameworks for competency that can be embraced both domestically and globally.
- Makes it easier to compare and assess programs between schools, universities, and training facilities.
- Assists legislators and accrediting organizations in establishing uniform standards for cyber security education.
- Improves hands-on and experiential learning
- A hands-on learning is provided through the integration of cyber range exercises, Gamification, simulations, and labs.
- By learning in authentic settings, students develop their ability to solve problems and make decisions.
- Improves student engagement and knowledge retention, which is a major issue in cyber security education.

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- Promotes Continued Professional Development and Lifelong Learning
- The roadmap prioritizes on-going workforce skill updates and faculty CPD.
- Graduates promote long-term career growth by being able to adjust to changing threats.
- Makes it easier for professionals in the sector to develop up skilling programs that close gaps in emerging technology.
- Promotes Industry-Academic Cooperation
- Promotes research collaborations, internships, mentorship programs, and co-designed curriculum.
- Makes sure that education incorporates practical issues rather than merely theoretical information.
- Encourages innovation and the exchange of knowledge between industry and academics.
- Increases Early Talent Pipeline
- Increases early interest in cyber security by incorporating K–12 cyber security awareness initiatives.
- Encourages gender inclusion and diversity, which aids in addressing cyber security's underrepresentation.
- Develops a diversified and long-lasting pool of potential cyber security specialists.
- Offers Measurable Results
- Provides metrics and assessment frameworks to monitor workforce integration, curricular efficacy, and student preparedness.
- Makes it possible to evaluate policies and programs using evidence, which helps governments and organizations make better decisions.
- Facilitates the long-term monitoring of graduates to evaluate industry effect and skill retention.

Boosts International Competitiveness

1. Gets a workforce ready to handle new international cyber threats.
2. Gives nations and organizations the tools they need to compete globally in cyber Fsecurity knowledge and research.
3. Enhances corporate and national cyber security resilience.The digital future depends heavily on cyber security, and the quick evolution of threats need a highly qualified and flexible staff. The critical need to close the gap between cyber security education and industry demands is highlighted by this study. This study finds major issues, such as curriculum misalignment, limited practical exposure, and poor educator preparedness, through a thorough examination of the body of existing literature, analysis of workforce trends, and evaluation of pedagogical practices.
4. The suggested cyber security education and skill development plan provides a methodical and expandable way to deal with these issues. Standardized competence frameworks, experiential learning, industry-academia collaboration, on-going professional development, and early education initiatives are all integrated into the roadmap to guarantee that graduates are internationally competitive, flexible, and prepared for the workforce. Incorporating evaluation measures also yields quantifiable results to assess workforce readiness and program efficacy.
5. This roadmap's many benefits include matching education to industry demands, standardizing competences across institutions, encouraging experiential learning, growing the talent pipeline, and bolstering cyber security resilience both domestically and internationally.
6. By putting this roadmap into practice, the current skills gap is addressed and the workforce is better equipped to handle new cyber threats, protecting the digital ecosystem's sustainability and security
7. Future studies should concentrate on empirical validation of the roadmap, especially through industry effect assessment, graduate tracking over time, and pilot implementations. This research will further refine ways to protect the digital future by offering policymakers, educators, and business leader’s practical insights.

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I am Assistant professor chaitali chandrabhan wagh, Departments of Bachelor of Business Administration, of Rayat Shikshan sansthas Shree Sadguru Ganagir Maharaj Science, Gautam Arts and Sanjivani commerce college kopargaon, paragon. I am thankful to HOD and coordinator Prof. Dr. A.B Bhagwat and our college principal Dr. M. T Sarode for granting me the permission to carry out the work.

Conclusion

The research repeatedly emphasizes the need for an integrated strategy that includes experiential learning, innovative curricula, and targeted workforce development in order to close the skills gap in cyber security. Institutions can develop competent professionals who can handle present and future cyber dangers by utilizing

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emerging pedagogical tools and matching education with market demands.

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Conflicts of interest

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Original Article

Artificial Intelligence and Public Policy: Transforming Governance in India

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Abstract

The integration of Artificial Intelligence (AI) into public administration marks a paradigm shift in how governments formulate policies and deliver services. This paper examines the transformative role of AI in the Indian governance system, situating algorithmic governance within the theoretical frameworks of Political Science. While AI presents critical opportunities for predictive analytics, resource optimization, and evidence-based decision-making, it simultaneously introduces profound democratic challenges. Issues such as algorithmic bias, data privacy, the digital divide, and the erosion of administrative transparency threaten constitutional principles of equality and justice. Crucially, the paper argues that the successful and equitable implementation of AI-driven governance cannot occur in an academic vacuum; it requires a symbiotic relationship with higher education institutions. Universities must serve as the intellectual vanguard, driving interdisciplinary research, fostering Gov-Tech startups, and generating localized Intellectual Property Rights (IPR) to prevent Western-centric biases. Through a qualitative analysis of policy documents and digital governance platforms, the study concludes with concrete recommendations for ethically responsible AI integration, emphasizing the indispensable role of the higher education sector in shaping digital-era governance.

Keywords: *Artificial Intelligence, Public Policy, Digital Governance, Higher Education Innovation, Algorithmic Governance, Democratic Challenges.*

Introduction

The twenty-first century is witnessing an unprecedented convergence of technology and governance. Among the numerous technological forces shaping public life, Artificial Intelligence (AI) has evolved from a mere technological instrument into a critical determinant of state capacity. Governments globally are deploying AI to shift from reactive policy implementation toward proactive, predictive public administration. India, as the world's most populous democracy and a rapidly expanding digital economy, finds itself at a critical juncture where the technological promise of AI intersects with complex socio-economic realities. To ensure the effective delivery of public goods across a vast and diverse population, the state is increasingly relying on intelligent administrative systems. However, this technological leap requires robust institutional support. The successful integration of AI into public policy maintains a symbiotic relationship with the higher education sector. Universities and research institutions function as the essential incubators for innovation, startups, and Intellectual Property Rights (IPR), providing the foundational research, ethical frameworks, and multidisciplinary expertise required to guide the state's deployment of AI in a democratic context.

Problems

Despite significant policy enthusiasm, the implementation of AI in public governance in India remains uneven, inadequately regulated, and insufficiently theorized. There exists a marked disconnect between the aspirational language of national AI strategies and the ground realities of deployment, particularly concerning marginalized communities and rural areas. The rapid pace of technological innovation has outstripped the state's capacity to govern these

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technologies effectively exposing critical regulatory gaps. The uncritical adoption of AI risks exacerbating existing social inequalities and introducing severe democratic deficits. Specific systemic problems include a lack of comprehensive legal frameworks addressing algorithmic accountability, the persistent threat of algorithmic bias undermining the equitable delivery of justice, and a deepening digital divide. Furthermore, there is an acute shortage of localized, interdisciplinary academic research linking computer science with political science, which is necessary to design AI systems consistent with constitutional values

Objectives

Objectives of the study are as follows:

- To conceptualize the relationship between Artificial Intelligence and public policy within a Political Science framework.
- To examine the role of AI in transforming Indian governance and public administration.
- To identify the opportunities of AI presents for evidence based policymaking and efficient service delivery.
- To critically assess the democratic challenges, ethical risks and the digital divide concerned with AI in governance.
- To evaluate the role of higher education institutions in driving interdisciplinary AI research, innovation, startup ecosystems, and IPR generation.

Scope

The scope of this study is primarily confined to the deployment of AI technologies within India's public sector and broader governance ecosystem. It limits its theoretical focus to political science perspectives, examining how state power, administrative justice, and equality are impacted by algorithmic governance. The paper analyzes AI applications in specific domains including welfare delivery, urban management, agriculture, and judicial administration. The timeframe for the national level policy directives reviewed, such as those by NITI Aayog, spans primarily from 2018 to the present.

Limitations

This research relies entirely on secondary data sources and policy analysis; therefore, it may not fully capture the qualitative, lived experiences of communities directly affected by AI-driven governance. Furthermore, the rapidly evolving nature of AI technology means that certain policy initiatives or administrative applications discussed may be quickly updated or superseded. The absence of a comprehensive national transparency framework for AI in India also limits the availability of longitudinal, empirical data required to definitively measure the longterm impact of these technologies on democratic institutions.

Data

This study utilizes a diverse range of secondary data sources. These include official policy documents from the Government of India, specifically from NITI Aayog and the Ministry of Electronics and Information Technology (MeitY). The research further incorporates peer-reviewed academic journals in Political Science, Public Administration, and Technology Policy, reports from international organizations, and prominent scholarly monographs concerning democratic theory and digital governance.

Research Methodology

The research employs a qualitative, analytical, and descriptive methodology. The primary approach involves critical policy analysis and conceptual analysis to unpack the theoretical intersection of AI and public policy, situating it firmly within Political Science traditions. A case study approach is integrated to empirically examine specific Indian government initiatives. The study synthesizes this data to construct logical arguments regarding the impact of algorithmic systems on democratic principles, leading to actionable policy recommendations.

Result & Discussions

Conceptualizing Algorithmic Governance

The intersection of Artificial Intelligence and public policy creates a new paradigm termed "algorithmic governance". Unlike private sector AI, which is driven by profit maximization, AI in public administration must remain subordinate to democratic values, constitutional mandates, and public welfare. This shift from traditional Weberian bureaucracy toward predictive analytical models raises fundamental political questions regarding sovereign power: Who controls the algorithm, and who is accountable when automated systems fail citizens?.

AI in the Indian Administrative Ecosystem

AI acts as a critical force multiplier in public administration through administrative automation, predictive analytics, and cognitive decision support. Routine bureaucratic processes are expedited, while vast datasets are utilized for forecasting infrastructure needs and public health interventions. India's existing digital infrastructure, notably Aadhaar and the Unified Payments

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Interface (UPI), provides the necessary data backbone for these advanced applications. Administrative figures, such as District Collectors, increasingly rely on digital dashboards for real-time district-level resource allocation, marking a definitive shift toward data-driven decentralized governance.

Opportunities for Evidence based Public Policy

The integration of AI offers unprecedented operational opportunities. In welfare administration, AI powered targeting can replace blunt eligibility criteria with nuanced needs assessments, significantly reducing both inclusion and exclusion errors in direct benefit transfers. Agricultural optimization represents another critical domain; initiatives like the Digital Agriculture Mission and Maha Agri Tech utilize AI and satellite imagery to advise farmers on crop yields, weather forecasts, and expedite crop insurance, directly impacting food security. Furthermore, national initiatives like 'Bhashini' deploy natural language processing to dismantle language barriers, a crucial necessity for ensuring inclusive democratic participation in a multilingual state.

Democratic Challenges and Ethical Risks

Despite substantial administrative utility, algorithmic governance introduces severe risks to democratic principles. The foremost challenge is algorithmic bias; AI systems trained on historical data inherently reflect existing societal prejudices. When deployed in law enforcement or welfare allocation, these systems automate and amplify marginalization, directly threatening the constitutional right to equality. Additionally, the opaque nature of complex algorithms the "Black Box" problem creates a profound accountability deficit. Justice demands transparency; administrative law cannot function if the state cannot explain the rationale behind an automated decision denying a citizen's rights. Furthermore, the aggressive aggregation of personal data poses significant surveillance threats to privacy and freedom, while India's stark digital divide ensures that the benefits of AI governance remain inaccessible to technologically excluded subaltern populations.

The Role of Higher Education, Innovation, and IPR

The dominant narrative of AI adoption in India is heavily techno-optimistic and currently relies overwhelmingly on private sector capabilities. The analysis indicates that higher education institutions are currently underutilized in the AI policy ecosystem. Universities must step forward to bridge the gap between technical innovation and critical sociological analysis. The creation of interdisciplinary programs combining Political Science, Law, and Computer Science is essential for training ethically informed AI governance professionals. Crucially, intellectual property frameworks for publicly funded AI research require urgent attention. Providing state backing for student led innovation and the generation of localized IPR within Indian universities will reduce reliance on foreign technologies and ensure that AI models are trained on contextually appropriate data. Higher education institutions are the optimal spaces to incubate "Gov-Tech" startups that design culturally contextualized, ethically robust solutions for public administration, preventing the imposition of Western-centric biases onto Indian governance.

Conclusions

Artificial Intelligence is fundamentally rewriting the operational mechanics of public policy and governance in India. It presents a viable pathway to an administration that is highly responsive, predictive, and structurally efficient. However, technological efficiency cannot be pursued at the expense of democratic sovereignty, administrative justice, and constitutional equality. The current trajectory, characterized by rapid deployment and insufficient regulatory oversight, risks entrenching social exclusion and hollowing out accountability. Realizing the true potential of AI requires robust institutional frameworks and continuous democratic deliberation. Consequently, higher education institutions must act as the intellectual vanguard in this transition. By driving interdisciplinary research, incubating ethically grounded policy startups, and generating localized intellectual property, universities and academic researchers can ensure that Artificial Intelligence remains a tool of the democratic state, subordinate to the rights of the citizen and the rule of law.

Recommendations

Based on the extensive policy analysis, the following recommendations are proposed:

- **Enact Comprehensive AI Governance Legislation:** The central government must implement statutory frameworks mandating routine algorithmic audits, transparency disclosures, and robust citizen redress mechanisms to counter the "black box" problem.
- **Establish an Independent AI Oversight Authority:** A statutory body must be created to audit AI systems deployed in public administration, investigate citizen complaints

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regarding algorithmic bias, and ensure compliance with constitutional rights.

- **Implement Regulatory Sandboxes:** The state should establish controlled testing environments where public sector AI applications can be rigorously evaluated for efficacy and socio-economic bias prior to nationwide implementation.
- **Establish Multi-Disciplinary AI Centers in Universities:** State and central governments should fund specialized research centers within universities that combine computer science, political science, and education faculties to research and develop localized AI policy applications.
- **Promote Public-Academia Partnerships for Startups:** The state should actively incentivize higher education students to develop "Gov-Tech" startups. Backing student-led Intellectual Property Rights (IPR) in administrative AI ensures culturally contextualized solutions and reduces external technological dependency.
- **Curriculum Overhaul in Higher Education:** Universities must integrate comprehensive modules on "AI and Ethics" and "Digital Public Administration" into Political Science, Public Administration, and Education curricula to prepare future administrators for digital era governance.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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