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(b) In the References List Names of the authors should be arranged according to the alphabetical order of surnames. The writing of references should follow the usual norms.

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Landscape of Green Banking in India – An Overview

Subhabrata De[*]

Abstract

Sustainable development aims to meet present needs without compromising the ability of future generations to meet theirs. The financial sector, especially the banking system, plays a vital role in promoting sustainable economic development, and this holds true for India as well. With rising environmental concerns, E-banking emerges as a crucial tool for reducing carbon emissions and supporting India's commitment to sustainability. E-banking not only enhances customer experience but also benefits the environment by promoting paperless and energy-efficient operations. However, challenges such as inadequate policies and regulations hinder the widespread adoption of green banking practices. To address this, the government and regulatory bodies must actively promote E-banking. This paper explores the green initiatives and technological advancements in the Indian banking sector aimed at sustainable development.

Key words: *Green Banking, Environmental, Social, and Governance (ESG)*

1. Introduction

Sustainable development and environmental preservation are now globally recognized as crucial to protecting our planet from the damage caused by human activities (United Nations, 2015). Numerous international initiatives aim to mitigate the adverse effects of development, such as global warming and climate change (IPCC, 2021). A central theme in these efforts is the emphasis on reducing fossil fuel consumption by adhering to the principles of the 3Rs: Reduce, Reuse, and Recycle (EPA, 2020).

Banks and financial institutions can significantly contribute to global efforts in making our planet a better place to live (Scholtens, 2017). By providing finance, banks can encourage businesses to adopt environmentally friendly practices (Weber & Remer, 2011). Offering incentives, such as cheaper funds for implementing green technologies, will have a long-term positive impact on the environment (Bihari & Pandey, 2015). As key technology implementers, banks can lead the way in global environmental initiatives by adopting green practices themselves. Additionally, through product innovation and the effective use of technology, banks and their customers can reduce resource consumption, such as paper, contributing to environmental protection (GABV, 2018).

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This paper seeks to spread awareness about green banking. It provides a clear explanation of the different options available in the banking arena to lower the consumption of natural resources and boost energy efficiency (Lalon, 2015). The paper focuses on eco-friendly IT infrastructure techniques that banks can implement, along with practical advice on embracing eco-friendly goods and services (Bose et al., 2017). Banking from home or online is not just convenient; it helps the environment by eliminating paper, materials, and trips to the bank,all of which reduce carbon monoxide emissions and pollution (Dharmaraj & Mani, 2021). The concept of green banking has gained prominence in recent years as awareness of environmental issues has grown (Jeucken, 2010). Banking institutions are increasingly recognizing their role in promoting sustainability (UNEP FI, 2022). Green banking encompasses a wide range of practices, including the development of green financial products, reduction of carbon footprints, and support for environmentally sustainable projects (Nizam et al., 2019). This paper aims to provide a comprehensive overview of green banking, highlighting its importance, implementation strategies, and impact on the financial sector and the environment. The banking sector is generally considered a service-providing sector and is often perceived as environmentally friendly in terms of emissions and pollution (Thompson & Cowton, 2004).

2. Green Banking

Green banking is a relatively recent addition to the financial industry. It is a type of banking that considers the effects on society and the environment, with the primary goal being environmental preservation. Green banking refers to banking practices that consider the environmental and social impacts of their activities and promote sustainable development. Bihari (2011) defines green banking as a form of banking that fosters environmental and social responsibility while aiming to reduce carbon footprints. Similarly, Shrivastava and Verma (2018) describe green banking as a comprehensive approach involving various environmentally friendly initiatives, such as e-banking, paperless banking, and financing green projects.

Green Banking is an umbrella term. It refers to practices and guidelines that make banks sustainable in economic, environment, and social dimensions. It seeks to maximize efficiency and effectiveness in banking procedures, as well as in the utilization of physical infrastructure and IT, with little to no negative environmental impact.

According to RBI (IRDBT, 2014), green banking is to make internal bank processes, physical infrastructure and IT infrastructure as effective and efficient as possible, with zero or minimal impact on the environment.

Green banking is an approach where financial institutions adopt environmentally friendly practices and policies. It aims to promote sustainable development and reduce the carbon footprint of the banking sector. “Green Banking” refers to the efforts of the Banking sector to keep the environment green and to minimize greenhouse effects

through rationalizing their strategies, policy, decisions and activities pertaining to banking service, business and in-house operational activities.

According to Indian Banks Association (IBA, 2014) "Green Bank is like a normal bank, which considers all the social and environmental/ecological factors with an aim to protect the environment and conserve natural resources."

Green Banking is a means to encourage the banks to adopt environment friendly practices, using the technology not harming the environment, investing in the projects promoting sustainability and shifting the customer base to electronic means by creating awareness.

Relevance of Green Banking

The relevance of green banking is increasingly significant due to the growing global awareness of environmental issues and the urgent need to address climate change. Green banking refers to environmentally-friendly practices and initiatives taken by banks to promote sustainable development and reduce the carbon footprint of their operations. Green banks encourage the efficient use of resources and the adoption of sustainable practices across various sectors, reducing environmental degradation and promoting conservation. Mishra and Sharma (2013) highlight the role of green banking in reducing carbon emissions through the adoption of energy-efficient technologies and promoting digital banking, which reduces paper consumption. The study also emphasizes the importance of financing green projects, such as renewable energy and sustainable agriculture, in contributing to environmental sustainability. Green banking aligns with several Sustainable Development Goals (SDGs) such as affordable and clean energy (SDG 7), climate action (SDG 13), and responsible consumption and production (SDG 12). On the economic front, Bahl (2012) argues that green banking can lead to cost savings for banks by reducing energy consumption and operational costs. The study also notes that green banking can enhance a bank's reputation and customer loyalty, leading to long-term financial gains.

3. Objectives:

Objectives of this paper

- To discuss the concept of 'Green Bank'.
- To Green Banking initiatives by various banks and
- To suggest ways to promote Green Banking in India

4. Green Banking: Product – Process – Policies

The main functions of a financial institution include mobilizing savings by accepting deposits, providing loans and credit facilities to individuals, businesses, and governments, and facilitating investment through various financial products and services. A bank is a financial institution and a financial intermediary that accepts deposits and channels those deposits into lending activities, either directly or through

capital markets. Banks offer different channels to access their different banking products and services through ATM, Branch, Mobile banking, Internet banking etc.

***Green Products*:**

The development of green financial products and services is another prominent trend in green banking. Banks are developing new products and services that respond to consumer demand for sustainable choices. These products are designed to promote environmental sustainability by supporting green projects and encouraging responsible consumer behaviour. Following are some of the options that banks should offer to their customers.

- Adopting e-banking and mobile banking platforms to provide customers with convenient, paperless banking options.
- Adaptation of digital banking reduces the need for visit branches physically, paper statements, and other resource-intensive processes.
- Promoting e-statements, e-receipts, and electronic communications instead of paper-based ones to minimize waste and resource use.
- Offering and promoting mutual funds that focus investment in 'green' companies.
- Green bonds have become a popular financial instrument for raising capital for environmentally friendly projects.
- Offering a special line of credit to help homeowners invest in energy-efficiency upgrades for their home.
- Banks can offer green loans and mortgages that provide favourable terms for projects or properties that meet certain environmental standards.
- Offering credit cards co-branded with environmental charities.

***Green Process*:**

A Green Bank requires each of its functional units and activities to be green – environmentally friendly and help to improve environmental sustainability. Banks requires to adapt low carbon technologies and develop new sustainable services process that will mitigate the risk of climate change. These processes encompass a range of strategies, including operational adjustments, digital innovations, and policy changes, all aimed at minimizing environmental impact. Bank have opportunities to incorporate these processes in their functional activities to become greener and more sustainable. Implementing smart energy management systems to monitor and optimize energy usage, reducing overall consumption.

Supply Chain Management (SCM)

- Implementing comprehensive recycling programs for paper, plastics, electronics, and other waste materials in bank branches and offices.
- Reducing waste by minimizing packaging, using reusable products, and encouraging employees to reduce, reuse, and recycle.

- Adopt techniques and plans to minimize inventory and wasted freight.

Electronic Customer Relationship Management (E-CRM)

- Encouraging customers to use digital platforms for transactions, account management, and communication to reduce paper usage.
- Promoting e-statements, e-receipts, and electronic communications instead of paper-based ones to minimize waste and resource use.
- Implementing electronic signature solutions for agreements and contracts to reduce the need for printed documents.

Sourcing and Procurement

- Prioritizing the purchase of environmentally friendly products and services, such as recycled paper, energy-efficient IT equipment, and eco-friendly office supplies.
- Choosing suppliers and service providers based on their environmental practices and sustainability credentials.

Green IT Solutions

- Using energy-efficient servers and cooling systems in data centres to reduce energy consumption.
- Leveraging cloud computing to reduce the physical infrastructure and energy required for IT operations.

Sustainable Investments

- Investing in companies and projects that meet specific ESG criteria, focusing on sustainability and ethical practices.
- Avoiding investment in industries that have a significant negative impact on the environment, such as fossil fuels, deforestation, and pollution-intensive sectors.
- Installing solar panels or other renewable energy sources at bank facilities to reduce reliance on non-renewable energy and lower greenhouse gas emissions.
- Implementing smart energy management systems to monitor and optimize energy usage, reducing overall consumption.

Product Life Cycle Management

- Design and offer banking products and services in such a way that consume less resources and energy and thereby reduce carbon footprint.
- Implement effective systems for product end-of life management that have minimal impact on the environment.

***Green Policies*:**

- Regularly assess the office and business environment and identify areas to be "greened."
- Regularly assessing the bank's carbon footprint and setting reduction targets to minimize its environmental impact.
- Installing solar panels or other renewable energy sources at bank facilities to reduce reliance on non-renewable energy and lower greenhouse gas emissions. Conduct energy audits and review equipment purchases and disposal policies and practices.
- Set SMART (Specific, Measurable, Attainable, Realistic, and Timely) green goals as the internal targets to reduce banks' carbon footprint along with timelines. Develop criteria for measuring progress towards the goals.
- Green building initiatives should adopt by the banks at strategic level. A green building is a building which is energy efficient, resource efficient and environmentally responsible, which incorporates design, construction and operational practices that significantly reduce or eliminate its negative impact on the environment and its occupants.
- Engage with key stakeholders and create awareness of environmental issues and their impact on the economy, the environment, and the society. Providing training and resources to employees about sustainability practices and encouraging them to participate in green initiatives.

Fostering Green Banking

Green banking can be an avenue to reduce pollution and save the environment aiding sustainable economic growth. Green Banking is a multi-stakeholders' endeavour where banks must work closely with government, NGOs, regulator, consumers, and business communities to reach the goal.

5. Green Banking Initiatives by Major Banks in India

RBI: The Reserve Bank of India (RBI) has undertaken several green banking initiatives aimed at promoting sustainable finance and supporting environmental conservation efforts. The Reserve Bank of India (RBI) has issued guidelines and notifications that indirectly support green banking practices, but it has not issued a specific, standalone guideline solely dedicated to "Green Banking Practices" under a particular notification number. Instead, the RBI has integrated environmental sustainability and green banking into broader frameworks, such as Priority Sector Lending (PSL) guidelines and climate risk assessments.

In December 2007, the Reserve Bank of India (RBI) issued a circular (RBI 2007-2008/216) highlighting the importance for banks to act responsibly and contribute to sustainable development and emphasizing the need for Indian banks to establish institutional mechanisms to enshrine sustainability.

The RBI issued notifications and guidelines regarding the importance of sustainable green banking practices.

- Priority Sector Lending – Targets and Classification (Master Directions): Notification Number: RBI/FIDD/2022-23/23, Date: September 2022. This notification includes renewable energy projects under the Priority Sector Lending (PSL) norms, encouraging banks to finance green energy initiatives.
- Climate Risk and Sustainable Finance Report: Document Type: Discussion Paper, Date: July 2022. This report by the RBI discusses the integration of climate-related risks into the Indian banking system and provides a framework for sustainable finance.
- Inclusion of Renewable Energy Projects under PSL: Notification Number: RBI/2015-16/374, Date: April 23, 2015. This notification formally included renewable energy projects in the PSL guidelines, promoting green investments.
- Guidelines for Issuance of Green Bonds by Banks and Financial Institutions: Though no specific RBI notification number exists solely for green bonds, the RBI supports the issuance of green bonds within the broader regulatory framework governing corporate bonds.
- Report of the Task Force on Sustainable Finance: Document Type: Report, Date: September 2020.

State Bank of India (SBI): SBI is the largest public-sector bank in India with over 24000 branches in India and around 195 branches in foreign countries (https://www.sbi.co.in/group/about-us.html). It occupies the highest value for assets, revenues and profits as well in India. SBI holds the dignity of being the first bank in India to bring the focus over green banking and came up with a separate policy for promoting environmental sustainability regarded as Green Banking Policy, since 2007. Under the initiative of becoming a green bank, the bank has started various services such as; paperless banking, kiosks which are self-operated by the customers, green debit and credit cards which include Vishwa Yatra card, Ez Pay Card, Smart Payout Card and more ensuring a steady movement towards green banking. SBI propounds to be the largest employer of solar ATMs in the country. The bank has installed around 250 ATMs with lenders covering the tops of 150 buildings with solar panels till September 2018 and expected to install around 10000 ATMs in the coming two years (businesstoday.in). Another factor contributing towards saving the planet includes providing electronic Annual Reports (eAR) to the shareholders became a signatory to Carbon Disclosure Project (CDP) along with the other 550 institutions with the objective of building and exercising stern actions on decreasing the carbon footprint and encouraging green banking practices. Bank has installed windmills collaboration with Suzlon Energy Ltd. to use wind power at the place of thermal power in its business operations and currently using wind power in its most of offices located in Gujarat, Tamil Nadu and Maharashtra in three states for its own energy needs.

ICICI Bank: The bank offers green products and services like (i) Insta banking: - It is a service which gives convenience to the customers to do banking anywhere and anytime through internet banking, mobile banking, IVR banking, etc. This reduces the carbon footprint of the customers as they do not require the physical statement or travel to the bank branches. Besides this ICICI Bank attempts to support other organizations in their endeavors to "Go Green", by funding and managing green technology projects.

Axis Bank Ltd: Axis bank communicated its efforts of reducing its impacts on the environment through its Business Responsibility Report. Axis bank's environmental management efforts are inclined towards resource conservation, renewable energy and energy efficiency. The bank -

- Encourages its customers to subscribe for e-statements and other electronic formats of communication to reduce paper consumption,
- Encourages to adopt green building concept for its office space (Bank's corporate office 'Axis House' is designed and constructed as a Platinum LEED-Certified "Green Building") and many other similar activities.
- Conducts tree plantation programs (Plant a Sapling initiative).
- Uses renewable energy units for the purpose of street lighting.
- Uses water collected from rainwater harvesting system and a sewage treatment plant.
- Uses furniture made out of a high percentage of recycled materials.
- Initiated solar-based UPS for ten ATMs under its Independent ATM Deployment (IAD) model.

Axis bank is very actively providing finance to projects in the areas of clean technology, renewable energy, energy -efficiency and sustainable infrastructure. Apart from this, Axis bank has also implemented various other initiatives in environmental management and energy efficiency domains such as implementation of 'Remote Managed Service' program that enables to centrally monitor and regulate energy use at its offices, shifting to highly energy efficient solid-state data storage system from hard disk storage technology at its data centres, etc.

IndusInd Bank: IndusInd bank is a private sector bank which has taken green banking initiatives with a goal to promote sustainable business practices to offset the effects of climate change. It had opened the country's first solar-powered ATM and pioneered an eco-savvy change in the Indian banking sector. Other green initiatives taken by the bank include the computing, e-archiving, e-learning, e-waste management, paper less fax, energy conservation, CNG cars etc.

Punjab National Bank (PNB): Punjab National Bank is among one of the India's oldest bank and was established on 19 May, 1894. Certain major green banking initiatives of PNB are:

Punjab National Bank (PNB), nation's leading Public Sector Bank, launches an environmental initiative 'PNB Palaash', an eight-month period campaign to embrace sustainability, which shall lead to cost savings and operational efficiencies through measures such as energy and resource conservation, paper reduction, waste management and streamlined digital processes. The primary objective of this project is to actively contribute to conservation endeavour, foster the adoption of sustainable practices, and promote active employee engagement.

IDFC FIRST Bank: Various efforts have been made by the bank to accelerate progress on climate change, green infrastructure, emissions baselining, influencing responsible purchase patterns, and lending to businesses such as EVs, which are critical in the transition towards a greener economy. For example, several large offices of the bank are LEED/IGBC certified, including its head office, which is rated at IGBC Platinum. The bank also responsibly manages its e-waste, which it disposes in an environmentally friendly manner.

With its ESG program, IDFC FIRST Bank strives to minimize its environmental footprint, encourage responsible consumer behavior, empower its employees and communities, adopt globally-recognized corporate reporting frameworks, and support global climate action movements. IDFC FIRST Bank evaluate their physical and transition risks and fixed GHG emissions across Scope 1, 2 and 3, to formulate a climate action plan.

HDFC Bank: HDFC have developed several green banking initiatives. The HDFC Bank, continuously transforming their operations to achieve low carbon growth. HDFC Bank has developed the HDFC Bank Sustainable Finance Framework dated December 2023 (the "Framework"), under which it intends to issue green, social and sustainability bonds, originate loans, and use the proceeds to finance or refinance, in whole or in part, existing and future projects that are expected to facilitate the transition to a low-carbon economy and advance socio-economic development in India. The Framework defines eligibility criteria in ten green categories: 1. Renewable Energy 2. Energy Efficiency 3. Pollution Prevention and Control 4. Sustainable Water and Wastewater Management 5. Environmentally sustainable management of living natural resources and land use 6. Terrestrial and Aquatic Biodiversity 7. Clean Transportation 8. Climate Change Adaptation 9. Circular Economy 10. Green Buildings. As part of its ESG strategy, the bank focus on offering loans for green products like electric vehicles at low interest rate and incorporating ESG sores in the credit decisions. The bank is also working a frame work for issuing green bank.

6. Ways to Promote Green Bankin in India:

Promoting green banking in India involves a combination of regulatory measures, awareness campaigns, and incentives to encourage banks and customers to adopt sustainable practices.

- The Reserve Bank of India (RBI) and other regulatory bodies can create specific guidelines and policies for green banking, requiring banks to integrate environmental considerations into their operations and lending practices.
- Banks can organize workshops, seminars, and awareness campaigns to educate customers about the benefits of green banking and how they can contribute to environmental sustainability.
- Encourage the development of financial products that promote environmental sustainability, such as green bonds, green mortgages, and loans for energy-efficient projects.
- Collaborate with NGOs, government bodies, and international organizations to promote green banking initiatives and ensure alignment with global sustainability standards.
- Invest in and support fintech companies that offer innovative solutions for environmental sustainability, such as platforms for carbon footprint tracking and sustainable investment.
- Promote the use of digital banking services, reducing the need for physical resources and lowering the environmental impact. Promote digital banking services, reducing the need for paper-based transactions and branch visits, thereby lowering the carbon footprint.
- Encourage banks to publish annual sustainability reports detailing their environmental impact, green initiatives, and progress toward sustainability goals.
- Introduce certifications for banks that meet specific environmental standards, promoting competition and recognition for sustainability efforts.
- Offer incentives for customers who choose green banking products, such as reduced fees or cashback on eco-friendly purchases. Establish awards for banks and financial institutions that excel in green banking, encouraging others to follow suit.

7. Conclusion

With the goal to stop global warming and create a sustainable ecosystem, businesses, governments, and individuals all have responsibilities. Thankfully, there is a rising dedication to solving the environmental difficulties we confront, along with increased awareness. Our progress would be hampered and future generations would suffer greatly if we did not address environmental degradation. As a result, all business and industrial sectors, government organizations, and private citizens must take proactive, multidimensional action. There are numerous initiatives underway globally to establish a standard methodology for handling environmental issues. These include the Equator Principles (EPs) and the United Nations Environment Program Finance Initiative (UNEP FI), which are the two principal initiatives.

Besides this, internally, in their day-to-day operations also banks are devising strategies to make their systems and processes environment-friendly. Green Banking is comparatively a new development in the financial world. It is a form of banking

considering the social and environmental impacts and its main motive is to protect and preserve environment.

Foreign banks are practising green banking on a much serious note. Some of the foreign banks have introduced a formal Environmental and Social (E&S) risk policy to govern lending activities way back in 1997. They are also signatory to the Equator Principles (EP)and moved ahead in building on bank's work to measure social and economic impact of lending, reduce annual paper consumption of full-time employees and continue to reduce energy and water consumption, etc. The Indian banks are still taking baby steps into this form of banking. Still, many of them are keen to actively pursue this strategy.

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A Comparative Analysis of MSME Act 2006 and 2020

Somnath Chakraborty*

Abstract

Micro, Small, and Medium Enterprises (MSMEs) are vital to India's economy, contributing significantly to GDP, employment, and exports. The MSME Act 2020, revising the 2006 Act, introduces turnover-based criteria alongside investment thresholds, equally emphasizing manufacturing and services. This study assesses the Act's impact on 'Ease of Doing Business' by analyzing three stakeholder perspectives: (1) Government (Ministry of MSME, West Bengal) views it as enhancing competitiveness; (2) District Chambers of Commerce remain uncertain; and (3) Industry representatives (FOSMI, FASII) highlight mixed effects. Analysis of 200 questionnaires explores relationships between investment, turnover, and profitability, offering insights into the Act's practical implications.

Key words: *MSME, Turnover, Investment in plant & Machinery. Profitability, GDP.*

1. Introduction

Micro, Small and Medium Enterprises (MSMEs) are the backbone of Indian economy. Since the adoption of First Industrial policy in 1956 emphasise was given on promotion of village and cottage-based industry along with large scale industries. India adopted the planned Economy and Planning Commission through successive plans laid emphasise for promotion of MSMEs by policy makers. Since second five year plan the priority of MSME sector increased leaps and bounds and its share to industrial output, manufacturing sector and of export and employment generation earning has been impressive.

The importance of MSME sector has grown leaps and bounds as policy makers laid emphasise for promotion of the sector since independence. The 'Make in India' and 'Start up India' are two new additions for promotion of this sector. Between these two, Make in India initiatives has been declared to facilitate investment, foster innovation, enhance skill development and Start-up India is formulated to build a strong ecosystem for nurturing innovation and infrastructure in the country.

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In the current scenario both Central and State Government is providing various facilities and credits to MSME units to ensure sustainable growth of this sector in India. Further, to ease the regulatory burden on the industry, a single window compliances and online mechanism of registration and compliance has been initiated for their promotion. Currently more than 6 crore MSMEs have a crucial role to play for promoting Atma Nirbhar Bharat.

Necessity of vibrant MSME sector is felt by policy makers both in developed and developing economies. In order to define MSME, policy makers in different countries developed some effective MSME models based on the concepts of Credit Guarantee, Single Nodal Entity, Cluster Development, Risk Capital Financing, Capacity Building, etc. Some well-known models adopted in this context are used in Italy, Malaysia Turkey, Mexico and China which has proved to be useful.

Global Trends in Classifying MSMEs

MSMEs have been classified from time to time based on different demographic and socio-economic factors in which they belong. Amongst the accepted definitions of MSME, definition provided by World Bank is popular and it classified unit as MSME based on three indicators viz., employee strength, assets size and annual sales.

Out of the 267 definitions published by International Finance Corporation and used by various organisations globally MSME is recognised by the number of employees. It is followed by other commonly used variable like turnover and value of assets. Rest took definitions used by different alternative variables viz loan-size, work-experience, state of technology, size of the manufacturing unit, initial investment amount. So far majority of the countries are using only one variable to define MSME. (Figure 1)

India registered industrial growth of around 5-8% annually in the first decade of the new millennium. Thereafter, it registered double-digit growth for the next few years before slumping to below 6% during 2015-2016. However, due to the high growth performance of this sector, it achieved a higher growth path@ of 10% during 2008-09. Thereafter, in growth rate slumped during post post-financial crisis. Growth rate over the last 10 years was moderate before the outbreak of COVID-19 19 which dashed a major gain of this sector and wreaked havoc as many of small-scale units were forced to close down businesses**.** (Figure 2)

International Scenario of MSMEs

Global data shows that MSME sector has a huge contribution not only in registering higher growth rates but also in generating employment, earning foreign exchange reserves and creating balanced development. The MSME sector contributes to 20% to the total GDP in Brazil.

In South Africa nearabout 40% of labour force belong Micro enterprises and 25% of GDP is derived from this sector whereas in small scale enterprise 27% of labour force is employed and 32% to GDP comes from this sector. In China, 68% of export earnings

is generated from this sector, whereas in Japan, 55% of earnings come from the manufacturing sector. In Bangladesh, SMEs had a phenomenal presence in the industrial sector, as majority of all Industrial units contribute 80% of industrial employment and 23% of total civilian employment, generating 75% of the household income is being generated in both urban and rural areas.

Contribution of MSME in the Indian Economy

There is a huge contribution of MSME sector to prepare the base of MSME sector through innovation & incubation. The manufacturing list of MSME sector consists of 6000 products, which includes traditional to high-tech items. The contribution of the MSME sector to India's GDP growth rate more or less remained stagnant at around 30% in recent years, which later declined partially.

The 73rd round NSS data conducted by National Sample Survey Office (NSSO), during the period 2015-16 proves the presence of 635 lakh unregistered MSMEs outside agriculture in the country, and they were engaged in different economic activities, setting aside the MSMEs registered under Factories Act, 1948, Companies Act, 1956.

The requirement of low capital with a huge scope of employment is the biggest benefit of MSME. Following the 73rd NSS data conducted during 2015-16, 1109 lakh jobs have been created in the MSME sector, out of which 360.41 lakh are in Manufacturing, 387.18 lakh in Trade and 362.22 lakh in Other Services. The following table shows the activity-wise distribution of employment generated by MSMEs**.** (Table 3)

Comparison of MSME exports to total exports

It has been observed historically that the MSME sector in India is contributing more than 40% to exports. This is evident from the following table that the share of MSME exports has increased from 43% in 2012-13 to 49% in 2017-18**.** (Table 4)

Comparing the growth of MSME exports with the total exports of the country,it can be seen from Table 7 that MSME exports registered a growth rate of 4% in 2014-15, but it slumped to -6 % in 2015-16. During the same period, overall export growth became negative. But this negativity was outweighed by a positive environment as overall export growth, including growth in MSME recovered during 2016-17 and 2017-18.

State wise Distribution of Estimated MSMEs

In India, 93% of MSME are clustered mainly in the top ten states. Analysing data on state-wise contribution of MSME it is seen that the highest number of MSME belong to the state of Uttar Pradesh with a share of 14%, followed by West Bengal, which occupies the second position with a share of nearly 14% in the country. The top ten performing states with respect to the performance of MSMEs are mentioned in the country. (Table 5)

2. Objectives of Research

The 2006 Act, like the earlier Acts, uses investment in plant and machinery and equipment to recognise MSME unit. The new criterion, on the other hand, under MSME Act 2020 not only introduced annual turnover but also took into account the effect of inflation by moving upward the investment ceiling and thus retained both of the benefits associated with MSME status. Various Chambers of Commerce and associations, and industry bodies already send representation for incorporating meaningful changes in the definition of MSME and consequently Ministry of MSME declared the NEW MSME POLICY in June 2020, incorporating these suggestions. The objective of this study is to make a comparison between the two definitions of MSME Act 2006 and MSME Act 2020 and try to forecast how far the New Act is an improvement over the old 2006 Act. (Table 6)

Scope of Research: In this section let's discuss in detail the features of these two Act.

The definition of Micro, Small & Medium Enterprises as per MSMED Act, 2006 are mentioned as below**:**

Manufacturing Sector

- Unit based on plant & machinery
- Investment limit of Micro Enterprises not exceeding twenty five lakh rupees
- It will be more than twenty five lakh rupees but not more than five crore rupees for small scale units.
- For Medium Enterprises it is More than five crore rupees but not more than ten crore rupees.

Service Sector

- Investment in equipment for Micro Enterprises falls within ten lakh rupees.
- For Small Enterprises it is more than ten lakh rupees but not more than two crore rupees.
- For Medium Enterprises it is more than two crore rupees but not exceeding five crore Rupees

The following benefits were obtained from MSME Act 2006.

Udyog Aadhaar Memorandum: With the introduction of UAM portal both of EM-1 and EM-2 has been merged into it. The earlier existed Entrepreneurs' Memorandum (EM part-I & II) was replaced by UAM for promoting ease of doing business. It is a single page online registration system for MSMEs based on self-declaration.

Udyog Aadhaar Number (UAN). To generate Udyog Adhar Number information based on self-certification are required at the time of online filing of UAM. A total of 68.25 lakh units have so far been registered under UAM till mid 2019.

Framework for Revival and Rehabilitation of MSMEs: The Ministry of MSME in May 2015 declared a Revival and Rehabilitation package. Later on, the Apex bank Reserve

Bank of India, has also constituted guidelines under which banks have been directed to create a framework for finalising a corrective action plan for the revival of MSMEs.

MSME Data Bank: In continuation with UAM, the Government of India, under the Ministry of MSME in order to assimilate different types of data on small-scale industries, declared the formation of MSME Data Bank. Data Bank is helpful for keeping up-to-date product/service related information of entrepreneur's and it can be accessed by various Government Departments under Public Procurement Policy. PSUs procured a worth of 33,264 crore from MSME sector in 2019, which is 30% of their total Procurement. (Economic Survey 2019)

In spite of above-mentioned benefits, MSME Act 2006 was subject to some limitations. One common criticism was MSME Act 2006 had age age-old and a revision of the ceiling in case of investment in plant and machinery became necessary to consider inflation. Moreover, it became easier to register under UAM with the help of Aadhar number of units under the old Act. So, it was difficult to differentiate good MSME units from ordinary units/trading units under the old act.

To overcome these limitations, the New MSME Act 2020 was introduced in a time when the economy was struggling to recover from the effects of COVID 19. In order to create effective demand and boost the economy, the Government of India announced a package of Atmanirbhar Bharat, part of the strategy was the revision of the ceiling of investment limit for MSME units.

In the package announcement, the difference between manufacturing and service has been abolished. The definition of micro unit has been fixed at Rs. 1 crore of investment and Rs. 5 crore of turnover. The limit of a small unit was increased to Rs. 10 crores of investment and Rs 50 crores of turnover. Similarly, the limit of a medium unit has been enhanced to Rs 20 crores of investment and Rs. 100 crores of turnover.

3. Discussion

Following the composite definition India is now using both investment and annual turnover as the criteria to recognise MSMEs. In this context the Reserve Bank of India's Expert Committee on MSMEs (2019) mentioned a study conducted by the International Finance Corporation in the recent past which analysed more than 250 definitions used by 150 countries across the world.

Intervention	Implications
Rs, 3 lakh crore collateral-free automatic loan for business to MSMEs	Nearly 45 lakh units resumed business activity and safeguard jobs
Rs. 20,000 crore debt for MSME	2 lakh MSMEs are expected to benefit.
Rs.50, 000 crore Equity infusion	Likely to help expand the size of MSME and help them to get listed in stock exchanges

Disallow of Global tender upto 200 cr	Increased business opportunities for MSME sector
E-market linkage	Expanded scope of business for MSME Sector

It is expected that with the implementation of policy decisions, Central Government has been following all relevant steps to ensure that the benefit must reach to the MSMEs.

- The earlier approved Three lakh crore collateral-free automatic loans by Cabinet Committee of Economic Affairs have been formally launched.
- Decision of allowing procurement upto 200 crore without global tender while amending General Financial Rules is expected to open up new business avenues for Indian MSMEs.
- To give proper directions to release MSME payments within 45 days.
- Extension of moratorium on repayment of loans for another three months was another step taken by the RBI.

4. Literature Review

Paramsivam C and Selvam P(2013), using secondary data and descriptive research methodology, focused on the progress and performance of MSME Sector. Pujar M(2014) mentioned that MSME sector provides both wage and self-employment, and this sector produces more than 6000 items ranging from traditional to high tech throughout the country. Mentioning their findings from the food and beverage sector Balasubramanian K and Madhavan S(2017) reveal that the performance of small-scale industry has excelled when compared with the overall Industrial segment, and the contribution of Food Products and Beverages is huge as used in this study. Kumar V (2017) in this paper has attempted to understand the contribution of MSMEs in generating employment & earning foreign exchange reserves in the country. Mohanty J.J (2018**),** through his paper, mentioned major challenges faced by MSMEs sector in the Indian economy along with its policy implications. Ramaswamy K and Vaidya R(2018) in this paper critically review and analyse the MSME sector in India and provide useful suggestions for achieving growth and success Davinder S (et.al)(2019) mentioned that Small-Scale Industry is one of the main pillars of India's economic development strategies since Independence. Both the government and policymakers have admitted the special role of MSME since 1951, and the sector has received adequate attention in subsequent industrial policy, also recognising a role for MSME in the Indian economy. India, being one of the fastest-growing economies of the world, needs to pay further attention to the utmost growth of MSMES. Ghosh A(2020) in his study paper informed that under what circumstances turnover based criterion was selected as the calculation of the value of investment in plant and machinery from year to year is not at all a manageable task for MSMEs**.** The author then shows further how the composite definition leads to dichotomy, as there are sectors like diamond, leather, where huge turnover is achieved

due to the nature of the final product, even with minimum investment in plant and machinery. Likewise, there may be sectors that has high capital investments but low turnover is achieved. Mentioning their article published in the Indian Express Jha S. and Kumar A (2020) apprehended that micro enterprises, which comprise 99.4% of 6.3 crore registered MSMES may fall out of the eligibility criterion to get the benefits. Nagraj R & Vaivhav V (2020) in their study paper mentioned that sphere of MSME is enormous as it includes the non-agricultural informal sector also. In this connection, they mentioned practical problem of estimation of MSME as registered MSMEs are defined by investment in plant & Machinery, whereas other official databases follow the employment criterion. Referring to an RBI Expert Committee study on MSME based on International Financial Corporation, a study by Anurag V and Surya S **(**2020) informed how current definition of turnover was selected from amongst different alternatives and explained how the current definition took into consideration both investment in plant and machinery and turnover-based criterion. Nadkar N (2020) mentioned that although industry bodies backed the government decision to have a single definition for taxation, investment and other business proposals for MSME yet they opposed the decision based on annual turnover only. A study of Press Information Bureau (2020) informed that a new composite formula for classification for both manufacturing & service has been implemented, and a new criterion on turnover has been introduced. While commenting on registration of start-ups under the MSME Act in the study by Dipti S.L. and Shruti S it was shown that start-ups are eligible to avail relief measures announced for MSME under the Atma Nirbhar Bharat. They further explained that start-ups operating and engaged in the manufacturing and services sector may consider registering themselves as MSME on the Udyog Aadhar Portal/currently known as 'Udyami'.

Research Gap

Although the new definition is an improvement over old definition of MSME, as it takes into consideration both annual turnover and investment-based criteria.The main objective of the introduction of turnover-based criterion is to promote ease of doing business, attract investments and create more jobs in the MSME sector and make business compatible with GSTIN framework. But there are the following apprehensions:

1. 1.It is apprehended that large companies with high turnover may produce goods in bulk and may sell them with the help of MSME units registered under it and thus reducing them to a mere supplier instead of a producer.
2. Turnover of small enterprises is subject to change and market fluctuation. More so due to the change of definition of Micro and Small Scale Enterprise, smaller firms with small turnover are finding it increasingly difficult to compete with firms in the highest category.

3. The change in the definition of MSMEs may lead to a change in their position. Enterprises presently known as small will be designated as micro, and those previously classified as medium will be reclassified as small.
4. The existing investment-based definition creates a disparity between older and newer unit. Establishing a unit to manufacture a product today would require several times more investment compared to what it was 15-20 years ago. Similarly, a micro unit based on historical data would become medium or large if set up today. It becomes a barrier for new entrants.
5. Undoubtedly, in spite of some benefits of the new definition, some units lose too because of the fact that the upper limit of turnover has been kept very less.
6. Investment and turnover both are parts in the books of accounts and are required to be statutorily maintained. Turnover is a common issue under GST.
7. There may be a challenge in sectors like diamond exporters, the majority of which may have a turnover of around 500 to 600 crores. It means since they crossed 250 crore turnover limit, they will lose the status of MSME,
8. To take advantage of schemes under the purview of the definition of MSME is important. If the ceiling to qualify MSME unit is kept low, firms will never be competitive and will not want to change their scale of production and thus remain unproductive forever.
9. The turnover threshold criteria of 100 crore for medium-scale firms are very low. This amount of investment is very low when measured from macro perspective.
10. The benefit of the Interest Subvention Scheme is applicable to those MSMES which are GST registered. Therefore, under turnover turnover-based criterion, firms registered only under the GST regime would be eligible to avail the benefit of the Interest Subvention Scheme.

5. Research Methodology

Research carried out is Exploratory since research is a medium to identify issues that can be the focus for future research. Sampling is representative as the focus is on MSME entrepreneurs.

Both primary and secondary data have been collected after talking with different stakeholders. Three different types of stakeholders have been interviewed: 1. Opinion of Director-in-charge, MSME Development Institute, Kolkata, 2. Interview of President /Secretary of different District Chambers of Commerce in West Bengal with explanations and concept note on probable impact of change. 3. Focus group approach from two Industry Associations-FOSMI and FASII.

6. Analysis and Result

Interview with Director, MSME DI Kolkata confirms that how new act will bring more transparency, as it has brought manufacturing & service at par. He also added that although the Current Act has expanded its scope as both manufacturing and service

sector units having proper Udyam record can participate in respective government tender and e-market platform.This in turn will help to promote genuine MSMEs both in manufacturing and service sector. Representatives of different district chambers are not very much aware of probable impact as they apprehend that major benefit would go to medium and partially to small scale industries with upward revision of ceiling, not the micro units..This view is supported by two leading Industry associations.

Interpretation

Out of 200 sample surveys from different district chambers of commerce in West Bengal majority of them (70%) belong to Micro category, and the rest are Small Scale and Medium Scale industries. An interrelationship amongst investment in plant and machinery, turnover and profitability is examined. Although there is a one-to-one correspondence between investment and profitability, it is observed from a sample that units with small investment have earned more profits due to a reduction in cost and efficiency. Efficiency can be measured by calculating the percentage of return on Investment.

Investment Identification in Plant & Machinery:

In case of an Existing Enterprise: Calculation of investment for an existing enterprise is based on the calculation of Income Tax Return of the previous year. In case of a new enterprise, the calculation of investment for a new enterprise is based on self self-declaration of an entrepreneur.

Calculation Based on Turnover

In case of Existing Enterprise: Information related to turnover and Export Turnover is to be linked with the Income Tax Act under CGST.
In case of New Entrepreneur: In case an enterprise does not have PAN card its turnover will be considered based on self declaration before 31.03.2021 and thereafter submission of PAN and GSTIN is mandatory.

Validity of EM Part Ii and UAMS Issued Till June 30, 2020

(i) The existing EM Part II and Udyog Aadhaar Memorandum of the MSMEs obtained till June 30, 2020, would remain valid till March 31, 2021.

(ii) MSME units having 'Udyam Registration Certificate' would be exempted from filing GSTR and/or ITR returns, and it will be valid up to March 31, 2021.

Value of Plant and Machinery or Equipment

The online form for Udyam Registration takes into consideration depreciated cost as on 31st March each year of the relevant previous year but as per new Notification No S.O. 2119 (E) dated 26th June 2020 based on written down value of Plant and Machinery or as at the end of the Financial Year defined in the Income Tax Act and not cost of acquisition.

3. In view of the above, earlier notification related to July 13, 2017, in 'Investment in plant and machinery for the purpose of classification as Micro, Small and Medium Enterprises stand cancelled.

Limitation

- Sample size is 200, and the result obtained gives an approximation.
- Due to the pandemic, more reliance on Google Forms,
- Major dependence on secondary data collected through Google form.
- Difficult to get ready-made data from this sector.

7. Conclusion

Why the change? 14 years has been passed since MSME Act 2006 came into being. It was inevitable to revise upwards the figures related to Investment in plant and machinery in order to cope up with inflation. Keeping this in mind, however the new MSME ACT 2020 introduced much awaited turnover based criterion in addition to investment based criterion. The objective is to help companies to grow, as it is convenient to clarify company's turnover using the GST data than the investment in machinery etc. Manufacturing companies has obligation using turnover as the main criteria apprehending an uneven level playing field with trading community who also claim MSME status provided they can satisfy all criterion in MSME Data bank and thus will increase competition for "genuine" MSMEs.

Industry bodies representing Micro, Small and Medium enterprises (MSMEs) have backed the government's decision to have a single definition for small businesses for taxation, investment and other business purposes but they have opposed the decision to base the definition only on annual turnover. The existing definition relies on self-declared investment on plant and machinery which new definition ignored. Perhaps we have to see for coming few years how MSME units (both manufacturing & service) perform in post GST regime, bringing more transparency and promoting ease of doing business due to adoption of composite definition (Annual turnover plus investment in plant & machinery) and help MSME sector to become more competitive. More so the upward revision of investment will give opportunity to few small scale industries but will bring intense competition amongst micro units.

Lastly the cost of registration and bureaucratic hurdles that small enterprise always faced is expected to be mitigated with the onset of online registration system. From the perspective of marginal and small units only 'Ease of Registration' and handholding can empower them which in turn can promote 'Ease of doing business'.

Government proposed turnover based definition along with the current investment-based definition of MSMEs to facilitate ease of doing business. The U.K.Sinha led RBI Committee on MSME worked on the new definition and opined that it would be easier to implement in a Goods and Services Tax (GST) regime which in turn would promote formalisation.

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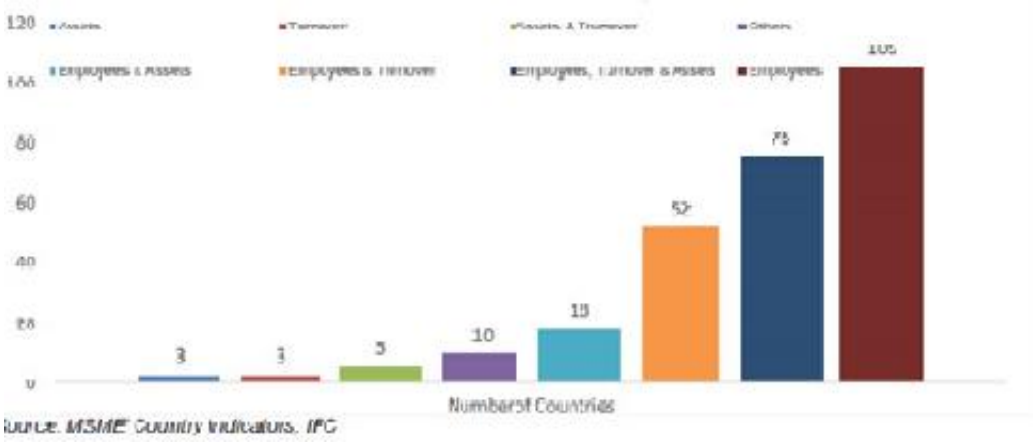
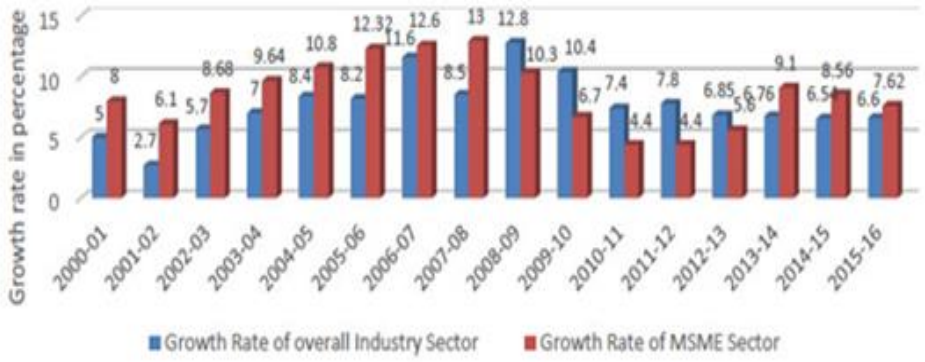
Annexure

Figure 1



Source: MSME Country Indicators, IFC

Figure 2



Source: Annual Reports of Ministry of MSME

Table 3: Proposed Employment in MSME Sector (Broad Activity Category Wise)

Broad Activity Category	Employment (in lakh)			Share (%)
	Rural	Urban	Total	
Manufacturing	186.56	173.86	360.41	32
Trade	160.64	226.54	387.18	35
Other Services	150.53	211.69	362.22	33
Electricity*	0.06	0.02	0.07	0
All	497.78	612.10	1109.89	100

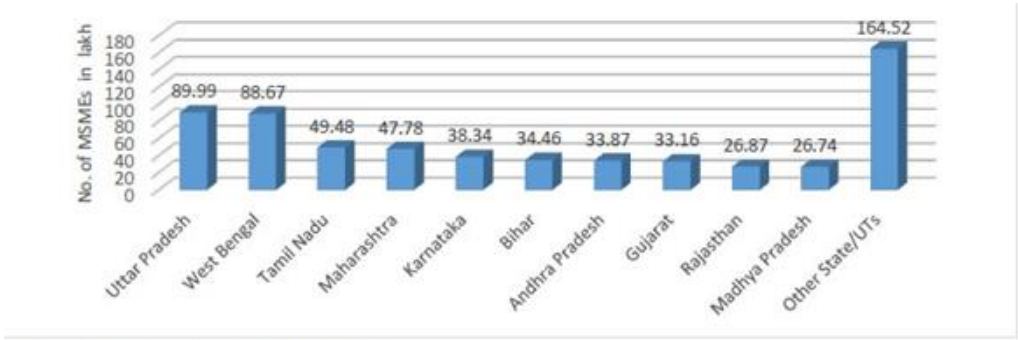
Source: National Sample Survey (NSS) 73rd round 2015-16

Table 4: Proportion of exports of Small Scale Industry in total exports (Amount in USD Million)

Year	Total Exports	Exports by MSME	Share of MSME Exports *(%)
2012-13	300400	127992	43
2013-14	314415	133313	42
2014-15	310352	138896	45
2015-16	262291	130768	50
2016-17	275852	137068	50
2017-18	303376	147390	49

**Decimal points rounded off*
Source: RBI & Press Information Bureau/DGCIS

Table 5



ource: Annual Report 2017-18 Ministry of MSME

Table - 6

Existing and Revised Definition of MSMEs

Existing MSME Classification			
Criteria : Investment in Plant & Machinery or Equipment			
Classification	Micro	Small	Medium
Mfg. Enterprises	Investment<Rs. 25 lac	Investment<Rs. 5 cr.	Investment <Rs. 10 cr.
Services Enterprise	Investment<Rs. 10 lac	Investment< Rs. 2 cr.	Investment<Rs. 5 cr.

Revised MSME Classification			
Composite Criteria : Investment And Annual Turnover			
Classification	Micro	Small	Medium
Manufacturing & Services	Investment< Rs. 1 cr. and Turnover < Rs.5 cr.	Investment< Rs. 10 cr. and Turnover < Rs.50 cr.	Investment< Rs. 20 cr. and Turnover < Rs.100 cr.

Source: MSME Report 2020-21

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Leveraging Public-Private Partnerships to Fund Infrastructure Projects in India

Sayan Basu[*]

Abstract

India has been afflicted by a severe lack of infrastructure. The Indian government has started a number of initiatives in this area because it believes that the public-private partnership (PPP) model is the best way to close this gap. The fundamentals of PPP and its operation in India are covered in this essay. Infrastructure financing is one of the main problems. An excessive reliance on commercial banks for debt repayment, a lack of funding from infrastructure finance firms, challenges with external commercial borrowing, a lack of mezzanine financing, the partial availability of insurance, pension, and provident funds, and non-financing issues are some of the issues that plague infrastructure finance in India that are covered in this essay. Other recent innovations like debt bonds for infrastructure, relaxed regulations for borrowing from the outside world, and equitable departure plans are all examined. The study suggests several financial changes that are required for PPP finance in India, such as raising the cap on funding for viability gaps, permitting balloon payments, permitting foreign direct investment, promoting corporate bonds, and creating infrastructure corpuses.

Keywords: *Infrastructure in India, Public-Private Partnership (PPP), Infrastructure Financing, Commercial Bank, Infrastructure Finance Companies, External Commercial Borrowing*

1. Introduction

According to Goldman Sachs, between 2005 and 2050, the GDP growth rate per capita will be between 7.2% and 8.9%. But one major barrier to India's development has been its inadequate infrastructure. The cost of doing business for Indian manufacturers is increased by 3% to 6% due to poor infrastructure. India invested an average of only 4% of GDP annually in infrastructure between 1998 and 2005, according to the World Economic Forum. While the nation's infrastructure spending more than doubled to 8% of GDP between 2004–2005 and 2009–2010, it fell well

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short of the ambitious goal set for the 11th Five Year Plan (FYP) period, which ran from 2007 to 2012. In contrast, China invests almost 20% of its GDP in infrastructure each year. The physical infrastructure of India is now incompatible with the projected expansion due to low levels of infrastructure investment, which also raises production costs, reduces capital productivity, and weakens the competitiveness of the country's productive sectors. India's economy has been and is expected to continue being supply-constrained as a result for the foreseeable future.

The ambitious infrastructure aims of US$1 trillion for the 12th FYP, which runs from 2012 to 2017, calls for a 50% contribution from the private sector. India wants to increase the amount it spends on infrastructure from between 5% and 8% of GDP in the 11th FYP era to between 8% and 11% in the 12th FYP period. There are numerous obstacles in the way of achieving the planned investment as outlined in the 12th FYP period plan. Given the numerous demands on budgetary resources, particularly in social areas like school education and primary and preventive health care, financing infrastructure through the budget is constrained. Private sector involvement is the answer to this conundrum because it not only supplies the desperately required money but also contributes to cost reduction and increased efficiency in a cutthroat market.

Public-private partnership (PPP), its variations, and how it functions in the Indian context are all covered in this article, along with new developments in PPP for infrastructure development and the challenges associated with funding PPP projects in India. The paper ends by outlining the different financial changes required for PPP financing in India, after outlining the most recent advancements in infrastructure finance in India.

2. Finance for Infrastructure

Different Infrastructure Finance Types

For the delivery of infrastructure services, there are three main forms of financing: project, corporate, and public finance. In addition to debt financing, public finance includes equity funding, or seed capital, which is supplied by the government through general budget reserves, designated reserves, self-raised money (such licence fees), intergovernmental grants, and fiscal transfers. Concession-rate policy loans, supplier credits, and fixed income instruments in the form of revenue bonds and tax-secured bonds backed by project-related revenue streams are the methods used to finance debt. Governments may provide explicit or implicit guarantees for the financing of public debt in certain situations.

Corporate finance is the process by which businesses use shareholders' equity and retained earnings to provide equity financing. Commercial bank borrowing is included in debt financing; subordinated debt, encompassing preferred stocks and

convertible debentures; borrowing done in private; and the issuing of fixed income securities. These securities, which include commercial paper, may be short-term or lasting longer (like corporate debts).

In essence, project finance consists of investments from corporations, the public sector, and finance organisations like India Infrastructure Finance Company Limited (IIFCL) and the Infrastructure Development Finance Corporation (IDFC) that do not have sovereign guarantees. The tolling of infrastructure projects is the main source of income. The majority of the time, project-specific businesses—also referred to as the "project company"—make project finance available, with sponsors holding shares in these businesses. Typically, equity is provided by sponsors investing in the project company's share capital. The infrastructure project's revenue stream, which is allocated to lenders through security agreements with trustees, fully secures the debt. Public finance schemes serve the public interest, whilst corporate and project finance initiatives support the private and club sectors.

Qualities of Infrastructure Financing

Infrastructure projects are not the same as industrial projects or business modernization and expansion initiatives. Fundamentally, infrastructure finance possesses the qualities listed below:

- Depending on the type of project, the gestation period for infrastructure financing ranges from 5 to 20 years. There is also variation in the life cycle, ranging from 10 to 50 years. Managing asset-liability mismatches, which typically last for five to ten years, is a challenge for lending institutions.
- Though there are certain exceptions, a mega-infrastructure project including a PPP necessitates a substantial investment. For example, the Hyderabad Metro Rail, created by the Public-Private Partnership (PPP), cost rupees (Rs) 118 billion during its 35-year concession period.
- Encouraging large investments to be made over long periods of time is risky. Risks can arise from a wide range of sources. The state administration's unwillingness to assist in toll collection or to cancel toll charges altogether for political reasons is one example of technological obsolescence. Other factors include changes in the environment (working from home made possible by improved information and communication technologies), technological obsolescence (in certain industries, like the telecommunications industry), and demand uncertainty (as in transport projects). Flyvbjerg found that actual traffic for rail projects was, on average, 39.5% less than expected traffic in a review of 210 transport infrastructure projects (including 183 road and 27 rail projects) worldwide. Roads, bridges and tunnels, and rail projects had average cost escalation rates of 44.7%, 33.8%, and 20.4%, respectively.

- Exorbitant prices may discourage customers and have the unintended effect of undermining economic growth. Because the project's revenue streams frequently depend on the underlying rate of inflation, returns in this case must be calculated in real terms. Additionally, a larger project returns during the project's first few years of operation decreased the risk for lenders.

Origin of Public-Private Partnership (PPP) and Its Branches

Although the government has historically been in charge of infrastructure development, there is an artificial scarcity of high-quality infrastructure facilities due to the significant and growing gap between infrastructure needs and available resources. This problem led to clogged roads and bridges, lengthy phone wait times, subpar public transit systems, intermittent electricity supplies, a dearth of hospitals and educational facilities, insufficient waste treatment facilities, and more. In turn, these issues result in increased accidents, decreased competitiveness, poorer output, and enormous expenses for society. During the 2004–2005 budget speech, India's then–finance minister emphasised that the country's infrastructure deficit was the most noticeable one. The Planning Commission acknowledged in the 11th FYP that the public sector could not provide the complete resources needed to close the infrastructure gap. Therefore, in order to achieve the total investment needs, private investment was required. Even while PPPs have gained traction since then, they are still limited to specific industries like telecom, ports, airports, and roadways.

The PPP model was invented in the UK. The UK government developed infrastructure facilities through partnership arrangements through the Private Finance Initiative. A little more than ten years ago, PPPs were hardly a blip on the radar screen. However, in 2004 Private Finance Initiative projects accounted for between 10% and 13% of all UK investment in public infrastructure. The rest of the globe imitated the UK. One of the most significant strategies governments employed to address the infrastructure gap was the financing, planning, construction, and operation of infrastructure by the private sector.

In India, PPPs are defined broadly as an agreement between a government or statutory entity, government-owned entity, and a private sector entity for the provision of public assets, related services, or both for the benefit of the public, through management-made investments or ventures undertaken by the private sector entity, or both, for a predetermined period of time; there is a significant amount of risk sharing with the private sector, and the private sector is compensated with performance-linked payments that meet predetermined, measurable, and specified performance standards. In contrast to conventional procurement approaches, the private sector takes on a bigger part of the planning, funding, designing, building, running, and maintaining of public assets. According to a Deloitte research study, some of the most popular PPP models are as follows:

- Design-build or build-transfer. In this arrangement, a commercial partner and the government enter into a contract for the design and construction of a facility that complies with government regulations. Following completion, management and upkeep of the facility will fall within the purview of the government.
- Construct-Lease-Transfer. The completed facility is leased by a private sector entity. The asset is transferred to the public sector organisation at no additional cost at the end of the lease period. The public sector entity retains operational control for the duration of the lease.
- Design-build-operate or build-transfer-operate. In this arrangement, the facility is designed, constructed, and run by the private partner for a predetermined amount of time. Nevertheless, the public-sector organisation receives title to the new facility upon completion.
- Design-build-operate-maintain or build-operate-transfer. This model combines, for a limited time, the build-transfer duties with those of facility management and maintenance by a private sector partner. The public-sector organisation takes over operations responsibility at the conclusion of the term.
- Develop, own, run, and transfer. In this instance, the government gives the private partner a licence to fund, plan, construct, and run a facility for a predetermined amount of time. At the conclusion of that time, the facility's ownership returns to the public sector organisation.
- Develop, own, and run. Under this paradigm, the government gives the private sector the authority to own a project and to finance, plan, build, run, and maintain it.
- Develop, assemble, fund, run, and maintain. In this model, a new facility is designed, constructed, financed, operated, and/or maintained by a private sector organisation under a long-term lease. The facility is turned over to the public sector organisation at the conclusion of the lease period.

The following PPP models for currently available services and facilities were found in the same study:

Rent a space: A private organisation receives a leasehold interest in an asset from the government. The asset is managed and operated by the private partner in compliance with the lease's conditions.

Giving in: The government gives the private organisation the exclusive right to supply, run, and maintain an asset for an extended length of time in compliance with the performance standards it has established. The asset is still owned by the public sector, but any enhancements made during the concession period are owned by the private operator.

Disposition: An asset is transferred in whole or in part by the government to a private sector organisation. In most cases, the government places restrictions on the sale that demand improvements to the asset and the provision of services.

PPP: Preferred Financing Mode

Under the PPP model, the private sector takes on a bigger part in the planning, funding, designing, building, running, and upkeep of public infrastructure. The party most qualified to manage the project assumes the risk. Numerous efficiencies have been found to come from PPP initiatives. Following is a list of a few of them.

a) Lessened excess in costs. PPP projects are less expensive than those carried out under engineering, procurement, and construction since the concessionaire is incentivized to employ economical methods during execution.

b) Lessened distortion of the economy. Globally, the idea that "user has to pay and polluter also has to pay" is gaining traction. Those who do not utilise infrastructure services pay the same as those who do if the services are kept as public goods (with non-excludability and nonrivalry rules applied). By allowing the commissioner to only collect fees from users, PPP removes distortion.

c) Efficiency in production and allocation. It is possible to use resources for a particular application more efficiently. Infrastructure can be built and operated more quickly, at a lower total cost, or both by utilising tried-and-true methods and providing incentives for creativity. Users pay for the services they use, thus infrastructure improvements that are most deserving are given priority over other initiatives.

d) Economic and societal effectiveness. More projects can be supported on a fixed capital budget when there is greater capital available. Infrastructure development accelerates the accrual of social benefits since the concessionaire is motivated to complete the project considerably ahead of schedule and commission it for income generating. Infrastructure accessibility is increased, which leads to an improvement in quality of life.

e) Prudence with money. Given their limited resources, governments often overlook concerns about the fiscal deficit. According to the Fiscal Responsibility and Budget Management Act of 2003, a higher percentage of PPPs in infrastructure development would aid in reducing the fiscal deficit.

f) The release of entrepreneurial vigour. Nations undergoing transition possess a vast reservoir of untapped entrepreneurial potential. The collaboration between infrastructure service providers and users would promote the nation's economic growth.

PPPs' Operation in India

The Indian government is currently working to establish an atmosphere that will allow the private sector to participate extensively in infrastructure development, either entirely or in part. PPP projects, including those for toll roads, ports, and airports, are founded on concession agreements between the government and the developer. Projects that are solely in the private sector are driven by the market, such merchant power plants and telephones.

PPPs do not benefit the system unless governments improve their ability to implement and oversee PPPs. Governments must create the appropriate framework and tools and take the initiative to resolve problems that arise with the PPP model. There is a shift in mindset, beliefs, and procedural formality while moving from the old procurement paradigm to PPPs. PPPs would be more widely accepted if they were viewed as a transparent and equitable means of luring private investment into public projects with the goal of improving the welfare of all parties involved. The Indian government has implemented several initiatives and steps in this direction over the last ten years. Below is a discussion of a few of them. The midterm assessment of the 11th FYP and the compilation of PPP infrastructure projects are the sources of the information on these initiatives.

The Committee on Infrastructure's Constitution

The Prime Minister chaired the Committee on Infrastructure when it was established on August 31, 2004. In 2009, it became the Cabinet Committee on Infrastructure (CCI). CCI's agenda includes developing institutions to optimise the role of PPPs, launching regulations that guarantee the timely production of world-class infrastructure, and keeping an eye on the status of important projects. Reforms in institutions, rules, and procedures have also been started by CCI.

Announcing Funding for Viability Gaps

In order to improve the financial viability of infrastructure projects that were competitively bid and determined to be economically and otherwise justified, but whose financial returns fell short of the typical benchmark, the viability gap funding (VGF) plan was introduced in 2006. PPP projects carried out by a government body are eligible for financial assistance from the central government under the VGF, which can amount to up to 20% of capital expenditures. During the project's operational phase, the sponsoring authority may additionally award up to 20% of the project's expenses. The full VGF for national highway projects is provided by the National Highways Authority of India, which receives transfers of excess funds from the central government. Competitive bidding is used to determine each project's VGF support. If all other conditions were met, the bidder with the lowest VGF quote would be the one to win the project.

Committee Empowerment - Institutional Empowerment

A committee-empowered inter-ministerial organisation was formed to evaluate and approve projects in order to receive the VGF grant for PPP projects. The VGF is released to the principal financial institution funding the concessionaire in order to guarantee that the concessionaire does not misuse the fund or taint the award process.

The India Infrastructure Finance Company Limited was established. Due to the high cost of this type of financing and the lack of market benchmark rates for obtaining long-term debt, private companies carrying out infrastructure projects under the PPP mode had restricted access to debt funds with longer maturities.

For this reason, IIFCL was founded in 2006 as a nonbanking organisation to offer long-term loans for the purpose of funding infrastructure projects with protracted gestation periods. Up to 20% of the project expenditures can be funded by IIFCL through direct lending and refinancing. This lending may consist of half subordinated debt, which functions as quasi-equity.

Development Fund for Infrastructure Projects in India

Even though a PPP project's concessionaire bears all project costs (with the exception of VGF), funding is needed for preparatory work in the form of advisory services, which includes project agreement preparation, project structuring, development costs, and consultant engagement. To provide financing for these kinds of uses, the Indian government's Ministry of Finance established the India Infrastructure Project Development Fund.

Structure and Example Papers

In PPP projects, the concessionaire receives the government's authorization to provide public goods for a designated length of time known as the concession period. In most cases, this strategy involved leasing or transferring public property, giving the government more power to recover user fees, operating public utilities and services in a monopolistic setting, and distributing risk and potential liability. Due to the involvement of numerous stakeholders, project agreement conditions and the concession awarding bidding process were typically complicated. Decision-making is streamlined and accelerated by standard documents, which also guarantee that the procedure is carried out impartially, openly, and without bias. This framework is provided by the planning commission's model concession agreements, which are available for different industries.

New Developments in Ppp for Infrastructure Improvement

PPPs are quickly taking over as the method of choice for building and managing financially feasible infrastructure projects. However, the PPP model has not yet been applied in many areas in India, including education, healthcare, irrigation projects, and the upkeep and renovation of water bodies.

States within states and nations as a whole continue to be at varying stages of PPP implementation and knowledge. Even with a fifteen-year experience and a thorough framework for PPPs, India is still at the beginning of the PPP market maturity curve. Governments might take a cue from the UK and other nations that have not embarked on massive PPP projects for healthcare, education, and defence infrastructure. It is possible to steer clear of some of the common errors committed in the early phases of the maturity curve, such as the propensity to use the same model for all infrastructure projects.

Thanks to the establishment of a strong and comprehensive framework that includes organisations like PPPAC, CCI, and an empowered committee-empowered institution, as well as clear procedures and documentation like model concession agreements, financial institutions and funds like IIFCL and the India Infrastructure Project Development Fund, India is poised to enter the second stage of the PPP maturity curve. Countries in Stage 2 of the PPP market maturity curve set up specialised PPP units in their agencies and are developing novel hybrid delivery models. At this point, the PPP market strengthens and broadens to encompass a range of projects and industries. Countries also utilise new money sources from the capital markets.

At the third stage of the PPP market maturity curve, nations innovate, refine, and increase their focus on the project life cycle while utilising more sophisticated risk models. A complex infrastructure market is developed with the participation of provident funds, insurance funds, pension funds, and private equity firms. These developments have not yet been observed in India.

3. Problems with PPP Project Financing in India

Insufficient Financial Support from Infrastructure Financing Firms

In the PPP model, there are still a lot of unanswered questions about financing private players. Approximately 70% of the resources needed by the private sector are financed through borrowing. It is vital to increase bank loan availability in order to close that gap. The IDFC and the IIFCL are considered insufficient to meet the sector's increasing financing demands, despite the fact that they are intended to offer long-term debt for infrastructure development.

Insufficient Asset-Liability Analysis and Excessive Reliance on Commercial Banking

From 13% of their total loan in 2000 to 33% in 2009, commercial banks lent more money to the infrastructure sector. The asset-liability mismatch is the primary concern in infrastructure debt financing since these funds are typically allocated for long-term projects. The private developer is also impacted by this problem. The developer transfers the load on the end user due to the project's short payback period and lengthy gestation period.

Examining certain regulatory concerns related to borrowing from financial institutions and banks is also necessary. Given that they are primarily funded by short-term deposits, banks are unable to provide funding for long-term financing. Liquidity risk and interest rate risk are two potential consequences of this mismatch. Although the bank's interest rate risk can be reduced by lending on a floating rate basis, the concessionaire would not be able to assess the project's long-term financial viability. Furthermore, banks and other financial institutions have little experience evaluating the creditworthiness of these kinds of initiatives. Additionally, depending solely on commercial banks to handle the entire debt component is not a good idea. Using a variety of debt financing sources is the answer.

The debt plans of the banks must also be in line with the needs of the infrastructure sector, just as they are with those of the agricultural and manufacturing sectors. Furthermore, it is widely understood that long-term obligations should be used to finance long-term assets in order to eliminate the mismatch between assets and liabilities. In order to adequately manage the risks associated with long-term infrastructure projects, derivative markets are crucial. However, India's derivative markets have not yet expanded.

Absence of Mezzanine Funding for Infrastructure Initiatives

In India, mezzanine financing, often known as quasi-equity funding, is still relatively new. In the event that loan repayment is delayed, mezzanine financing enables the financing business to convert the loan into equity. Mezzanine loans have an interest rate that is somewhat higher than senior lender loans. Owing to PPP projects' average debt-to-equity ratio of 70:30, the concessionaire could be charged with using loans to leverage the project. Mezzanine finance has the potential to buck this trend and increase concessionaire accountability. Mezzanine financing is a new venture for a few Indian private equity firms. Mezzanine finance can be obtained through long-term lending financial institutions like IDFC and IIFCL.

Use of Pension and Provident Funds, Insurance Funds, and Other Funds for Infrastructure Projects

Life insurance companies are required to allocate a minimum of 15% of their life fund towards housing and infrastructure. In 2011–2012, just 10% of the funds under administration were allocated to funding infrastructure development. This figure demonstrates that insurance companies have not made the necessary contributions to the funding of infrastructure. It has not been used to finance infrastructure as of yet due to the conservative attitude on the utilisation of pension funds. However, initiatives are underway to include provident and pension funds in the financing of infrastructure.

Additional Concerns Regarding Infrastructure Financing

When a project is delayed, it causes serious problems for the concessionaire, financial institutions, project authority, government, and all other stakeholders. The financial estimations are erroneous as a result of the delays in land acquisition and environmental clearance, the aberrations and delays in policy making that result in policy stagnation, and the lack of prompt redress processes caused by the delays in project planning and implementation. It has no beneficial effect on stakeholders and raises end users' service fees. Delays put the return on the investment at risk by driving up construction expenses. The concessionaire's cash flow and ability to repay the loan would be impacted by a delay in the commercial operations date (COD), as it would result in the concessionaire receiving less money from customers. As a result, the project that was once financially feasible would no longer be sustainable.

4. Recent Advances in India's Infrastructure Finance

The following discusses several recent government-introduced initiatives for improved financing of infrastructure.

Debt fund for infrastructure and takeout financing

Due to the asset-liability mismatch, commercial banks are unable to fund PPP infrastructure projects with repayment terms of fifteen to twenty years. The asset-liability mismatch may be resolved if commercial banks are permitted to move the loan to another financial institution after a duration of five to six years, which often aligns with the project's construction phase. We refer to this strategy as takeout financing. To guarantee that the project receives long-term financing from several lenders, the loan is moved from the financing bank's books to another financial institution (second lender) within the predetermined timeframe—let's say a year from the COD. The money from the second lender is received by the first lender.

The Deepak Parekh Committee suggested creating the Infrastructure Debt Fund (IDF) in order to raise Rs 500 billion (US$11 billion), and the Indian government subsequently unveiled the IDF in order to enable takeout financing. The framework permitted the establishment of the IDF by one or more sponsors, who might be multilateral organisations, commercial banks, investment banks, or nonbanking financial firms. Ten percent or more of the total fund must be invested by the sponsors. In order to make things easier for offshore investors, the 20% withholding tax on interest payments on IDF borrowing was lowered to 5%. An income tax deduction of up to Rs 20,000 was available to domestic investors who invested in these bonds. In exchange, they would receive an interest rate ranging from 7.5% to 8.25%, either annually or cumulatively. IDF bonds had a 10-year term and a 5-year minimum lock-in period. Generally speaking, IDF makes roughly 10% more than it pays its investors in interest. The remaining amount is retained as a corpus to cover any obligations resulting from nonperforming assets after operational costs are subtracted. When lending to project firms, IDF pools all of the bonds; they are not project-specific. IDF was limited to PPP projects that had finished a full year of business operations. Commercial banks would be spared the asset-liability mismatch issue by IDF funding one year after the COD, since PPP projects (like roads) take approximately four to six years to start operating commercially. This is because the debt can be transferred from commercial banks to IDF one year after the COD.

Since 2011, a number of financial firms have offered IDF bonds. The amount raised was Rs 30,000 in 2011–2012, the first year of deployment; in 2012–2013, it was roughly Rs 25,000, and for 2013–2014, the objective is Rs 500 billion. However, in comparison with the US$1 trillion infrastructure investment target for the 12th FYP, India's Rs 500 billion is insufficient.

Relaxation of External Commercial Borrowing Regulations

In January 2013, the Reserve Bank of India loosened the requirements for infrastructure financing companies seeking external commercial borrowing. Infrastructure finance companies can now borrow up to 75% of their net worth abroad without the Reserve Bank of India's approval, compared to 50% previously. Additionally, the percentage of their exposure to currency risk that needed to be hedged was lowered from 100% to 75%. However, the advantage resulting from the relaxation of the hedging requirement would have been negated by the increase in the value of the Indian rupee relative to the US dollar between March and October 2013.

Secured Credit for the Development of Infrastructure

In March 2013, the Reserve Bank of India declared that, subject to a few restrictions, the debt owed to lenders in public-private partnerships (PPPs) might be classified

as secured. The terms include a predetermined increase in user charges or an extension of the concession period if project revenues are lower than expected, the requirement that user charges and toll payments be kept in an escrow account where senior lenders have priority over withdrawals by the concessionaire, and the senior lender's right to substitute in the event of concessionaire default.

Reasonable Ways to Leave

For PPP road projects, the B K Chaturvedi Committee suggested fair departure alternatives for the concessionaire in 2009. The idea was to accelerate the rotation of capital for construction companies, which would attract more investment for infrastructure projects under the PPP, if developer companies were permitted to divest their equity holding to operation and maintenance companies at the end of the construction phase without any lower limit. The change of ownership was reinterpreted by the B K Chaturvedi Committee to mean that the bidders' equity portion could fall below 51% at any point up to two years following COD. It further said that until two years following COD, each consortium member reviewed for prequalification and short listing in response to the request for qualification should own at least 26% of such equity. The B K Chaturvedi Committee eased the requirement for the bidder to hold any stock after COD, although it still required the bidder to hold 51% until two years after that. Ultimately, it was agreed that the bidder would retain a minimum of 26% of the concession for the next two years following COD. The Indian government said in June 2013 that the bidder for both finished and continuing projects could fully forfeit its equity.

India Needs Financial Reforms for PPP Financing

Employing Home Savings

Gross domestic savings make up more than 30% of GDP in India. The majority of low-risk, low-return savings in India go towards bank deposits. The new place to put money that has a medium risk and return ratio is a mutual fund. The stock markets are where high-risk, high-reward savings are allocated. The government can provide inflation-indexed government bonds, which have an underlying sovereign guarantee, to finance infrastructure by allocating a sizeable portion of low-risk, low-return and medium-risk, medium-return deposits from India.

Household savings in 2012–2013 were approximately Rs 10.9 trillion, or 7.7% of GDP. Currently, an individual investor can receive up to Rs 20,000 in income tax benefit by investing in IDF bonds. In order to leverage domestic savings for infrastructure financing, the Working Sub-Group on Infrastructure Funding Requirements and Its Sources advocated raising the income tax exemption for IDF bonds to Rs 100,000 for the 12th FYP (2012 to 2017). When real estate investments are expected to provide a high return and mutual funds, which are somewhat riskier

and return-oriented, are predicted to yield a 15% annual return, it is difficult to attract voluntary investments for the IDF bonds. When equity investors in infrastructure projects expect a 20% to 25% return on their shares, it makes sense to assume that household investors expect a return of 8% plus inflation. IDF bonds may have interest rates that are adjusted to inflation and have a maturity duration of roughly 15 years in order to increase their appeal. By doing this, domestic savings would have the choice to be invested in long-term infrastructure finance.

Permitting International Investment

In greenfield projects, the automatic route allows for 100% of foreign direct investment (FDI). FDI through the automatic method is allowed up to 74% in the case of ongoing projects, nevertheless. Additionally, 100% FDI is allowed under the automatic route in the following industries: mining for coal and lignite; developing buildings; mining for precious stones, diamonds, gold, silver, and other minerals; natural gas and petroleum; power generation, transmission, distribution, and trading; and manufacturing telecom equipment. Up to 74% of FDI is permitted in communications services, subject to certain limitations. If it comes to air transport services, FDI is permitted up to 49 percent. With 100% FDI for infrastructure projects, particularly those with lengthy maturation periods, the ambitious goals of infrastructure development as outlined in the 12th FYP may be realised.

Raising the VGF Ceiling

As of right now, VGF can account for up to 40% of the project's overall cost. When it comes to road developments, the National Highways Development Project's first two phases—which involve high-density corridors—are practically finished. The National Highways Development Project's subsequent phases do not offer as much financial reward as the projects in its first two phases did. Only 20,000 km of the approximately 35,000 km road network were given awards. Just 787 km were awarded in 2012–2013, and from April 2013 to October 2013, not a single kilometre was awarded. For instance, the building times for rail and electricity projects are much longer, the financial outlays are substantial, and the anticipated return on investment is long-term (about 30 to 40 years). For instance, the Rs 118 billion Hyderabad Metro Rail PPP includes a 35-year concession period and an extra 25-year entitlement covering the five-year construction period. Given this, increasing the VGF ceiling from the present 40% of the total project cost to 49% with higher concessionaire equity would be preferred by the project authority. Actually, there should be a link between the concessionaire's equity and the VGF. When the equity component is minimal, there is less skin in the game. For projects that access the VGF and are expected to yield windfall profits, the concession agreement should contain provisions that guarantee a fair distribution of the benefits between the concessionaire and the authority.

Permitting Payment by Balloon and Payment by Delayed

The concessionaire must pay the principal and interest within 7 years of the project's start date because commercial bank loans have a duration of roughly 7 years. Project financing institutions may choose to provide money at the start of the project but permit a concessionaire to defer repayment until the commercial loans are fully repaid, as opposed to seeking takeout financing at the conclusion of the term of the loans from commercial banks. Moreover, using a balloon payment may potentially cause the repayment to be postponed.

Motivation for Corporate Bonds

Thirty percent of Indians reside in urban areas, according to the 2011 census, and by 2030, that number is predicted to rise to forty percent. However, the current state of the infrastructure—roads, power, drinking water, sanitation, and other amenities—remains well short of the increasing demand. The urban local bodies can only cover less than one-third of the entire funding requirements for infrastructure development with their current revenue streams. The stimulus for corporate bonds would supply the required funding for VGF when PPP projects pertaining to urban infrastructure are awarded.

Developing Financial Capability for Government: Requirement for a Transport Infrastructure Corpus

About half of the retail price of petrol and diesel in India is taxed, with the federal government and state governments sharing this portion approximately equally. The union government's share of the central excise tax on petroleum goods brought in Rs 748 billion in revenue in 2012–2013. The high taxes on petroleum products should ideally go towards building sustainable, environmentally friendly, and fuel-efficient transportation infrastructure as well as programmes to mitigate the effects of climate change, improve transportation safety, and other related issues. At the federal and state levels, a transport corpus that is predominantly funded by petroleum product taxes is required in order to provide the funding required for VGF of mega transport projects.

A Comprehensive View of PPP and Its Finance

The majority of the departments and ministries responsible for infrastructure are under the concurrent list of the union and state governments; both could contribute at the same time. However, only a few state governments have used PPPs to construct infrastructure thus far, despite the fact that all state governments can easily copy the PPP project framework and increase their investments in a range of physical and social infrastructure sectors. By 2010, the union and state governments had finished or were in the process of implementing PPP projects at a total cost of Rs 1012.57 billion and Rs 2064.81 billion, respectively. Five states—Uttar Pradesh,

Gujarat, Maharashtra, Karnataka, and Andhra Pradesh—accounted for 58.3% of the total value of state government PPP projects.

PPP financing-related concerns are inextricably linked to a wide range of other problems plaguing PPPs and the overall administrative framework. Developers that invest in long-term PPP projects run a significant risk unless succeeding elected governments maintain continuity in policy and treat developers fairly. Developers must swiftly redress through arbitration or litigation when the government reneges on the mutually negotiated concession agreements without justification.

5. Conclusion

In India, PPPs have undoubtedly accelerated. According to the World Bank's PPP Data Update Note 68A, India has ranked highly among countries receiving private investment in infrastructure since 2006. India's 43 new projects with private participation in the first semester of 2011 accounted for over half of the investment for new private participation in infrastructure projects for developing nations. The Planning Commission of India has set a higher acceleration rate for the 12th FYP, which spans from 2012 to 2017. For the 12th FYP, an estimated Rs 65 trillion (US$1 trillion) in total finances will be required, leaving about Rs 14.6 trillion (US$231 billion) in financing gaps. The structure of the PPP model is quite well-developed, although it still needs certain adjustments. Apart from the general economic slowdown, the main issue has been how to finance infrastructure. Recent trends indicate that PPPs are increasingly being used to award larger contracts. For instance, the Golden Quadrilateral's current four-lane highways would be converted to six-lane roads under PPP, a difference of several hundred km from the road portions that were previously granted. Railroads, which were previously not included in comprehensive development plans, must be included in the PPP reforms.

The total project cost of railway projects is almost always significantly higher than that of road projects when railways use PPPs. Better infrastructure finance arrangements must therefore be established. In addition, as India gets ready to move into the second stage of the PPP maturity curve, PPPs need to address hitherto unaddressed sectors like irrigation, the construction and maintenance of water bodies, rainwater harvesting, education (especially primary and secondary education), power, river linking, the creation of new channels and inland waterways, primary and preventive healthcare, and specialty hospitals. A wide range of financial instruments are needed to address the massive financing needs, and the proposals made in this article will help achieve that goal.

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Resilience of Carbon Efficient Index: An Assessment of Global Shocks

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Abstract

This paper investigates the resilience of carbon efficient firms in an overwhelming global crisis, including economic and social, that was expected to generate profound impact on low-carbon growth trajectory. To this respect, the current study has estimated the vector auto regressive model with the Standard & Poor's (S&P) 500 Carbon Efficiency Index (CEI) and global crisis indicated by stock market volatility index, financial stress index, natural disaster events, climate policy uncertainty index, economic policy uncertainty index and geo-political risks. The study has used monthly data from November 2018 to June 2024, obtained from secondary sources. The climate finance has been identified as resilient to global shocks in general, except for financial shocks. The results suggest that financial shock has a significant impact on climate finance indicated by S&P 500 Carbon Efficient Index. More stressed financial conditions or intense volatility in the financial market put downward pressure on carbon efficient index. The paper provides insights for firms interested in climate finance and carbon-efficient portfolios and safe-haven status for stakeholders.

Keywords: *Carbon Efficiency Index, Financial Shocks, Climate Shocks, Resiliency*

1. Introduction

The 2015 Paris Agreement, endorsed by 196 nations, has the potential to drastically transform economies, societies, and the environment on various scales. Firstly, UN member countries committed to keeping the global temperature rise well below 2°C above pre-industrial levels (Monasterolo and de Angelis, 2020). To achieve this, reducing greenhouse gas emissions has become a crucial objective (Benz et al., 2021;

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Işık et al., 2017, 2021; Ongan et al., 2021). Secondly, countries acknowledged the necessity of climate finance, green investments, green technology, and capacity-building to support the transition to low-carbon, climate-resilient development (Peake and Ekins, 2017). This necessitates shifting economic and financial policies from traditional approaches to environmentally sustainable ones (Benz et al., 2021; Isik et al., 2021). Post-Paris Agreement, many governments and corporations have increased their commitments to achieving net-zero carbon dioxide (CO2) emissions in the coming decades as part of global sustainability efforts (International Energy Agency [IEA], 2020). Tools like green bonds, green loans, sustainable bonds, and carbon stocks have become more prevalent for promoting a low-carbon economy and reducing emissions (Banga, 2019; Benabdellah et al., 2021; Fatica and Panzica, 2021; Palea and Drogo, 2020; Tolliver et al., 2020). However, economic and demographic shocks have significantly altered political and economic priorities. For instance, the 2020 pandemic shifted global priorities from climate change to economic recovery. As a result, many firms adjusted their contributions to green taxes and climate finance. These global shocks have also impacted long-term efforts to limit greenhouse gas emissions under the Paris Agreement (Reilly et al., 2021).

A stock market index measures the performance of a group of stocks or securities in a financial market, providing insights into the overall health and direction of the market. Increasingly, indices consider the risk associated with fossil fuels or high carbon emissions. These "carbon indices" inform investors about potential exposure to government regulation or shifts in consumer attitudes that increase the cost of carbon, thereby influencing investment priorities. The S&P 500 Carbon Efficient Index (CEI) measures the performance of S&P 500 companies while adjusting for their carbon emissions per unit of revenue. The index integrates low-carbon considerations into broad market indices, adjusting company weights within industries based on their carbon-to-revenue ratios to reduce overall carbon exposure while maintaining industry allocations. Companies in the CEI are drawn from sectors included in other common stock market indices but exclude large carbon emitters that do not disclose their emissions. The index also adjusts weights based on carbon emissions per unit of revenue. From January 2019 to January 2024, the CEI's five-year annualised return is approximately 13%, performing as well as or better than several other major indices. Movements in the US stock market can affect both developed and developing markets, causing a spillover effect (Shehzad et al., 2021).

This paper adds to the limited research on how the different global shocks has affected sustainable businesses. It examines the response of the Standard & Poor's (S&P) 500 Carbon Efficiency Index (CEI) to global stresses and shocks, including climate, financial, geopolitical, and demographic risks. Understanding how low-carbon company shares respond to these shocks can inform the design of corporate sustainable development policies and foster innovative strategies that reflect the evolving relationship between

business, society, and nature (Edwards, 2021). The current study's novelty lies in its investigation of the S&P 500 CEI amid global market uncertainty and fluctuation. It highlights the crucial role played by economic uncertainty in firms' strategy formulation and management decisions (Mirza and Ahsan, 2020). This study offers new insights into the resilience of low-carbon companies and economies by assessing the impact of economic uncertainty on the S&P 500 CEI.

The rest of the paper is organised as follows: Section 2 reviewed the performance of the carbon efficient index in the context of global stresses and shocks. Section 3 presents the analytical approach of the current study including data and methodology. Section 4 reports and discusses the empirical findings. Section 5 concludes the paper and discusses the policy implications.

2. Performance of the carbon efficient index: a review

Energy indices provide a clear summary to measure the energy performance of the country which is a prerequisite for policy making. Increasing rates of greenhouse gases (GHGs) emissions are causing dangerous climate changes which seem irreversible. Therefore, it is vital to assess the state of countries with the GHGs and carbon emissions in order to develop low carbon economies. This requires a comprehensive statistical analysis. Different literature developed different types of aggregated composite index of energy security and environmental sustainability for each of the world's highest GHGs and CO2 emitting countries. Carbon efficient index is based on a comprehensive set of indicators including carbon emission and energy metrics. Composite indicators have been used to combine all the indicators in a holistic way. Higher values show a better efficiency and vice versa. The composite index analysis can rank the countries based on their efficiency score and provides a roadmap and guidelines for the future policymakers. The S& P 500 CEI is such a composite index launched in October, 2018 which is explained in the following paragraphs. Here it is important to mention that the S&P 500 and the S&P 500 Carbon Efficient Index (CEI) represent different facets of the stock market, with the latter emphasizing companies with lower carbon emissions. The S&P 500 Carbon Efficient Index (CEI) is designed to measure the performance of companies in the S&P 500 while adjusting for their carbon emissions. This index aims to provide investors with insights into companies that are managing their carbon footprint more effectively, aligning with the growing emphasis on sustainability and environmental responsibility. The performance of the S&P 500 CEI can be particularly revealing during episodes of global shocks, such as financial crisis, demographic crisis, and geopolitical events. The performance of the S&P 500 CEI during different episodes of global shocks are described below. Analysing the performance of S&P 500 vis-à-vis S&P 500 CEI during various global shocks provides insights into the resilience and stability of sustainable investments compared to the broader market (Koçak et al., 2022).

A. Global Financial Crisis

During the global financial crisis, the overall stock market experienced significant declines. The global financial crisis led to a sharp decline in the S&P 500, with significant volatility as financial institutions faced unprecedented challenges. The broad market experienced a substantial drop in value, reflecting the widespread economic turmoil. The S&P 500 CEI, like other indices, faced considerable volatility. However, companies with lower carbon footprints often demonstrated better resilience due to their forward-thinking strategies and robust risk management practices. While the CEI did decline, the performance gap between it and the broader S&P 500 was narrower, indicating that companies focused on sustainability might be better positioned to withstand financial shocks.

B. COVID-19 Pandemic (2020)

The COVID-19 pandemic caused unprecedented disruptions across the globe. The initial impact of the COVID-19 pandemic caused a sharp downturn in the S&P 500, reflecting the sudden halt in economic activity and uncertainty. However, the index rebounded strongly due to the rapid adaptation of many sectors, particularly technology. During this period, the S&P 500 CEI showed notable resilience compared to the broader S&P 500 index. Many low-carbon companies, particularly those in the technology and healthcare sectors, managed to adapt quickly to the new normal. Their agility, coupled with their lower carbon footprints, helped them maintain stability and even achieve growth during the pandemic. Companies with lower carbon footprints often had more robust risk management and sustainable business practices, helping them navigate the crisis better. This resilience underscored the importance of sustainable business practices in navigating unexpected global health crisis (Koçak et al., 2022).

C. Oil Price Shocks

The S&P 500 tends to be significantly impacted by oil price shocks, given the substantial presence of energy companies in the index. Volatility in oil prices can lead to pronounced fluctuations in the S&P 500. Historically, oil price shocks have had a mixed impact on the S&P 500. However, the S&P 500 CEI tends to be less affected by fluctuations in oil prices due to its emphasis on companies with lower carbon emissions. These companies are often less dependent on fossil fuels and more invested in renewable energy and energy-efficient technologies. As a result, during periods of oil price volatility, the CEI has often outperformed the broader S&P 500, highlighting the financial benefits of a low-carbon strategy.

D. Geopolitical Tensions and Trade Wars

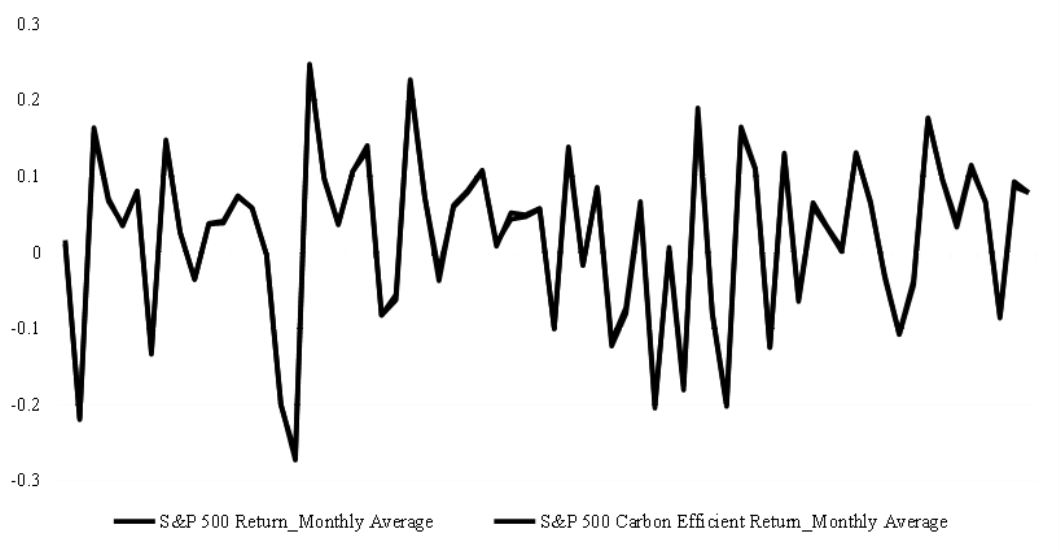
Geopolitical tensions, such as trade wars, can create significant uncertainty in the markets. During such episodes, the S&P 500 CEI's performance has varied. Companies

within the CEI that are more globally diversified and less reliant on carbon-intensive industries have shown greater resilience. Under the S&P 500, sectors heavily reliant on international trade and global supply chains can be particularly affected. Their strategic focus on sustainability and innovation has allowed them to navigate geopolitical risks more effectively than their higher carbon-emitting counterparts.

E. Climate Change-Related Events

With the increasing frequency of climate change-related events, such as extreme weather, the performance of the S&P 500 CEI has gained attention. Companies within the CEI that have robust climate risk management strategies tend to perform better during such events. Their proactive approach to mitigating climate risks and reducing emissions has positioned them well in the eyes of investors who are increasingly prioritizing environmental sustainability. Companies with significant carbon footprints may face increased regulatory scrutiny and operational challenges.

Figure 1. Movement of S & P 500 and S & P 500 Carbon Efficient Index from November 2018 to June 2024



Source: S&P 500 and S&P Carbon Efficient data 2018-2024

The S&P 500 Carbon Efficient Index has demonstrated varying degrees of resilience and performance during different episodes of global shocks (Koçak et al., 2022). However, the overall performance of both the indexes for all firms moves almost in similar pattern over June, 2018 to June, 2024 (Figure 1). Generally, companies with lower carbon emissions and strong sustainability practices have shown better adaptability and stability (Rao et al., 2023). In fact the S&P 500 CEI slightly outperforms the broader S&P 500 during periods of crisis due to the sustainable practices and robust risk management of its constituent companies. This trend underscores the

growing importance of sustainability in investment decisions and highlights the potential long-term benefits of focusing on low-carbon, environmentally responsible companies. These findings highlight the growing importance of integrating environmental considerations into business strategies and investment decisions (Rao et al., 2023). As global challenges continue to evolve, the emphasis on sustainability and carbon efficiency will likely become even more critical in determining the resilience and success of companies within the index.

3. Data Description

The study have used monthly data from November 2018 to June 2024. The start date of the sample period is based on the launch date of S&P 500 Carbon Efficient index. S&P 500 CEI has been used as a proxy for climate finance index. This index measures the performance of low carbon emitting companies from the list of S&P 500.

As mentioned earlier that the primary focus of the study is to identify the effects of various shocks on S&P 500 CEI; accordingly, the current study have considered four different types of global shocks. Financial shocks has been captured by CBOE VIX and the Financial Stress Index. The Chicago Board Options Exchange's (CBOE) Volatility Index, VIX, is used to capture the stock market volatility. The Financial Stress Index (FSI) is used to measure the stress in the global financial market. It is constructed from 33 financial market variables, such as yield spreads, valuation measures and interest rates. The FSI is positive when stress levels are above average and negative when stress levels are below average. Climate shock has been captured by two alternative indicators – the number of recorded Natural Disaster Events (NDE) and the Climate Policy Uncertainty Index (CPUI). The number of global reported natural disaster events and total affected population in any given year is recorded mainly by the Centre for Research on the Epidemiology of Disasters (CRED) under the Emergency Events Database (EM-DAT) processed by Our World in Data. EM-DAT contains essential core data on the occurrence and effects of over 18,000 mass disasters all over the world. This variable considers the disasters like Drought, Earthquake, Extreme Temperature, Flood, Fog, Glacial Lake outburst, Landslide, Mass movement, Extreme weather, Volcanic activity and Wildfire. In addition to that the study have followed the textual-based Climate Policy Uncertainty (CPU) index of Gavriilidis (2021). Economic Policy Uncertainty (EPU) and Geo-Political Risk (GPR) index is used for the economic policy and geo-political shocks respectively. The summary statistic of these variables are reported in the Table 1.

Table 1: Descriptive Statistics

	S & P 500 CEI	**VIX**	**FSI**	**NDE**	**CPUI**	**EPU**	**GPR**
Max	0.0628	1.009	7.086	2.167	-0.94	0.607	0.709
Min	-0.206	-0.37	-6.61	-2.32	1.232	-0.43	-0.60
Mean	0.0075	0.001	0.012	0.006	0.007	0.006	0.006
Median	0.0134	-0.02	-0.08	-0.01	-0.01	-0.01	-0.08
SD	0.0352	0.194	1.181	0.823	0.351	0.176	0.220
Skewness	-2.20	1.58	0.825	-0.03	0.322	0.637	0.455
Kurtosis	10.92	6.306	20.40	0.293	0.895	1.52	1.18
No of observations	119	119	119	119	119	119	119

Source: Authors' calculation.

The correlation of the variables are reported in the Table 2. The results of unconditional correlation shows that S & P 500 CEI is significantly negatively correlated with VIX only. All other global shocks are insignificantly correlated with S & P 500 CEI.

Table 2: Unconditional Correlation Matrix for the Variables

	S & P 500 CEI	**VIX**	**FSI**	**NDE**	**CPUI**	**EPU**	**GPR**
S & P 500 CEI	1						
VIX	-0.77***	1					
FSI	-0.19	0.43**	1				
NDE	-0.07	-0.02	0.02	1			
CPUI	-0.03	0.04	0.09	-0.11	1		
EPU	-0.20	0.28*	0.17	0.09	0.26	1	
GPR	-0.01	0.01	-0.04	0.06	-0.12	0.07	1

*Note: ***(**)[*] represents the statistical significance at 1%(5%)[10%] level of significance Source: Authors' calculation.*

4. Empirical methodology and results

The empirical exercise for addressing the current objective, first we conduct unit root test to ensure the stationary property of the variables and then the Vector autoregressive (VAR) model to analyse the effect of various shocks on S & P 500 CEI. The unit root test and VAR model are explained in the following paragraphs.

Unit Root test:

The study used the Augmented Dickey–Fuller (ADF) test and Phillips–Perron (PP) test to detect the presence of unit root in the dataset. The results are reported in Table 3. The results show that all the variables are stationary at level i.e. I(0) process. Furthermore, the study have performed Zivot-Andrews test and Hylleberg, Engle, Granger and Yoo (HEGY) test to rule out the possibility of unit root with structural break and the risk of having seasonal unit root problem.

Table 3: Results of Unit Root test

Variable	**ADF test**	**PP test**	**Decision**
S & P 500 CEI	-10.09***	-10.07***	I(0)
VIX	-11.20***	-16.03***	I(0)
FSI	-17.39***	-19.47***	I(0)
NDE	-13.06***	-42.33***	I(0)
CPUI	-15.41***	-31.36***	I(0)
EPU	-14.04***	-19.22***	I(0)
GPR	-14.11***	-19.93***	I(0)

*Note: *** represents significant at 1% level of significance Source: Authors' calculation.*

Vector Autoregression (VAR) model:

To find the effects of global shocks on S&P 500 CEI, the study construct the following baseline VAR (p) model including the seven variables – S&P 500 CEI, VIX, FSI, NDE, CPUI, EPU and GPR.

$$\mathbb{X}t = \Theta\mathbb{W}t + \Gamma 1\mathbb{X}t-1 + \Gamma 2\mathbb{X}t-2 + \cdots + \Gamma p\mathbb{X}t-p + \varepsilon t$$

Here, $\mathbb{X}t$ is a (7×1) vector of aforementioned variables. $\mathbb{W}t = (1, t, t2)'$ include terms to simultaneously fit the constant, linear and nonlinear trend respectively. All the variables used in the VAR model are ensured to be stationary and it has been further verified by the stability of the VAR model. The use of an inappropriate number of lags can lead to the problem of misspecifications. Hence, the paper uses the Akaike Information Criterion (AIC) to choose the optimal lag length. Here optimal lag length is one. Estimated result is reported in Table 4.

The empirical exercise has considered two alternative proxies for the financial shock and the climate shock. Accordingly, the study has estimated four alternative model specifications. The estimation result shows that only the financial shock has a significant impact on S & P 500 Carbon Efficient Index. More stressed financial conditions or intense volatility in the financial market put downward pressure on S&P 500 CEI. No other shock has had a significant impact on S & P 500 Carbon Efficient Index. Hence, it can be summarising that climate finance is resilient to global shocks in general, except for financial shocks.

Table 4: VAR estimation results

	S&P 500 CEI	**S&P 500 CEI**	**S&P 500 CEI**	**S&P 500 CEI**
S&P 500 CEIt-1	0.12** (2.16)	0.14*** (2.60)	0.21** (2.14)	0.23*** (2.85)
VIXt-1	-0.07*** (2.73)	-0.08*** (2.92)		
FSIt-1			-0.03*** (2.43)	-0.01*** (2.35)
NDEt-1		-0.05 (1.04)		0.01 (0.63)
CPUIt-1	-0.005 (0.59)		-0.03 (0.95)	
EPUt-1	-0.30 (1.06)	-0.59 (1.10)	-0.03 (1.15)	-0.58 (1.10)
GPRt-1	0.01 (1.20)	-0.02 (0.96)	0.06 (0.01)	-0.02 (0.34)
Constant	0.008 (2.81)***	0.004 (2.98)***	0.09 (3.26)***	0.10 (3.11)***
No of Observations	119	119	119	119
R-square	0.65	0.63	0.59	0.62
Adjusted R-square	0.54	0.55	0.48	0.55

*Note: t-statistic is reported in the parenthesis (). ***(**) represents the statistical significance at 1% (5%) level of significance.*

Source: Authors' calculations.

5. Conclusion

The current study has examined the impact of the global crisis indicated by Stock market volatility index, financial stress index, natural disaster events, climate policy uncertainty index, economic policy uncertainty index and geo-political risks on the climate finance indicator S&P500 CEI in for monthly data. The methodology followed a time series method to capture the presence of unit roots following the VAR model. The key findings of the estimation suggest that the climate finance has been identified as resilient to global shocks in general, except for financial shocks. The results suggest that financial shock has a significant impact on climate finance indicated by S & P 500 Carbon Efficient Index. More stressed financial conditions or intense volatility in the financial market put downward pressure on carbon efficient index. Furthermore, this paper suggests that the S&P 500 CEI slightly outperforms the broader S&P 500 during crisis due to the sustainable practices and strong risk management of its constituent companies. This trend highlights the increasing significance of sustainability in investment decisions and points to the potential long- term benefits of prioritizing low-carbon, environmentally responsible companies. These findings emphasize the need to integrate environmental considerations into business strategies and investment decisions. As global challenges evolve, focusing on sustainability and carbon efficiency

will likely become even more crucial for the resilience and success of companies within the index. Consequently, the current findings have important implications for developing sustainable business models. Further research could explore carbon-efficient indexed firms across different industries and from developed to developing countries. This type of research will provide new insights into low-carbon and alternative business models, contributing to sustainable development policies and the creation of stable investment portfolios, especially for sectors like climate finance that need investments with safe-haven status.

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Mediating Influence of Drone on Perceived Brand Value – A Study Among Travel and Food Vlogs

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Abstract

This study explores the evolution and impact of vlogging and drones. Vlogging, now a mainstream form of creative expression, gained popularity through platforms like YouTube, Instagram, and TikTok. It allows users to share experiences and connect with audiences globally, often using advanced camera setups and editing techniques. Drones, or unmanned aerial vehicles, have transformed industries by performing complex tasks such as agriculture monitoring, wildlife tracking, and leak detection. Equipped with technologies like GPS, infrared, and radar, drones are cost-effective tools reshaping sectors like defense, tourism, and events. India's drone market is projected to reach INR 2.5 trillion by 2030. Despite legal and financial limitations, drones offer strategic potential—especially when viewed through the lens of content creators. Thus, both vlogging and drones reflect the growing influence of technology on society and open up vast possibilities for innovation.

Keywords: *Vlogging evolution, Social media platforms, Creative content, Digital storytelling, Unmanned aerial vehicles, Drone applications*

1. Introduction

Vlogging has become a popular way for people to express themselves creatively and connect with others online. Social media platforms like YouTube and Instagram provide a way for vloggers to reach a larger audience and build a community. On August 10, the art of vlogging is celebrated. Vloggers use their platforms to share their experiences, express their creativity, and even earn money through sponsorships and commercials. It's an excellent way to meet people from all over the world and form a community. On 2nd January 2000, Adam Kontras pioneered vlogging by creating a short video of him sneaking his dog into a hotel where pets were prohibited. The

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popularity of vlogging surged in 2005 when YouTube's co-founder, Jawed Karim, posted the first YouTube vlog clip titled "Me at the Zoo." to his channel, Jawed. Since then, vlogging has evolved significantly, with actors and social media influencers now using it to keep their audience engaged. Vlogging is a creative way for people to share their daily lives, experiences and opinions with a wide audience. Platforms like Instagram and TikTok have helped vlogging to evolve and adapt to trends in digital media. In the early 1980s, Adam Kontras uploaded a 15-second video of himself sneaking a cat into his apartment complex, creating the first vlog. Director Luuk Bouwman posted a video journal of his post-college travels in 2002, coining the term "vlog." In 2004, director Steve Garfield named it the "year of the vlog."Vlogging faced technical difficulties in uploading, storing, and releasing online videos, which hindered its growth. However, YouTube's debut in December 2005, allowed it to expand beyond the most technically adept vloggers, with 100 million views and 65 thousand video uploads every day. In 2006, popular vloggers such as iJustine, Philip DeFranco, and Grace Helbig began their channels. From 2010 to 2015, smartphones allowed for easier vlogging. Although the iPhone launched in 2007, it didn't gain popularity until 2010. This cultural phenomenon made it possible for anyone to shoot and upload a video to YouTube in less than a minute, and YouTube views increased as people spent more time-consuming content on their phones. In 2015, Casey Neistat revolutionized the vlogger genre with his innovative storytelling, camera angles, and video editing. Today, most vloggers use a DSLR or mirrorless camera with a shotgun microphone, multiple camera angles, and spend hours editing each vlog.

Drones are small to medium-sized unmanned aerial vehicles (UAVs). It stands out for its capacity to operate remotely and independently while maintaining high levels of flight. The drone system combines robotics and aircraft. They can run on electric, jet, or thermal engines. They also have advanced technology including GPS, radar control, infrared, and altitude cameras. This English name comes from the Germanic word treno (drone) or drunjus. Drunjus was the Gothic name for noise, derived from the Greek word “threnos” (funeral song). It was initially named in 1946, giving rise to the term “drone,” which means “unmanned aerial vehicle”. It was reported in Popular Science. Following World War II and 9/11, this technology was used to perform more military research. Drones can be used to monitor crops, detect water leaks, track extinction-threatened species, locate people in emergencies, forecast weather, accelerate energy grid inspection and maintenance, and so on. From a business perspective, the drone revolution is causing a significant shift in critical sectors of activity since they can execute complex jobs at lower costs. The present drone market is valued at $29.86 billion in the United States alone, and it is predicted to increase at a 38.6% annual rate until 2030. According to the EU, it will reach €10 billion per year by 2035. By 2030, India's drone market is anticipated to be valued approximately INR 2.5 trillion. Ten years ago, the market size was only Rs 29 billion. The defence industry is

predicted to make the largest contribution to the drone market by 2030. Technological connect and understanding has a more comparative value. Second and third generation entrepreneurs engaged with freelancing have been observed to engage more with tech driven business more than the first generation. Drone is such a technological innovation which has given birth to premature deindustrialization. It has brought a new value to the event and tourism business. It helps to achieve highest precision in the delivery of those service products. Due to legal restrictions and capital burden its applicability is in selective practice. Therefore, the endless strategic possibilities offered by the use of Drone have to be explored from the perspective of YouTube viewers.

2. Review of Literature

Mangina et al., (2016) discovered that drones and virtual reality can enhance the lives of people with limited mobility by providing live video and physical activity experiences. According to Ramadan et al., (2016), the authorization of civilian drones for commercial use, such as food deliveries, raises privacy and security risks, including potential misuse for surveillance, cyber spying, and data snooping. Reiche et al. (2018) identified that "intra-governmental partnerships," government and industry collaboration, "strong corporate integrity," and "regulatory authority" help reduce the barriers to drone markets. The study by Deville et al., (2018) introduces a new form of the Traveling Salesman Problem with Drone (TSP-D) to decrease total operational expenses, including transportation charges and waiting penalties. According to a 2018 study by the NIAS, "drone technology has been around since the mid-19th century, with unmanned balloons used by the British for bombing raids in the 1800s." Nirmal (2018) studys the development of a wireless drone control interface for home security applications in a study of 19 types of drones currently available on the market (like the DJI Phantom 4 and GoPro Karma). The study by Vela and Black in 2018 explores the impact of verticality on advertising information processing, specifically drone angles, and suggests that mental simulation can influence viewer attitudes towards advertisements. In his 2019 research, David Swanson found that drones were being used more in last-mile delivery to enhance logistics services in different countries. The Carneiro's (2019) study created specialist drones for agricultural data collection and performance verification. The system was able to navigate well and collect the information included in the study. A study by Raj and Sah in 2019 reveals that "technological advancements" and "government regulations" are the most significant factors influencing the use of drones in the logistics sector. According to Sah et al., (2019) regulations, privacy and security threats, public perception, psychological, environmental, technical, and economic aspects are the critical barriers for implementing drones in the logistics sector. Research by Chiang et al., (2019) observed that drones offer speed, flexibility, and customer convenience while reducing energy consumption and greenhouse gas emissions, promoting environmental sustainability.

Yaacoub et al., (2020) focused on the risks and safety associated with the use of drones, including cyber-attacks, threats, and challenges. The study provides a comprehensive overview of the drone/UAV domain, including lethal and non-lethal security solutions. Benarbia and Kyamakya (2021) explored that e-commerce companies are looking to drone delivery as a solution to lower costs and shorten delivery times to meet increasing demand for last-mile delivery options. Jasim et al., (2021) found that drones, due to their low cost and mobility, are being used in a variety of sectors, such as health, agriculture, and traffic surveillance. Pamnani and Parvathi (2021) showed that the food service sector needs to create a comprehensive model that looks at consumer intention and behaviour in order to motivate them to develop drone technology and create new marketing campaigns. Sabino et al., (2022) found that the use of drones by civilians is increasing, which improves urban connectivity. However, the public perception of drones is influenced by socio-cultural factors, perceived risks like misuse, privacy violations, malfunctions, and safety issues, and expected benefits like flexibility, emergency response, lower costs, and increased safety. Azizul et al., (2023) examine that factors like 'drone roles' and 'drone handling skills' greatly influence farmers' acceptance of using drones in rice cultivation in Malaysia. A study by Arias et al., (2022) found that factors like performance risk, compatibility, personal innovativeness, and environmental friendliness significantly influence the intention to use drones. Berbeka's 2022 case study reveals that UAVs are most frequently promoted in Polish tourism venues like congress and trade centres, attractions, and hotels, as well as for meeting and event experiences. This study by Tafesse and Khalid (2022) explores the effectiveness of drone video ads in eliciting favourable viewer responses. It proposes that exposure to a drone video enhances viewers' perceived presence and novelty, leading to a favourable attitude towards the brand and increased social media sharing intention.

Initially criticized for military and weaponry uses, drone technology proved successful in rescue operations in the early 2000s. When we think of military drones nowadays, we envision sleek, sophisticated aircraft and quadcopters. However, the world's astronauts and soldiers were the first to develop drone technology—balloons, drones, and aerial targets, all of which were revolutionary and inventive at the time. Since the mid-19th century (1800s), militaries all around the world have used drone technology for training, targeting, anti-aircraft strikes, bomb detection, surveillance, and prisoner negotiation. In 1849, the Austrian Navy launched 200 incendiary balloons to conquer Venice. In the early twentieth century, the United States military began investigating drone technology to develop training levels.

Nikola Tesla first wrote about unmanned aerial vehicles in 1915. A.M. Low made the first attempt to employ self-propelled drones as aerial targets back in 1916. The first pilotless torpedo was produced by the Dayton-Wright Airplane Company during World War I. Following World War I, corporations tried to enhance drone technology with

studies like the Hewitt-Sperry Automatic Airplane and the Kettering Bug, which is an autonomous aerial vehicle. The military did the most of the work during this time period, until 1935, when actor and model aviator Reginald Denny became the first civilian to develop a remote-controlled vehicle. During WWII (1939-1945), the Allied and German military employed drones to train aircraft gunners and support missions. Following World War II, drone inventors began to include jet engines into their designs, such as Australia's GAF Jindivik and the US Navy's Beechcraft Model 10001. However, following World War II, technology stagnated until the Vietnam War.

In the early years of the conflict, the United States Air Force began to use unmanned aerial vehicles to lessen the danger of pilot deaths in hostile settings. Drone technology development continued even after the Soviet Union shot down an American surveillance plane in 1960. In the late 1960s, the American government deployed drone technology to support naval missions and the Vietnam War, however the majority of missions were classified.

In the early 1970s, Israel started deploying drones to investigate the Yom Kippur War. At the same time, the US admitted the deployment of drones in Vietnam. Armed Forces Journal International stated in 1982 that the US flew over 3,435 drones for surveillance and decoy purposes throughout the war. During the 1980s and 1990s, the US military made significant investments in this technology. In the 1990s, the US Department of Defence contracted AAI Corp and Israel's Malat to develop improved drone technology, which resulted in more cost-effective technologies.

In the mid-1990s, the US government initiated the Predator program, which resulted in the MQ-1 Predator with hellfire anti-tank missiles on its wings. This paved the way for the MQ-9 Reaper in 2007. When most people think of military drones, they see Predators and Reapers. More than 36 countries, as well as various terrorist groups and non-state actors, already use weaponized drones.

In the 1990s, the Indian Army bought unmanned aerial vehicles (UAVs) from Israel, followed by the Indian Navy. During the 1999 Kargil war with Pakistan, India first utilised military drones for visual surveillance along the Line of Control (LOC). After India lost an aircraft to Pakistan's infrared-guided missiles because its defences were inefficient and susceptible, Israel discreetly provided the Indian Air Force and surveillance drones to track intelligence along the Line of Control. Since then, the government's Development Research and Development Organization (DRDO) and other private Indian companies have begun to manufacture drones and develop UAV technology.

Following 150 years of military research and development, drones were first employed for non-military applications in 2006. In the same year, the Federal Aviation Administration approved the first commercial drone permits. Government organisations are starting to experiment with drone technology for disaster relief and

border surveillance, while businesses are starting to employ it for commercial purposes including pipeline inspection, crop evaluation, and security. Amazon declared in 2013 that it will deploy drones for delivery, which sparked widespread interest. While the business area has struggled with restrictions over the last decade, the personal and recreational drone market has developed unchecked. The majority of recreational drones used by consumers for non-commercial purposes are quadcopters, which have four propellers. They are far less expensive than commercial systems, costing less than $2,000, but lack the necessary software and sensors.

The first regulatory submission of medical materials took place in the United States in 2015. The global market for medical drones is expected to reach $947.6 billion by 2027. In 2018, organisations all around the world, including the United States, China, and Israel, began investing in research on the use of drones for taxi services, photography, indoor applications, and more. In 2019, drone deliveries of retail items totalled 12.9. That figure is predicted to reach 122 million by 2023. By 2021, the FAA expects there to be approximately 900,000 registered drones in the United States alone. There are about 500,000 registered drones for recreational use. Meanwhile, drone sales are studied to reach $12 billion by 2021.

The Ministry of Civil Aviation has approved a pilot program with the Telangana government to investigate alternate logistical channels for effectively, safely, and securely transporting medical supplies from remote places via drones. This campaign will begin with the delivery of vaccines and medicines to community health centres and PHCs. Similar agreements exist to deploy drones for agricultural research, with the goal of encouraging a wave of technology in the agricultural and farming sectors. Kisan drones are used to inspect crops, map landscapes, and spray pesticides and nutrients. Law enforcement organisations employ drones extensively to monitor COVID-19 hotspots and containment zones, ensuring strict adherence to lockdown restrictions. The effort to map the Abadi region to capture SVAMITVA's inhabitants (surveying and mapping villages utilising artificial village site technology); The fast expansion of drone use, which has resulted in the incorporation of drones into drone-based railway safety surveillance systems, has prompted the DGCA to develop new rules and regulations to govern their use. Broader objective of the were

- To explore how drones can act as a game changer in enhancing the brand value of food and travel vlogs on social media like YouTube.
- To understand how use of drones in food and travel vlogs can increase viewership compared to traditional food and travel vlogs on YouTube.
- To analyze how drones can create aesthetic appeal among viewers.

3. Research Methodology

Methodology is the systematic, theoretical analysis of the methods applied to a field of study. The purpose of this research is to achieve the stated objectives. This research was conducted to analyse the mediating influence of drones on perceived brand value.

• **Data Collection Method:**

All the data that has been collected through the primary sources are by using questionnaires.

• **Survey Method:**

The survey was done by non-probability judgmental sampling method considering the limitations of time, financial support and other resources.

• **Survey instruments:**

The Survey was done by a structured self-developed questionnaire. It was a detailed questionnaire to collect all the relevant information to fulfil the objective of our research. The questionnaire had 2 sections. The first part was to cover the demographics. The last section was a series of statements against which the respondent showed his/her degree of agreeability. In the questionnaire 5-point Likert scale was used to collect the data, where Strongly Disagree (SD) =1, Disagree (D) =2, Neutral (N) =3, Agree (A) =4 and Strongly Agree (SA) =5.

• **Sample size:** There were a total of 110 respondents.

• **Sampling location:** The survey was done in Kolkata, India.

• **Data collection duration:** The time taken to do this survey was four (4) weeks.

4. Analysis and Findings

Demographic profile

Our questionnaire was distributed in March 2024. During this time 110 responses from in and around Kolkata were collected and news for analysis. An illustration representing the respondent demographic percentage is shown in the table below. 30% respondents belong to 18-25years of age group whereas, 27%, 20%, 13%, 6%, 1% were respectively from 26-33, 34-41, 42-49, 50-57 and 58-65 years of age group. 53% were male and 47% were female.

Majority (61.8% respondents agree and 20.0% strongly agree) of respondents agreed regarding the necessity of Product Sophistication & Technological Advancement in travel vlogs and use of Drone as a symbol of forward thinking, innovative brand identity, brand Familiarity, competitive value. It has also been confirmed that this can enhance viewership as it helps to capture attention and interest.

To reduce the dimensions of the variables affecting the "Engagement of viewers of food and travel vlogs designed by using drones" factor analysis has been done. Cronbach's alpha of the dataset is 0.8937, KMO value is 0.67 and sample size is 110 which is 5 times than the variables considered for the study. Therefore, the dataset is eligible to be assessed by factor analysis. The factor analysis have derived five factors whose Eigenvalue is greater than or equal to 1. Among those factors we have found Factor I and Factor II only are having variables with loading value more than or equal to 0.56. The result is as follows,

Factor I – Q4, Q9, Q12, Q14, Q20, Q21, Q24, Q26, Q32

Factor II – Q5

Therefore, to understand this relationship between independent variables and dependent variable (i.e. Engagement of viewers of food and travel vlogs designed by using drones)

After factor analysis we have done multiple regression to reveal the disparity of influence of independent variable on the dependent variable. Variable Q13 is considered as dependent variable whereas the independent variable retrieved from Factor analysis are: Q4, Q20, Q21, Q5, Q14, Q24, Q26, Q32, Q9 and Q12. The result of the regression is as follows, 0.4942 which means these people are in favour of my data

Regression Table

Equation	Observation	Parameters	RMSE	"R-sq"	FP
Q13	110	11.617195	0.4942	9.671896	0.0000

Q13	Coef.	Std. Err.	t	P>t	[95% Conf. Interval]	
Q4	-0.0298354	0.1006316	-0.30	0.767	-0.2295103	0.1698394
Q20	0.0097182	0.0980756	0.10	0.921	-0.184885	0.2043214
Q21	0.007148	0.0850345	0.08	0.933	-0.1615789	0.1758749
Q5	0.0183828	0.0991808	0.19	0.853	-0.1784135	0.2151791
Q14	0.2782633	0.1202191	2.31	0.023	0.0397226	0.516804
Q24	-0.164324	0.0780384	-2.11	0.038	-0.3191691	-0.009479
Q26	0.1945547	0.0957382	2.03	0.045	0.0045895	0.38452

Q32	0.0563613	0.0987155	0.57	0.569	-0.1395116	0.2522343
Q9	-0.141789	0.1052404	-1.35	0.181	-0.3506088	0.0670307
Q12	0.5025055	0.0852576	5.89	0.000	0.3333359	0.6716751
_cons	1.073901	0.4356716	2.46	0.015	0.2094338	1.938368

Q13 = 1.073 - 0.0298*Q4 + 0.0097*Q20 + 0.0071*Q21 + 0.0183*Q5 + 0.2782*Q14 - 0.1643*Q24 + 0.1945*Q26 + 0.0563*Q32 - 0.1417*Q9 + 0.5025*Q12

The most important variable which is having the maximum influence on the "Engagement of viewers of food and travel vlogs designed by using drones" is Appeal and functionality impact, the second one is Attention capture and interest, the third one is Performance and reliability.

5. Conclusion

Droneshave become increasingly prevalent in various industries over the past few years. From agriculture to filmmaking and even delivery services, drones have revolutionized the way businesses operate. In this paper, we have explored how drones are being used in YouTube travel and food vlogs and how they can enhance brand image, create aesthetic appeal, and increase viewership and engagement.

The use of drones in YouTube travel vlogs has significantly increased in recent years. These vlogs provide a unique perspective of the places being visited, giving viewers a bird's eye view of the location. Drones can capture stunning aerial shots that can't be captured by traditional cameras. The use of drones can also showcase the beauty of a location in a more visually appealing way, which can increase viewership and engagement. It can also create a sense of adventure and excitement for viewers, which is a crucial element of travel vlogging.

Similarly, the use of drones in food vlogs has become increasingly popular. Food vloggers can use drones to capture aerial shots of food markets, farms, and restaurants. Drones can capture the beauty of the surroundings and make the vlog more visually appealing. This can enhance the overall viewing experience and increase engagement. Additionally, drones can provide a unique perspective of the food being prepared, such as aerial shots of a pizza being made or a cocktail being shaken. This can create a sense of excitement and anticipation for viewers.

According to a survey conducted in Kolkata, the use of drones in YouTube travel and food vlogs can enhance brand image. Brands that use drones in their vlogs are perceived to be innovative and technologically advanced. This perception can positively impact the brand image, leading to increased brand loyalty and customer

engagement. Additionally, the use of drones in vlogs can create a sense of exclusivity, which can attract a niche audience.

While the use of drones in YouTube travel and food vlogs has many benefits, it is important to note that proper regulations and safety measures must be put in place to mitigate privacy and security concerns associated with drone usage. Drones can invade people's privacy and can be a security threat if flown near sensitive areas. Therefore, it is crucial to have proper regulations in place to ensure the responsible use of drones. To conclude drones are now popular in YouTube travel and food vlogs. They enhance brand image, create aesthetic appeal, and increase viewership. However, privacy and security concerns must be addressed. As drone technology evolves, its impact on various industries will be fascinating.

Implication

The above text highlights the growing importance of vlogging and drones in our society. The rise of vlogging has allowed individuals to express themselves creatively and build a community through various social media platforms. It has also opened up new opportunities for businesses and advertisers to promote their products through sponsorships and commercials.

Similarly, drones have revolutionized various industries, including agriculture, energy, and defence, by executing complex tasks at a lower cost. The drone market is predicted to grow exponentially, and its applications are endless. However, legal restrictions and capital burden hinder its widespread applicability.

Furthermore, the text suggests that the use of drones and virtual reality can enhance the lives of people with limited mobility by providing live video and physical activity experiences. Overall, the implications of these technological advancements are vast and diverse. They offer new opportunities for creativity, innovation, and business growth. However, it is essential to consider the potential privacy and security risks associated with them and ensure that they are used ethically and responsibly.

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Role of Librarians in Copyright Protection of Library Resources of Higher Educational Institutions in India

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Abstract

In our country, the protection of Intellectual Property is governed by four legislations, viz. inventions by the Patent Act, 1970; designs by the designs Act, 1911, (modification in 1970); trade marks by the Trade and Merchandise marks Act, 1958; copyright by the Copyright Act,1957 as amended in 1983,1984, 1992, 1994,1999, 2012, 2016 and 2021. This paper describes the copyright law and its generations, copyrightable works, copyright issues in relation with library and library services at higher educational institutions. Here it also has been discussed how copyright law fall into a danger in digital environment and in this respect the role of librarians. This study describes that what steps are to be taken by the library authority to protect Copyright Law in both print and digital environment.

Keywords: *Copyright, Copyrightable works, Intellectual Property Rights, Libraries and copyright, Punishment for infringement of copyright law, Role of librarians in copyright protection.*

1. Introduction

To develop the knowledge on a subject beyond the classroom libraries play an important role in academic institutions in many spheres. Library collections consist of both the copyrighted and public domain materials with the objectives of smooth access of these collections by the students and faculties in support to teaching, learning and research. Librarians are responsible for dissemination of information. They are also expected to protect intellectual property rights of creators. Due to rapid development of Information and communication technology (ICT) it is a crucial challenge for librarians to protect copyright from infringement by the users that are legal cornerstones of library services. Since libraries are the major purchasers of information in print as well as digital formats so it is their responsibility to ensure

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lawful and equitable use of information resources for balance of copyright. As per International Federation of Library Associations and Institutions or IFLA's opinion Copyright can be defined as a person's exclusive right to authorize certain acts (such as reproduction, publication, public performance, adaptation, etc.) in relation to his or her original work of authorship. The creator of work typically owns the copyright, at least initially (www.ifla.org, 2023). Creators protect their intellectual properties by this right. Reprography services and document delivery (DD) services are the important library services of higher educational institutions. In present digital era, download of open access materials or e-resources are the most important facilities of any higher educational institutional library. So, maintain the copyright protection in library is very difficult.

In this paper I have discussed the concept of copyright, relation between copyright and library services. Beyond these which matters cannot be protected by the copyright law or what may be copied, infringement of copyright, user's responsibilities and librarian's responsibilities also have been discussed.

2. Objectives of the Study

The primary objective of the study is to examine the role of libraries to protect the copyright. Without this the study will discuss on the following issues:

- To know the genesis of copyright law;
- Identify the copyrightable works;
- Identify the works not protected by the copyright law;
- To know how violate the copyright law;
- How protect the copyright in digital environment; and
- Identify the role of libraries in copyright protection.

3. Methodology

For this study both primary and secondary sources have been used. Primary sources like research journals, conference proceedings and web sources have been consulted. Secondary sources like encyclopaedia, text books have been consulted. After the deep and through study of different sources relevant subject matter has been collected and as per relevancy of the content it has organized. A conclusion has been drawn after the detail discussion on the topic.

4. Literature Review

Singh and Pachauri (2019) in their paper "Copyright protection for digital content on websites" highlighted the misuse of access facilities of digital content and violating the right of author or creator or publisher. For this reason many countries are correcting their digital copyright law. To protect the interest of the author or creator it is required

to conceive a smart and appropriate corrective law with remove the existing difficulties.

Onoyeyan and Awe (2018) made a survey among 63 librarians from the five selected universities in Ogun State of Nigeria to know the role of librarians in the protection of copyright in Nigeria. Through this survey they found that librarians are aware of the provisions of copyright law and take some measures to prevent copyright.

Sanjeeva and Powdwal (2017) in their article have discussed the awareness of the concept of 'Author rights' among the researchers and role of librarians. For this study they have conducted a survey among faculty members and researchers of 27 research institutes in Mumbai. From this study they revealed that the awareness of researchers about author right is poor. The researchers were less concerned about transferring copyright. In this paper authors have also highlighted the role of librarians play to assist researchers and faculty in understanding and retaining their rights to the scholarly work created.

Magara (2016) for his study conducted a survey in educational institutions, libraries and archives in Uganda to assess the state of copyright infringement in Uganda. In this paper they have recognized a continued advocacy to open access to information resources, under the legal exceptions of fair use for educational purpose. They have tried to recommend the policy for balance copyright protection and access to information.

5. What is Intellectual Property Rights (IPR)?

Since copyright is a part of Intellectual Property Rights (IPR), so it is required to discuss the IPR in brief. Intellectual Property Rights are the rights given to persons over the creations of their minds. They usually give the creator an exclusive right over the use of his / her creation for a certain period of time (https://www.wto.org, 2023). IPR is a legal system consisting of copyright, patents, designs and trademark which are mechanisms to establish their ownership and to prevent illegal copying of intellectual creations. It also covers layout designs, integrated circuits, geographical indicators and anti-competitive policies in contractual licenses. In our country, the protection of Intellectual Property is governed by four legislations, viz. inventions by the Patent Act, 1970; designs by the designs Act, 1911, (modification in 1970); trade marks by the Trade and Merchandise marks Act, 1958; copyright by the Copyright Act, 1957 (Srivastava, 2001) came into effect from January 1958. The Act has been amended five times since then, i.e., in 1983,1984, 1992, 1994, 1999 and 2012 (https://copyright.gov.in, 2023). The Copyright Act, 2012 was effect on 2013 was last amended in the year 2016. The Government of India has notified Copyright (Amendment) Rules, 2021 vide Gazette notification under reference G. S. R. 225(E) dated 30th March, 2021(https://pib.gov.in/PressReleasePage.aspx?PRID=1710417, 2023).

6. What is Copyright?

According to International Encyclopaedia of Information and Library Science (Feather & Sturges, 2003), Copyright is a legal concept that concerns rights to copy. Copyright protects the labour, skill and judgement that someone – Author, Artist or some other creator - expends ion the creation of an original piece of work, whether it is a so-called 'literary-work', a piece of music, a painting, a photograph, a TV programme or any other created work.

World Intellectual Property Organization (WIPO) defines that copyright (or author's right) is a legal term used to describe the rights that creators have over their literary and artistic works. Works covered by copyright range from books, music, paintings, sculpture, and films, to computer programmes, databases, advertisements, maps, and technical drawings (https://www.wipo.int/copyright/en, 2023).

V. T. Kamble, D. S. Amoji, S. Sengeeta and H. Arjun describe the copyright as a legal device that gives the creator of a literary, artistic, musical, or other creative work the sole right to publish and sell that work. Copyright owners have the right to control the reproduction of their work, including the right to receive payment for that reproduction. An author may grant or sell those rights to others, including publishers or recording companies.

Copyright is distinct from other forms of creator protection such as Patents, which give inventors exclusive rights over use of their inventions, and Trademarks, which are legally protected words or symbols or certain other distinguishing features that represent products or services. Similarly, whereas a patent protects the application of an idea, and a trademark protects a device that indicates the provider of particular services or goods, copyright protects the expression of an idea (Kamble and others, 2012).

7. Genesis of Copyright Laws

The history of copyright laws can be traced back to 1662, when the concept was developed to protect publishers against piracy due to the technological advances, which made cheap and easy printing of books (Urs, 2004). During 18th century in England Queen Anne, around 1710, set a pattern for formal copyright statutes. England was followed by the United States in 1790 when the first U.S. copyright law was enacted by Congress and by France in 1793. Since then, the copyright laws have spread worldwide and several international bodies came into existence to look into the copyright laws and their enactment. For example, international bodies like Berne Convention in 1886, the Universal copyright convention, 1952 and the Berne and Paris conventions in 1971. To make sure that conventions stay current and signatory countries observe them, a number of world bodies have been created mainly to administer the conventions. The World Intellectual Property Organization (WIPO)

created in 1967, the U.N. Educational Scientific and Cultural Organization (UNESCO) and the World Trade Organization (WTO) are now charged with administrating the Trade-Related Aspects of Intellectual Property Rights (TRIPPS). These organizations, together with National Legislature, keep these conventions and National copyright acts current through amendments. India has the copyright law but Indian Copyright Act provides certain exceptions, generally referred to as "fair use" or "fair deal" includes reproduction of literary, artistic, or dramatic work for private use, research use, criticism, reviews, training and educational purposes (Aswath & Reddy, 2012).

7.1 Copyright Law in India

A law called the Indian Copyright Act, 1957, was passed in independent India; it went into effect in January 1958 and has since undergone eight revisions, in 1983, 1984, 1992, 1994, 1999, 2012, 2016 and finally it was last modified in the year 2021respectively in order to accommodate the new developments taking place with regard to the implication of the Copyright Act.

Some of the Major Changes Introduced via 2021 amendment are:

- The Copyright Board has been substituted by the Appellate Board.
- Changes to rules for collection of royalty by the Copyright Societies.
- New rules have also been introduced under Rule 66(1) of the copyright rules, detailing new items that must be made available by the society on their website.
- Changes to accommodate the electronic records.
- A copyright journal has been introduced, which will be available on the official website.
- In (1) of Rule 69, the phrase "The Register of Copyrights shall be kept in physical and electronic form has been changed to physical or electronic form (Aslam, 2023).

8. What are Copyrightable works?

Article 2 of the Berne Convention states that: "The expression 'literary and artistic works' shall include every production in the literary, scientific and artistic domain, whatever may be the mode or form of its expression." The convention lists the following examples of such works:

i) Books, pamphlets and other writings;

ii) Lectures, addresses, sermons;

iii) Dramatic or dramatico-musical works;

iv) Choreographic works and entertainment in the dumb show;

v) Musical compositions and with or without words;

vi) Cinematographic works to which are assimilated works expressed by a process analogous to cinematography;

vii) Works of drawing, painting, architecture, sculpture, engraving and lithography;

viii) Photographic works to which are assimilated works expressed by a process analogous to photography;

ix) Works of applied art;

x) Illustrations, maps, plans, sketches and three dimensional works relative to geography, topography, architecture or science;

xi) "Translations, adaptations, arrangements of music and other alterations of a literary or artistic work," which "shall be protected as original works without prejudice to the copyright in the original works"; and

xii) "Collections of literary and artistic works such as encyclopaedias and anthologies which, by reason of the selection arrangement of their contents, constitute intellectual creations" – again, the Convention provides that these "shall be protected as such, without prejudice to the copyright in each of the works forming part of such collections." (https://www.wipo.int/tools/en/gsearch/html, 2023).

9. Limitations of Rights

One can use any copyright materials without the permission of the copyright holder for the following reason (http://www.naukri.com/lls/copyright/cpwrt.htm, 2023).

- Single copy for private, personal or non-commercial use – research and syudy
- Teaching
- Quotations
- Criticism or review
- Judicial proceedings

10. Libraries and Copyright

Libraries are the reliable information centre for any information seeker since it is the storehouse of information resources and librarians are the manager to provide different types of information resources through different channels. Information is available in different forms likes published, unpublished, print and non-prints. As information manager librarians make the bridge between authors, publishers, aggregators, distributors, vendors, and users and so on with the information resources. The most difficult task for librarians is to balance copyright and use of copyrighted materials within the purview of laws. The librarian can ensure the reputation of

organization and may avoid misuse of copyrighted material by its stakeholders by creating awareness about copyright laws. The library sector, however, is proud to view itself as a custodian of the public interest in this regard.

As a transmission agency for communication of knowledge, ideas and information from creators to end-users, libraries are definitely concerned with copyright legislations. They have been for years collecting and processing works of authors and making these available to the library patrons. Even in the modern digital age, libraries are continuing to provide access to the mass of digital resources published world-wide. However, rigid copyright legislations aiming exclusively to bring commercial benefits to copyright holders without considerations to other social issues are counterproductive. It is an undisputed fact that authors have to be rewarded for their works which are their intellectual properties. Others should not be permitted to derive commercial benefits illegally from their works. However, the same works need to be brought to the notice of users and made accessible to everyone – students, researchers and teachers – without infringing on the rights of the creators of the works. The copyright legislations protect the rights of the creators while access to the materials is provided by libraries under certain conditions. The policy of "fair use" in USA which allows copying of copyrighted materials for educational and non-profit purposes is aligned on this progressive approach to copyright. It is important for society to allow users access to the ideas, knowledge and information contained in copyrighted materials. Just like the creators have access to other materials in creating their work, ne researchers should equally have access to ensure progress and continuity in the pursuit of new knowledge and for the advancement of science. Scholarly research and communication are impaired if all copyrighted materials are inaccessible or are exclusively available through purchase of the rights for use (Nisbet, 2003).

Due to academic use of information or knowledge for the development of society National Copyright law provide some flexibilities like exceptions for libraries and archives. To increase the use of library resources and development of library services they depend on these exceptions and limitations of copyright law which support the growth and development of study and research activities in higher educational institutions. To support teaching and learning in academic institutions specifically higher educational institutions libraries provide so many information and document delivery services to its researchers and faculties with some conditions which avoid the violation of copyright law.

11. Library services and Copyright law

Copyrighted materials made available via Document Delivery and Interlibrary Loan (DD/ILL) services are for the use of faculties, students and staffs of colleges and universities to support the research and educational functions. The use of copyrighted materials in all formats, including the creation, online delivery, and use of digital copies

requested via DD/ILL must be in compliance with copyright law. The Libraries also provide reprography services through Xerox to its clients. This reprography service must likewise be in compliance copyright law.

College, University and / or Research libraries also offer mediated printing and scanning service (for a fee) to library patrons and library staffs. This service supports private study, scholarship, research, and teaching. "Mediated" means that a library staff member makes the reproduction for the requester, either for the requester's convenience or because the requested material is fragile or rare. These services must be in compliance with copyright law. Libraries also provide digital services through electronic media like e-mail. As per request of library client library sends an electronic journal article or a chapter of a digital book to support of their study. It is also must be in compliance with copyright law.

12. Copyright Law in Digital Environment

Rapid development of Information and Communication Technologies (ICT) are making trouble to maintain copyright law in present digital environment. Due to massive development and growth of research in different subject areas new information is publishing un-intrudingly. This new born information captured, processed and produced in digital form. Without spend any cost these digital information may be copied without any loss of quality. Much of the search is based on Google search engine but in the library there exist so many search options as per database or project subscribed. Digital library assists users in exercising the fair use of copyrighted resources in right way. Such as library provides electronic journal articles which called electronic document delivery services that build on the cost advantage copyright law intentionally gives to users.

Legislation of India in 1998 passed the Digital Millennium Copyright Act, which refreshed copyright laws to address the substances of Digital Technology at exhibit. With the development and advancement of technology and all the more especially digitization, the whole world has perceived the requirement for a Digital Copyright Law. In this manner, the current copyright law was developed, as the pattern of keeping up records as digital data plainly requires insurance a need felt all around the globe (Singh, 2019).

13. Problems of Copyright law in digital environment

The digital and networked environment has posed several problems to the Copyright law. This is because:

- In the digital medium, works are more equivalent: In digital form, all Copyrighted works-pictures, sounds, texts, music or movies – consist of strings of bits. All therefore, fit the definition of “literary work.”

- The plasticity of works in digital form: Works in digital form are easily transform form one form to another.
- Automatic generation of works in digital form: The digital medium also permits new works to be created for which no human another can readily be designated.
- Technological and contractual means for overcoming digital replicability: A well – recognized problem digital technologies pose for Copyright arises from the ease and low cost with which multiple copies can be made and distributed in digital form, especially in a networked environment (www.umuc.edu/library/libhow/copyright.cfm, 2022).

14. What May be Copied?

The following may be copied and distributed:

- Entire works or sections of works that are in the public domain;
- Entire works or sections of works used with permission from the copyright holder;
- Portions of books, journal issues, and other print resources that meet a reasonable determination of fair use;
- Works used under the provisions of a contract or license agreement; such agreements may differ from, and often take precedence over, what is allowed under copyright law; and
- Copyrighted works owned by the library, where the library has first determined, on the basis of a reasonable investigation, that the copyrighted work cannot be obtained at a fair price.

Library staff reserves the right to refuse or otherwise limit requests if, in their judgment, the requested materials and/or intended use would exceed fair use or otherwise constitute copyright infringement.

15. User's Responsibilities

The user is the library patron: student, teacher, researcher, etc.

►Users should request copies of copyrighted works only to serve personal study, scholarship, or research needs.

►Users should request only the amount of material needed.

►Copies of copyrighted materials made available through interlibrary loan services become the property of the user and should not be reproduced for further distribution, except where there is a reasonable determination of fair use.

16. Role of Librarians in Copyright Protection

Libraries are major purchasers of copyright protected works, both analog and digital, and make such works available for patrons to browse, read and use. As an educational agency library is poised to ensure that knowledge is acquired and disseminated and to ensure that equal access to information is enjoyed by all. Librarians and information professionals do, where possible and to the best of their ability, protect against copyright abuse of library material in collections. It is the responsibility of librarians to maintain the balance between the interest of copyright owners in receiving fair reward for their efforts and the interests of copyright users in receiving reasonable access to copyright materials. In this regard, librarians may implement a series of limitations and exceptions to the exclusive rights of copyright owners. Keeping in mind the copyright law librarians may display the notice about "user's responsibilities" and "what may be copied?" for user awareness. To protect copyright librarians may follow other ways as stated below:

►The library will not make and distribute copies of copyrighted works if it has notice that the copy will be used for anything other than private study, scholarship, research, or teaching purposes. Here librarians should preserve a form signed by the users indicating the copy is for research or private study should continue.

►Library staff will not knowingly engage in related replication or distribution of multiple copies of the same copyrighted material, except where there is a reasonable determination of fair use.

►All reproductions will display the copyright notice or be accordingly stamped. See Copyright Notices on Library Reproductions.

►A "Warning Concerning Copyright Restrictions" sign will be prominently posted at every library location where mediated copying requests are accepted.

►A digital library can be protected by a password or the IP based authentication. Here the library user only can use the library collection. It restricts the unauthorized user for misuse of library.

►Watermarking may be sought as one solution.

►To protect the images, there is software called SafeImage which uses JAVA. Technology are disables the save option of computer. This seems to be fantastic idea in sight.

►To obtain the user's affirmation of his or her awareness of copyright law, library copyright policies, and his/her intention to comply with these policies, the "Warning Concerning Copyright Restrictions" must be printed within a box located prominently on the mediated copying request form.

17. Punishment for infringement of Copyright

Violation or infringement of copyright law used to occur by the users due to different reasons. It may be lack of knowledge on plagiarism, high cost of original resources, out of print or out of stock of original resources, unavailability of sufficient quantity or copy of original resources, ignorance or not enough knowledge on copyright provisions, lack of trained or skilled people, etc.

Infringement of Copyright (Kumar, 2009) is punishable with imprisonment for 6 months to 3 years with a fine of rupees fifty thousand to two lakhs if it is committed first time and in case of second time and more if the infringement is committed, the person shall be punishable with imprisonment for a term not less than 1 year up to 3 years and fine of rupees one lakh to two lakhs. The law permits any police officer with the rank of sub-inspector or above to arrest responsible person without any warrant and produce him before the court of a Metropolitan Magistrate or a first class Judicial Magistrate provided he/she is satisfied that offence has been or is being or is likely to be or committed.

In addition, the Government of India has taken various steps to bring about changes in the administration of copyright law in the light of the provisions made in the Agreement on Trade-related Aspects of Intellectual Property Rights. India has participated in many bilateral arrangements or multilateral international treaties and conventions concerning intellectual property rights, which have a bearing upon the nature of amendments in her national laws. In order to get implemented the copyright law and the IPR regulations, India has the membership of number of international bodies.

18. Conclusion

Copyright protects the copyrighted materials for a certain period. After that period the public has to enjoy freely those intellectual materials. Presently, we live in a digital age and there is a danger of copyright becoming legal protection mechanism. In this regard, it can say that librarians have to play a crucial role in controlling as well as facilitating access to the increasing number of local and remote electronic information resources. Libraries are increasingly using IT products for storage and retrieval of information, and other in house jobs. By leasing the use of information, libraries are at the risk of infringing the Copyright. Therefore, libraries should be allowed limited copying by appropriate changes in the Copyright act. Librarians should also actively defend copyright works against piracy, unfair use and unauthorized exploitation, in both the print and the digital environment.

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Forest Fire Dynamics in North-eastern India: Causes, Management, and Sustainability

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Abstract

Forest fires, occurring in nature, pose challenges in many countries and are common in India's forest landscape. So forest fires shape India's forests, yet knowledge gaps exist on their causes, extent, and impact on local management. Human activities cause about 90% of Indian forest fires, making monitoring crucial. Among the clusters, the North Eastern States are declared extremely fire-prone. In north-eastern states, forestry is closely linked to fire due to the widespread practice of shifting cultivation, a seasonal occurrence from February to May annually. Approximately 55% of fires occur in the North-Eastern cluster, where there is 36% forest cover in a concentrated burn-prone area. Among the seven states, Mizoram experienced the highest number of forest fire incidents, followed by Manipur and Assam, considering the MODIS detected fire points only. Most of the state's highest forest fire detections occurred in 2020, except in Mizoram and Nagaland, where the highest forest fire detected here was in 2010. The regression between the five classes of fire-prone forest areas (in%) and fire points has shown a negative but significant relationship for the extreme fire-prone areas and a positive but significant relationship for the less fire-prone areas in 2019 and also for 2021. The regression between forest cover and forest fire occurrences revealed that 'r' values and p-values are not changing significantly with time considering the data of 2005, 2007, 2011, 2013, 2015, 2017, 2019, and 2021. The relationship between forest types and fire point detection has shown negative and insignificant results in most years, as the p-value ranges from 0.2 to 0.7.

Key Words: *Forest fire, MODIS, Shifting Cultivation, Fire alert system, NDMA*

1. Introduction

A forest is a natural resource that has various applications to maintain a balance between the environment and ecosystem. The progressive issues of forest fire have become a matter of environmental concern not only for India but also for the world. Progressive changes in climate and anthropogenic factors are considered to be the major controlling factors of forest fire incidents. Currently, due to the rise in population and urban development, forests face threats from both human-caused and natural wildfires. It is known that forest fires are classified into three main categories: a) natural, b) intentional, and c) unintentional. Jaiswal et al. (2002) informed us that the

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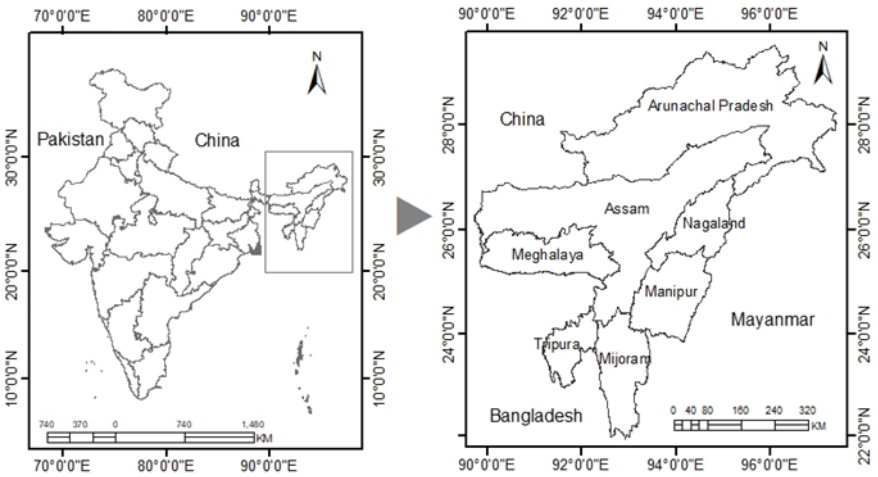
range of forest fires in some states of India is around 33%, and in some other states it is 90%. For a forest ecosystem and sustainable environment, forest fires can be considered a natural disaster with a significant threat. In India, forest fires are quite common, and the north-eastern states are considered to be more vulnerable. In the hilly tracts of north-east Indian states, slash and burn agriculture is very common, also known as 'Jhum, which is found to be a significant and major cause of forest fire. The fires in northeast India are mostly related to slash and burn agriculture (Ramakrishnan, 1988; Majumder et al., 2011; Chakraborty et al., 2014). Various elements, including land abandonment, socio-economic changes in rural regions, traditional fire-prone activities, neglect, landscape composition, land use, population density, forest management policies, increased recreational forest activities, and other human-related factors, collectively influence the occurrence, scale, and spatial pattern of wildfires (Badia et al., 2011; Catry et al., 2009; Ganteaume and Jappiot, 2013; Martinez et al., 2009;).It is also suggested that in 90% of cases, forest fires are mostly caused by human factors like firewood burning, deforestation, slash and burn agricultural practices, controlled burning, etc. Though forest fire gives some positive support to the local people by changing land use, making soil fertile, implementing flexible agricultural practices, etc., it is also responsible for some significant environmental impacts. Whatever the type of forest fire is, it will cause high carbon emissions (Hao et al., 1996; Fearnside, 2000), biodiversity loss (Brown and Davis, 1959; Meijaard et al., 2001), and a changing chemical composition of the atmosphere. It will also emit a large amount of trace gases, aerosol particles, and black carbon (Crutzen and Andreae, 1990; Dwyer et al., 1998). Even due to forest fires, almost 100 million tons of smoke aerosols are released into the atmosphere, increasing surface albedo and water runoff as a result of biomass burning. Aside from the depletion of vegetation, soil properties also get affected (Darmawan and Mulyanto 2001; North Eastern Regional Node for Disaster Risk Reduction). North Eastern Space Applications Centre, 2023).The north-eastern region (NER) is known for its diverse habitats and high level of endemic biodiversity with a high level of endemism, making it a global hotspot. (Myers et al., 2000). Arunachal Pradesh, Mizoram, Nagaland, Tripura, Manipur, and Assam are the most significant states affected by forest fire, and physiographically, they fall into the North East Hills, Eastern Himalaya, and the Bramhaputra and Barak Valley Plains. Over 36% of the nation's forest area is considered at risk of regular forest fires, with nearly 4% being extremely susceptible and 6% classified as highly fire-prone. (ISFR 2019). Increasing human dependence on forests leads to fragmentation and fires (Cochrane, 2003; Sewak et al., 2021). So, this paper focuses on dynamicity of forest fire, its relationship with forest cover, forest fire prone areas and nature of forest types in the North Eastern States.

2. Study area

The study area includes seven eastern most states of India. These are Arunachal Pradesh, Mizoram, Nagaland, Tripura, Manipur and Assam. These states have a significant amount of forest cover and are considered the states most affected by forest fires in India. Geomorphologically this are including structural origin, denudational origin, fluvial origin geomorphological units. In Assam the Bramhaputra valley covers maximum area but the structural origin landscapes are most predominating in Manipur, Meghalaya, Nagaland, Tripura states (Fig:1). some basic characteristics of the states are given in the following table no 1.



3. Objective and methodology

Forest fires have become a significant environmental issue that needs to be kept under observation. Forest fires of different intensities and sizes impact vast areas annually. According to forest inventory data, forest fires in India vary in intensity: 54.40% occasionally, 7.49% moderately, and 2.40% at high levels, leaving 35.71% untouched (ISFR). N-E states like Assam, Arunachal Pradesh, Manipur, Mizoram, Meghalaya, and Tripura are considered fire-prone, with high forest cover (36%) and fire detections (40%) (Sewak et al., 2021). Monitoring forest cover for fire threats is crucial. Forest fire incidents are studied using data from the FSI, or Forest Survey of India. Since 2004, FSI has alerted state forest departments and other users about detected forest fires detected by the MODIS Sensor on NASA's Aqua and Terra satellites. FSI has shared SNPP-VIIRS alerts since 2017 with 375m x 375m resolution, but for this study, MODIS or Moderate Resolution Imaging Spectroradiometer (1km x 1km resolution)-identified forest fire points from 2005 to 2021 were used to maintain data consistency. Alerts are sent up to the beat level in 10 states, including Andhra Pradesh, Bihar, Himachal Pradesh, Jharkhand, Karnataka, Maharashtra, Mizoram, Punjab, Telangana, and Tripura, up to the range level for Kerala, and up to the district level for other states and UT's without administrative boundary information. Deforestation, forest loss, shifting cultivation, and tribal slash-and-burn practices are linked to forest fires, according to various sources. The objective of the paper is to detect the nature and trend of forest fire incidents in the north-eastern states of India using descriptive statistics. Three correlation analyses have been considered, leading to the formulation of

hypotheses that include: fire-prone forest areas and forest fire points; forest cover and forest fire occurrences; the nature of forest types; and fire point detection. District-level forest cover data is also available in the forest survey report for 2005, 2009 (a 2007 assessment is given), 2011, 2013, 2015, 2017, 2019, and 2021.

Table 1: Selected state and their basic characteristics

State	Location	Temp (°C)	Annual Rainfall (mm)	Forested Land (%)2021	Physiographical domain
Arunachal Pradesh	26°28' N to 29°30' N 91°30' E to 97°30' E	0 -31	2,000-8,000	92.99	Eastern Himalayas, Northern plain, Bramhaputra valley
Assam	24°07′ N to 28°00′ N 89°42′ E to 96°02′ E	5- 32	1,500- 3,800	23.62	Bramhaputra valley, Central Assam hills, Barak Valley
Manipur	23°50′ N to 25°42 N 92° 59′ E to 94°46′ E	15 - 38	1250 - 2700	77.79	rugged hills and narrow valleys and the inner area of flat plain
Meghalaya	24°58′ N to 26°07′ N 89°48′ E to 92°51′ E	2 - 33	4000 - 11436	42.30	Meghalaya plateau divided into Garo, Khasi and jayantia hills
Mizoram	21°56′N to 24°31′N 92°16′E to 93°26′E	11-29	2,100-3,500	77.70	Rugged, steep hill ranges and interspersed valleys.
Nagaland	25°10′ N to 27°4′ N 93°15′ E to 95°6′ E	21- 40	1,800-2,500	52.23	Narrow strip of hilly country running N-E to S-W Assam plains to its N & N-W.
Tripura	22°57′ N to 24°32 N 91 o 10′ E to 9220′ E	7- 36	2,250 – 2,500	60	hill ranges, *undulating plateau land and* low-lying alluvial land

4. Nature and types of the forest fires, fire season and factors behind forest fire issues in North East India:

4.1 Forest fire and its types: Forest fires are of three types:

(i) Surface fire: spreads with a flaming front and burns leaf litter, fallen branches, any other fuels, etc. located at ground level.

(ii) Ground fire: Decomposed organic materials undergo smouldering or glowing combustion beneath the surface of recently fallen needles and leaves, known as duff, as well as in deep organic soils and large-diameter wood in contact with the soil (Reardon, 2020).

(iii) Crown fire: intense forest fires burn tree canopies, spreading quickly with strong wind, heavy fuel, and steep slopes. These fires devastate forests by burning deep into the soil, creating fireballs that ignite more fires. Thinning dense forests can prevent such disasters. Crown fires can send superheated gas balls half a mile away, igniting new blazes. (FRI, 2018).

Forest fires in India are classified into four main classes, each with distinct causes listed in the table 2. In the Himalayan forests of Uttarakhand and Himachal Pradesh, pine needle accumulation worsens summer forest fires. Despite most fires being low intensity, crown fires occur in mountain pine forests. Demand for forest products and growing populations escalate fire risks. Challenges like terrain and limited resources hinder fire management in the Himalayas and North East India, where many fires are caused by humans (Chakborty, et al. 2014).

Table 2: Cluster wise main causes of forest fire

Forest fire cluster	Causes of forest fire
(i) North Eastern India	Dominance of community-owned forests, local communities practice shifting cultivation, a major cause of annual forest fires.

(ii) central India	Teak and Sal forest of Central India the forest fire is caused due to collection of non-timber forest products.
(iii) North western Himalayas	The thick buildup of flammable litter on the pine forest floor is the primary cause.
(iv) Western Ghats and Eastern Ghats	various biotic activities are associated with forest fire incidents

Source: Forest Fire in India, Forest Research Institute (2018)

4.2 Components of forest-fire: Fire is a natural phenomenon that occurs when oxygen reacts with a combustible material, releasing energy in the form of heat and light at elevated temperatures. Fire is created by combining fuel, heat, and oxygen and these three components produces "fire triangle**"(Fig.2).** Removing any of these components causes the fire to collapse. Firefighters aim to eliminate one of these essentials to extinguish fires.

4.3 Forest fire season: Normal fire season in India starts from the month of February and ends in June, more specifically in mid- June. It is also notable that most of the forest fire in North east is from February to April (Sentinel Digital Desk, 2023). India's monsoons drive seasonal forest fires; peaks in March & April before monsoon, while Northeastern fires in December & January for jhum cultivation preparation (Dogra, et al.2018)

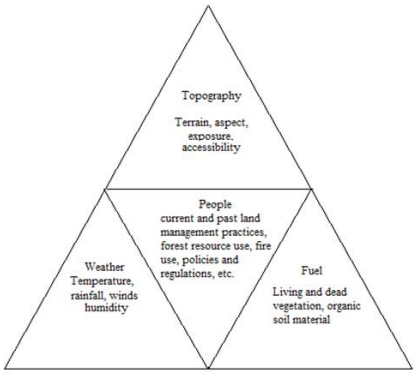


Figure 2: The wildfire triangle. (Adapted from Roy (2004) and Schnepf et al.(2010). Source: Forest fire in India, Page-11

4.4 Causes of forest fire: Generally, causes of forest fire

Forest fires may be caused by natural factors like lightning and dry weather, excessive atmospheric temperature, etc., while human causes include fires from cigarettes, electric sparks, and negligence. Climate change affects fire occurrences. In India, 95% of fires are human-caused, leading to ecological degradation. Human-caused fires can start from unattended campfires, debris burning, discarded cigarettes, or intentional acts. Some fires occur naturally from stone rolling, bamboo rubbing, or lightning, leading to ecological degradation by reducing moisture levels (FRI, 2018). Oxygen availability in a fire depends on intensity and structure, which also influence fire temperature and the spatial extent of the hot zone (Justice et al. 2006).

***4.4.1 Weather condition*:** Weather factors influence fire behaviour: temperature, humidity, wind speed, and drought raise fire risk. Strong winds can rapidly spread fires. It supplies fresh oxygen and pushes the fire towards the new fuel sources. Wildfire risk increases in very dry conditions, including drought, heat waves, and

strong winds (WHO, 2024). Strong winds fueled a recent forest fire near the Dunagiri temple in the Almora district of Uttarakhand, posing a threat to pilgrims as it engulfed the shrine's passage. 'Forest officials attributed the rapid spread of the fire to strong winds, which transformed it into a "crown fire."(ET,online 2024). Temperature: the higher the temperature of the fuel, the greater the probability of fire ignition. Higher solar radiation enhances the ambient temperature, and the fuel becomes more dry and heated after absorbing that heat (FRI, 2018). Even talking about the cause of the recent fire in Uttarakhand, Uttarakhand's chief conservator of forest (forest fire and disaster management) PK Singh told 'Down to Earth' that such large fire incidents are taking place due to an increase in temperature and lesser rainfall. In the case of Uttarakhand, the temperature has risen to around 4 degrees Celsius, along with the lack of rain, making the forest fires more dangerous (Kukreti,2019).Similarly, with a lower humidity level, the forest fire aggravates as the fuels become dry, catch fire easily, and also burn faster.

i) Thunderstorm lightning can trigger forest fires, as many of these blazes originate from natural events like lightning strikes igniting trees (Satendra and Kaushik, 2014).

ii) In regions with bamboo, forest fires can ignite due to the friction between clusters of dry bamboo. Additionally, natural forest fires can be triggered by volcanic eruptions.

iii) Volcanic eruptions also lead to forest fires naturally.

4.4.2 Fuel: Moisture, chemical makeup, and fuel density determine the inflammability. Fuel content, distribution, vegetation, terrain, weather, and fuel chemistry affect fire size and intensity (Snider et al., 2003, 2006; Orr et al., 2023) Plants with resins or oils burn faster and hotter. Fuels must be dense but spaced to allow air for combustion. Except for this, the density of the fuel is also important, as close existing fuel particles can ignite each other faster, but if they are so close that air can't circulate, then the fuel will not burn (FRI, 2018).

4.4.3Soil as a fire determining factor: Soil type and moisture within the soil also determine the fire probability. Soil with a higher moisture content and amount of organic matter present can determine the duration and extent of a forest fire.

4.4.4Shifting cultivation and forest fire: Forest fires in India are mostly started intentionally by small-scale farmers or landless rural individuals. Slash-and-burn shifting cultivation is the main cause of forest destruction in the northeast (Saigal, nd.). Shifting cultivation, a traditional farming method in India's northeast, covers 84% of land (0.76 million hectares), involving active Jhum (53%) and abandoned Jhum areas (47%) as of NRSC 2011. Approximately 0.44 million tribal families rely on this practice for their livelihood. (Yadav, 2013). Mertz et al. defined shifting cultivation as "swidden cultivation, which is a form of land use system that employs a natural or improved fallow phase that is longer than the cultivation phase of annual crops, sufficiently long

to be dominated by woody vegetation and are cleared by means of fire" (2009). FAO in 1957 considered the shifting of fields a major threat, especially in the tropics. Many nations, like India, have tried to stop shifting cultivation by implementing or formulating various policies and laws (IWGIA 2014). Despite efforts, slash-burn farming persists and contributes to deforestation (Punitha et al.2018). As noted in ISFR 2019, shifting cultivation is a key feature in hilly areas and has deep roots in tribal communities. The method of slash-and-burn farming is the primary cause of changes in forest coverage in the area (ISFR 2019).Over the years, the shifting of fields from one place to another has continued to be a main characteristic. In 1957, FAO considered this a serious threat to the land use of a region, specifically in the tropical world. Though many countries, including India, have implemented, tried to implement, or formulated various policies and laws to eradicate the shifting cultivation system (IWGIA 2014), the level of deforestation is also associated with slash-and-burn agriculture. In ISFR 2019, it is noted that shifting cultivation in hilly parts is considered a district feature of the land use in the region. Even historically, shifting cultivation has been closely connected to the social and cultural fabric of tribal societies and communities. The method of slash-and-burn farming is the primary cause of changes in forest coverage in the area (ISFR 2019).This agricultural method involves cycles referred to as "rotational bush fallow agriculture," starting in December with clearing, burning in mid-February to mid-March, ploughing, cultivating crops, harvesting, leaving the land fallow, and then repeating the process on new plots (Marak et al., 2023). The increase in shifting cultivators and decreasing forest soil productivity have shortened the cultivation cycle from 20 years to 4 years, leading to more conversion to shifting cultivators due to insecure land access. (Satendra and Kaushik, 2014).

4.4.5 Deforestation and forest fire: Slash and burn agriculture in North-East India by various tribal communities' leads to deforestation, affecting biodiversity and traditional livelihoods. North-East India is part of the Himalaya and Indo-Burma biodiversity hotspots and also houses over 100 tribal communities, mostly relying on resource-based livelihoods. Rising population and poverty encourage forest exploitation, impacting local ecology significantly. In 1996, an estimated 64 million cubic meters of timber were used, half from forests and the rest from farm forestry. Illegal activities like timber mafia and land encroachment, along with construction projects like dam construction, also contribute to deforestation (Satendra and Kaushik, 2014). So, forest management is crucial to prevent overexploitation and degradation, considering challenges like timber mafia, shifting cultivation, and a lack of scientific strategies. The traditional practice of shifting cultivation has been a key factor in the degradation of forests and land, leading to significant changes in the landscape.

4.4.5 Fodder crops or fresh grass: Forest fires are also intentionally caused to meet the need for fodder for grazing cattle. Therefore, people ignite fires in the forest to

stimulate the growth of fresh grass during the dry season, thereby fulfilling a significant portion of the grazing needs.

4.4.6 Illegal logging: Smugglers and poachers often ignite forest fires in order to conceal evidence of illegal logging activities.

4.4.7 Cleaning forest path and settling scores: Villagers also set small fires to clear the path or pack track from dry littering like branches, leaves, litter, etc. If such fires are left untreated, they can become disastrous. Sometimes miscreants set fires in order to settle scores with the forest department.

4.4.8 Miscellaneous factors*:* forest fire may be a consequence of both natural and anthropogenic causes. Though it is true that human factors act as the main driver of fires in India, the relationship between forest fire incidents and people, weather, fuel, and topography is illustrated in the figure number 2**.** In many cases, the fire is also used to keep away wild animals like boars and leopards. Except for this, other causes include:

(i) Careless handling and extraction of resin from Chir pine cones or burning of torchwood during the summer.

(ii) Habitations close to or within the forest generally depend on the wood as fuel, and sparks from such burning may lead to forest fires.

(iii) Legal and illegal charcoal-making industries, specifically small and medium, are quite common in the forests, and such activities may lead to forest fires.

(iv) Road construction in forests can ignite huge fires when charcoal heat used to smelt coal tar lights up dry litter.

(v) Forest-dwelling tribes frequently use fire to search for wild animals and their habitats. Even the growth of the leeches is prevented by fire.

(vi) The gathering of non-timber forest products by indigenous or local residents living in close proximity to the forest has significantly contributed to the occurrence of forest fires.

(vii) Occasionally, farm residues are set on fire after harvesting the crop. Many times, when the fires do not take off properly, they can spread to the nearest adjoining forest fire.

(viii) Sparking from transformers and vehicles passing through the area may ignite fires in a forest region.

(ix) Fire Controlled burning is done before the dry season to eradicate combustible material and prevent large forest fires; if mishandled, it can escalate into a large flame (Satendra and Kaushik, 2014).

5. Outline of forest fires issues in north east states

FSI's trend analysis reveals 10.66% of India's forest cover is highly fire-prone, with the North-East showing the highest forest fire incidents. Since 2004, FSI has helped state forest departments and other agencies deal with forest fire incidents. About 55% of fires happen in the North-Eastern cluster, with the highest forest cover of 36%, in a concentrated area prone to repeated burns. "This repeated pattern of burning on small forest areas is consistent with the practice of shifting cultivation (jhum) seen throughout the northeast. Fires in the North-Eastern cluster occur mainly from slash and burn agriculture (World Bank, 2018). Due to population growth, there has been a reduction in the time between fires, from 20–30 years to 2-3 years, breaking the ecosystem's resilience (Puri et al., 2011). Within the states of the North East region, Arunachal Pradesh has 11.34% of extreme to moderately fire-prone forest area, and a total of 10193 (%) fire points have been demarcated from 2005 to 2023 as per MODIS. The mean number is 784, and the variability is 59%. Siang (west) district holds the highest percentage of forest fires, and in 2022, the highest number of fires have been detected, i.e., 11% of the total number of detected fires. In Tripura, a total of 16400 fire points and 4001 fire points on average were recorded, and the coefficient of variation is 110%. Nagaland shows 1494 average fire detections, with 93% variability considering 2005–2023. Here, 26% years are fire prone with more than 1000 fire detections. In Meghalaya State, 20747 fire points were recorded, with a mean of 1729 and 87% variability. Over 61% of the 18 years (2008 excluded with no data) observed had more than 1000 annual fire detections. In Manipur, about 3519 forest fire points on average are detected annually, with 103% variability. In 84% of the 19-year period, over 1000 forest fires were detected each year, with peaks in 2020 and 2023 at 4275 and 3634 fires, respectively. In Mizoram, there were 5873 forest fire points on average, considering 2005–2023, and the variability is 103%. Within 19 years, 89% had over 1000 forest fires; of these, 54% had 2000–3000 fires, 31% had 3000–4000 fires, and 15% had over 4000 fires. In Assam, a total 31484 forest fire points were recorded, with an average of 1312 across twenty-four districts. Only two districts had no fire incidents. 79% of 19-year-olds saw over 1,000 fire detections. Overall, 238% variability for Assam has been found. The highest fire points were in KarbiAnglong (12266, or 39%) and DimaHasao (10305, or 33%) districts. The remaining districts had varying fire point levels. The wide range created a high coefficient of variance. Over all, it was found that more than 1000 fire points are quite common in all states except Arunachal Pradesh (Table 3). So, Mizoram, Manipur, Assam, Meghalaya, Nagaland, Tripura, and Arunachal follow the highest to lowest order in terms of percentage of forest fire points detected with respect to the total forest fire points of these states. The Z-score has shown that Mizoram, Manipur, and Assam are only three states that have shown forest fire points higher than the regional average.

Table 3: State wise total, mean, STDV fire points and distribution of forest fire in years

State	total	mean	STDV	CV %	Years (in %) with number of forest fire detections (2005-2023-MODIS)						District with highest forest fire detections
					<250	250-500	500-750	750-1000	>1000	Total	
Arunachal	10193	784	465	59	11	16	58	11	5	19	Siang-west (15%)
Assam	31484	1312	3119	238	16	0	0	5	79		Karbi-anglong (39%)
Manipur	31674	3519	3632	103	11	5	0	0	84		Churachandrapur (30%)
Meghalaya	20747	1729	1502	87	11	06	00	22	61		RiBhoi (22%)
Mizoram	46985	5873	6068	103	11	0	0	0	89		Aizwal (37%)
Nagaland	16430	2054	1196	58	16	0	11	47	26		Kohima (23.4%)
Tripura	16400	5335	4288	80	5	26	16	11	37		North Tripura (62%)

Source: Calculated by author based on Near Real Time monitoring of Forest (Forest Fire based on MODIS)

Table 4: State wise forest area in different fire prone classes (in %)

State	Extremely fire prone		Very highly fire prone		High fire prone		Moderate fire prone		Total		Less fire prone	
	2019	2021	2019	2021	2019	2021	2019	2021	2019	2021	2019	2021
Arunachal Pradesh	0.01	0.05	0.97	1.44	3.49	4.13	6.87	6.71	11.34	12.33	88.66	87.67
Assam	21.98	11.18	6.10	17.20	14.48	12.01	13.72	9.37	56.28	49.76	43.72	50.24
Manipur	4.48	9.85	33.15	37.16	35.85	32.68	15.36	12.63	88.84	92.32	11.17	7.68
Meghalaya	5.74	9.32	18.38	20.56	20.13	21.80	17.77	17.02	62.02	68.7	37.98	31.30
Mizoram	29.21	26.28	38.46	49.73	24.64	18.91	5.35	3.05	97.66	97.97	2.34	2.03
Nagaland	3.05	2.88	18.48	25.54	38.05	39.59	25.65	20.23	85.23	88.24	14.77	11.76
Tripura	26.95	32.27	21.90	16.18	12.62	10.53	10.76	8.31	72.23	67.29	27.77	32.71

Source: FSI Forest Report 2019-2021

5.1.1 State based chronological variability

State-level description and analysis are required to understand the variability of the forest fire incidents. The district-level average number of forest fire detections is given in Table:5, from 2005 to 2023.

5.1.1.1 Arunachal Pradesh

In Arunachal Pradesh, 62% of districts had fewer than 1000 fire incidents from 2005 to 2023. Siang West and Changlang had over 70 fire points, while Tawang and Upper

Siang had fewer than 10 on average. The variability of the forest fire point in these districts varies from 58% to 149%.Siang West and Lower Subansiri districts have less than 60% data variability.The remaining 46% of the districts, i.e., Kamang East, Dibang Valley, Siang Upper, Siang East, Tirap, and Tawang District, have more than 75% variability. Most of Arunachal Pradesh's district has varying forest fire occurrences. Z-score shows that Dibang Valley, Siang East, Siang Upper, Upper Subansiri, Lower Subansiri, and Tawang—these 46% districts have fewer fire point detections than the state average, while Changlang, Kamang east and west, Lohit, Popumpare, and Tirap show more detection.

5.1.1.2 Assam

Except Baksa and Udalguri, all Assam districts faced forest fires. Karbi-Anglong and Dima-Hasao displayed the highest percentages, i.e., 39% and 33%, respectively. Except for this, all other districts share less than 10% of the total forest fire points in the state. Significant variability in the district-level forest fire incidents can be found, i.e., from 55% to 436%. 58% of the districts have less than 100% variability in forest fire incidents. Chirang, Dhimaji, Morigaon, Dibrugarh, Lakhimpur, Tinsukia, Shivsagar, and Nilbari are eight districts that have maximum forest fire point variability in this time phase. This may be due to occasional or inconsistent fire incidents within 2005–2023 or a very sudden increase or drop in fire incidents. As an example, Chirang district from 2005 to 2023 recorded a fire incident only in 2007, and Dhemaji district had forest fire issues only in nine years within a nineteen-year span. The z-score shows only 17% of the districts, i.e., Cachar, DimaHasao, Haliakandi, and KarbiAnglong, have more forest fire incidents than the state average.

5.1.1.3 Manipur

In Manipur, 56% of the districts recorded more than 1000 fire point detections. Churachandrapur tops the list the list with 9507 fire points, representing 30% of the state's total. Tamenglong (25%) and Chande (19%) districts follow with the second and third highest forest fire percentages, respectively. Bishnupur district experiences the fewest incidents, while data variability is 255%, showing the maximum variable fire issues. InChurachandrapur (56%), Imphal West (98%), Senapati (82%), Temanglong (63%), and Ukhrul (63%), districts, have less than 100% variability. The other 44% of the district displays over 100% data variability, indicating inconsistent fire detections or fewer fire incidents. The calculated Z-score shows 44% of the districts have forest fire points less than the state average.

5.1.1.4 Meghalaya

Within 12 districts of Meghalaya, RiBhoi district has shown 22% of the total fire point detections considering the 2005–2023 time span, and it is the highest. The next three districts are West-Khasi Hills (21%), East Garo Hills (17%), and West Garo Hills (10%).

As the 2005–2023 time span is taken, they have experienced some changes in district distribution. Eastern West Khasi Hills was created due to the bifurcation of the West Khasi Hills district in 2021. After the creation of Eastern West Khasi Hills from West Khasi Hills, no detection of fire has been recorded, and from 2005 to 2021, the district did not exist. Almost all the districts in Meghalaya have shown more consistent fire detections. The variability of fire point data from 2005 to 2023 for all districts varies from 51% to 97%. 55% of the districts have less than 60% variability, and West Jayantia Hills district has maximum variability, i.e., 97%, and RiBhoi district has the lowest variability, i.e., 51%. This consistency shows that the regular occurrence of fire incidents may be due to the continuous practice of slash-and-burn agriculture. The z-score shows that 64% of the districts have forest fire points less than the state's average, representing relative regulated fire incidents. The remaining 36% of districts, including East Garo Hills, West Garo Hills, West Khasi Hills, and RiBhoi district, have more fire points than the state's average.

5.1.1.5 Mizoram

Mizoram has eight districts, and among them, Kolasib and Mamit have had no forest fire incidents from 2005 to 2023, as per FSI MODIS data. This may be due to horticultural expansion and a number of activities like the afforestation and conservation NAP program, the Green India Mission, the intensification of forest management, the Green Mizoram program, and the successful implementation of the Fire Prevention Programme for creating awareness and sensitization amongst the general public, etc. (NABARD, 2022). Rest assured, all the districts have more than 1000 fire incidents in total. Considering six districts, Aizwal (17324 or 37%) has recorded the highest average fire point detections and percentage, followed by Lunglei (25%), and Lawngtlai (16%). The data variability also ranges from 53% to 67%, representing a moderately stable data distribution. Only in Serchhip district (67%) can data variability be found. But the z-score has shown that 50% of the districts, i.e., Champhai, Saiha, and Serchhip districts, have forest fire points less than the state's average, representing a controlled form of fire expansion.

5.1.1.6 Nagaland

Within eleven districts of Nagaland, 73%, or eight districts, have records of forest fires. The rest of the district, including Kiphire, Longleng, and Paren, doesn't have any data on forest fire point detection. However, among the districts, Kohima has the highest number of fire point detections and can be considered the most fire-prone district. Kohima's share is almost 23.4%, followed by Tuensang at 23% of the total 16430 detected fire points in the state. Within eight fire-prone districts, 87% have more than 1000 fire points in total (2005–2023). The variability of fire point detection in these districts varies from 51% (Tuensang and Wokha districts) to 78% (Mon district), representing a moderately uniform number of forest fire incidents. For Mon districts,

the variability is quite high. Among these districts, only Dimapur has less than 500 detected fire points, i.e., less than the other districts. The calculated Z-score has shown that 63% of the districts have forest fire points less than the state's average, and Kohima, Tuensang, and Wokha districts have a higher number of forest fire points.

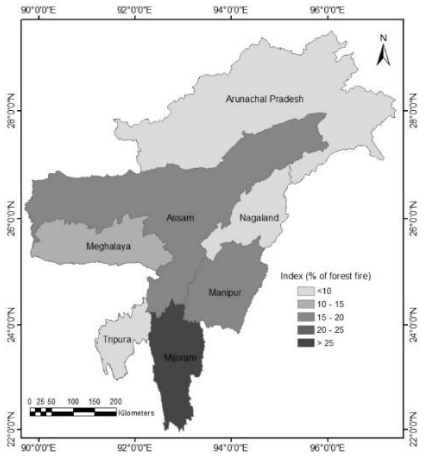


Figure 3: State wise forest fire detections (in %) to the total forest fire detections of these seven states (AS per MODIS)

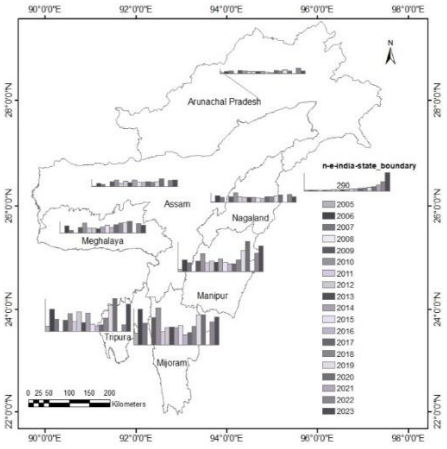


Figure 4: State wise average number of forest fire points detected as per MODIS (2005 – 2023)

5.1.1.7 Tripura

At present, Tripura has eight districts, i.e., Dhalai, Gomati, Khowai, North Tripura, Sepahijala, South Tripura, Unakoti, and West Tripura. Except for Dhalai, North Tripura, South Tripura, and West Tripura District, all four other districts, i.e., Gomati, Khowai, Sipahijala, and Unakoti District, were created in 2012 from South Tripura, West Tripura, and North Tripura Districts (https://tripura.gov.in/districts). However, the data provided by FSI follows the former four district division of Tripura. Dhalai district has not recorded any fire point detection in the time span, i.e., 2005–2023. The other three districts have more than 1000 fire points in total, but North Tripura district holds 62% of the total 16004 fire points in the state. 29% of the fire points are present in South Tripura, and the rest, 9%, belong to West Tripura district. The average number of fire points in North, South, and West Tripura is 552,257 and 80, respectively, and the variability is 61%, 73%, and 74%, respectively. Except for North Tripura, the other two districts have forest fire points that are less than the state's average.

5.1.2 State based active fire: From November 2020 to June 2021, fire incidents lasting less than 24 hours were most common in all states, and the maximum fire lasts up to 7-8 days (Fig. 5), with an average of 363 occurrences. On average, 75 fires lasted one day, 45 for two days, 31 for three days, and 11 for four days. Arunachal Pradesh, Manipur, Meghalaya, and Tripura had fire incidents lasting over 10–12 days, and only for Tripura 1% of the total detected fires can be noted, but other states are less than 1% (Table.6).

Figure 5: State wise number of large forest fire events and active days

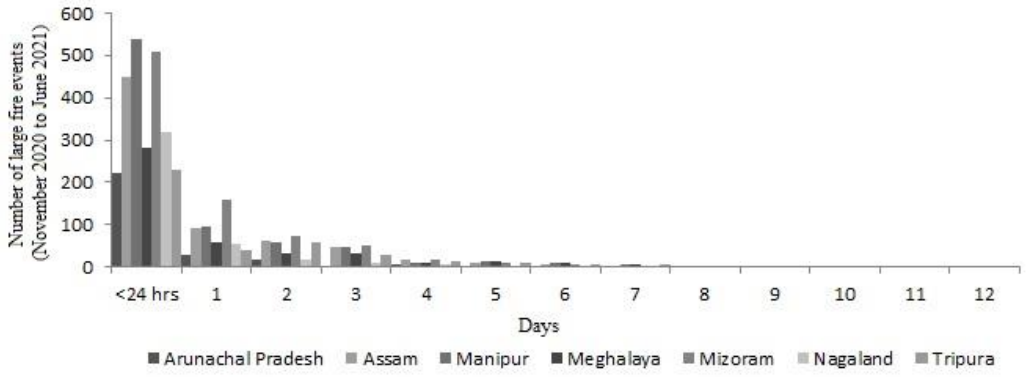


Table 5: State wise number of large forest fire events detected season 2020-21

States	Days												
	<24 hrs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Arunachal Pradesh	222	27	17	4	5	1	1	0	0	0	1	0	0
Assam	448	91	60	48	17	10	7	2	1	4	0	0	0
Manipur	537	97	57	46	10	15	11	6	4	0	0	0	1
Meghalaya	283	58	31	32	10	13	10	5	3	0	0	1	0
Mizoram	508	158	73	49	18	9	5	4	1	1	0	0	0
Nagaland	317	53	18	10	5	3	2	1	0	1	0	0	0
Tripura	228	40	58	28	13	9	6	6	1	1	2	1	0
Mean	**363**	**75**	**45**	**31**	**11**	**9**	**6**	**3**	**1**	**1**	**0**	**0**	**0**

6. Forest fire and associated forest situations

The FSI report for 2019 and 2021 provides the percentage of forest area prone to fires in each state. The reports from the years 2005, 2009 (includes the 2007 assessment), 2011, 2013, 2015, 2017, 2019, and 2021 are available for analysis within the selected timeframe of 2005 to 2023.

6.1.1 Fire prone area and forest fire points

Data from FSI shows state-wise fire-prone forest areas, i.e., extremely fire-prone, very high, high and moderate fire-prone, and less fire-prone forest areas (in%). Mizoram, Manipur, Nagaland, and Tripura have high fire-prone forest areas, and Arunachal Pradesh has the lowest. The correlation between the five classes of fire-prone forest areas (in%) and fire points according to 2019 data shows -0.83, -0.48, -0.21, 0.029, 0.6 'r' values, and 0.02, 0.27, 0.65, 0.95, and 0.2 p-values, respectively. For 2021, the 'r' value becomes -0.9, -0.7, -0.2, 0.2, 0.8, and the p-value become 0.01, 0.09, 0.7, 0.7, and 0.04, respectively. So, a strong negative 'r' value and significant p-value were found in cases of extreme fire-prone areas in 2019, and in 2021, a strong negative 'r' value and significant p-value were found in cases of extreme fire-prone areas, but a strong positive 'r' value and significant p-value were found in less fire-prone areas.

6.1.2 Forest cover and forest fire occurrences

It can be assumed that there is no relationship between forest cover percentages and forest fire occurrences. Due to changes in administrative divisions over time, the regression analysis is conducted only for years with available and reliable data. The regression value and p-values are

represented in Table 6. From calculation it is found that the regression values and p-values are not changing significantly. In Arunachal Pradesh, a positive relationship was observed from 2005 to 2019, with significance seen only in 2015, indicating no significant association between forest fire points and forest area. In Assam, total forest cover is significantly correlated with forest fire detection for all selected years. For Manipur, the relationship is significant in most of the years except 2005 and 2021 (the COVID year). This may be due to an insufficient number of fire incident detections. In Nagaland and Tripura, there is an insignificant relationship between forest cover and forest fire detections for all the selected years, though the trend is positive. There may be other factors that determine the forest fire incidents in Nagaland

6.1.3 Nature of Forest types and fire point detection

FSI also provides forest areas in three categories: very dense forest, moderately dense forest, and open forest. The relationship between forest cover (in%) and fire detections was examined for 2005, 2007, 2011, 2013, 2015, 2017, 2019, and 2021, with most years showing negative and insignificant results as the p-value ranges within 0.2 to 0.7 for the first two types. For open forests, though the relationship stands positive, the p-value ranges from 0.2 to 0.8, depicting an insignificant relationship. In 2021, only the very dense and open forest areas were affected by forest fires, with R values of 0.8 and 0.6 and p-values of 0.04. The relationship with moderately dense forest had a positive r = 0.8 but an insignificant p-value of 0.12.

7. Forest fire management methods

Forest departments in States and UTs employ diverse methods to manage forest fires, demonstrating effectiveness in prevention and mitigation. These methods are categorized as traditional and advanced, outlined by NDMA. These methods are as follows:

7.1 Traditional methods: Forest departments in the States and UTs of India employ diverse methods to manage forest fires, demonstrating effectiveness in prevention and mitigation. These methods are categorized as traditional and advanced, as outlined by the NDMA. These methods are as follows:

7.1.1 Controlled Burning: Controlled burning, also known as prescribed burning, is the deliberate setting of fires carefully planned and executed during times to promote the overall health of a forest. The burned materials typically consist of dead grass, fallen tree branches, small dead trees, and dense undergrowth. The burning plan, expansion and intensity of fire, firefighting tools, and smoke management tools are also kept.

7.1.2 Fire Terracing: generally the practice of fire terracing done along roadsides during the initiation of the fire seasons. Fire terracing involves the deliberate burning of vegetation along roadsides and pathways to mitigate the risk of accidental fires caused by human actions. This burnt strip acts as a barrier to fire advancement.

7.1.3 Fire lines: This is a traditional method of fire control followed by the forest departments of states and UTs. These are of two types, i.e., Kuccha and Pucca Lines, and are mainly used to prevent the spreading of forest fires. In Kuccha lines, the shrubs and undergrowth of the forest are cleared or removed, but trees are retained. But pucca lines are clear felled areas like roads, paths, and natural streams separating one forest from another.

7.1.4 Back or counter fire approach: This approach involves igniting a controlled fire at a safe distance from the advancing blaze in a strip of unburned forest. By burning up all the available fuel, the counterfire ensures that the advancing blaze subsides and is extinguished upon reaching the area. Additionally, fire lines, streams, gullies, and paths are utilized to contain the fire on one side. Historically, counter-fires safeguarded government reserves from zamindari forest wildfires.

7.1.5 Rock wall: Rock walls are built in various locations to provide permanent fire control barriers, safeguarding the forest from the threat of both surface and ground fire.

7.1.6 Fire watchers and fire watch towers: fire watchers are generally selected from the members of joint forestry management committees or from nearby villages for the fire season, i.e., 1st January to 15th June. In this phase, they help effectively remove the fallen leaves or organic debris to make fire lines. In a fire-sensitive forest, early detection depends on the fire watch towers. The designs of the fire watch tower ranges from a rudimentary or semi-permanent small tree house or hut to a solid reinforced concrete (RCC) structure.

7.1.7 Soil and moisture conservation: Implementation of various soil and moisture conserving activities like Contour trenches, gully plugs, boulder structures, and water harvesting systems help conserve soil and moisture, reducing forest fire risks.

7.1.8 Ticket patrol system: In British rule, this method was followed by the Forest Department in the central provinces. Here, tickets and routes were issued to the fire watchers from one naka in the morning and carried by them to the next naka after traversing the forest area stretch. While traversing the forest, fire watchers detect and dispose of forest fires.

7.2 Modern Practices: practices include the following techniques

7.2.1 Fire alert system: FSI utilized geospatial technology to create the fire alert system. The satellite identifies fire points, which are then transmitted to forest officers via mobile and email for necessary intervention by the forest department. In 2004, district-level forest fire alerts based on MODIS data were started. In 2008, SMS alerts on the number of fires at the state or district level started. Gradually email alerts with KML files at district-level vulnerability reports published in 2012. Burnt scar assessment in 2016, complete automation of the entire Forest Fire Alert System, addition of the SNPP-VIIRS sensor to the monitoring system, and alert dissemination up to the beat level started in 2017. In 2018, the feedback system improved; in 2019, the FSI Van Agni Geo portal and early alert-based Fire Weather Index started. In 2020, WMS, WFS, and API to the state department started, and further strengthening occurred. In 2021, special monitoring and special reports on the unusual increase of forest fires developed.

7.2.2 Mobile squads: During fire season, staff patrols intensively to detect and dispose of fires, using mobile squads to bring manpower from nearby villages to fight forest fires promptly.

7.2.3 Use of leaf blower: petrol/diesel-run leaf blowers are now being employed to combat wildfires by clearing a path at a safe distance from the encroaching fire.

7.2.4 New communication devices: Nowadays, forest departments are utilizing wireless systems, particularly in protected areas, for communication purposes, especially in relation to forest fires.

7.2.5 Community involvement: Forest departments have implemented a collaborative strategy to manage forest fires. Joint Forest Management (JFM) serves as a crucial mechanism for involving individuals in forest management.

The government of India has taken a number of action plans to prevent fire incidents.

- The National Action Plan for Forest Fires (NAPFF) was started in 2018, and its main focus was to inform and empower communities residing on the forest fringe. They were also suggested to incentivize collaboration with the state forest department.
- The Forest Fire Prevention and Management Scheme (FPM): this is the program assigned to assist states in dealing with forest fires. (NDMA, nd.)

8. Conclusion

Forest fire incidents are quite hazardous in India. In the Northeastern States, the number of forest fire points has increased over time. The predominance of community forests and tribal culture deliberately increased the forest fire incidents sustained for a longer period of time historically. Mizoram, Tripura, and Manipur are the three states with the maximum number of fire points. In 2008 and 2021, the lowest number of fire points was recorded. Lockdown and COVID situations may be factors for fewer forest fire occurrences in 2021. Otherwise, the Jhum cycle, the conservation attitude of local people, or the ban or legislation on forest fires in 2008 could be the reason for the number of wildfires. In 2022 (in Arunachal Pradesh, Assam), in 2020 (Manipur, Mizoram, and Tripura), and in 2010 (Mizoram and Nagaland), the states had the highest number of fires, or these are the fire years of the states. Forest fire-prone areas are not equally and significantly associated with forest fire points. Assam and Manipur are two states that have shown a significant association between fire-prone forest areas and fire points. Forest cover and types of forest, like very dense, moderately dense, and open forest, are not significantly associated with the fire points. Various schemes and laws have been implemented, but the scenario has not changed. Beside human influence, global temperature rise is also becoming significant. Proper implementation of environmental and forestry laws, control of global temperature, afforestation, and the development of consciousness among local tribes.

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The Historical Evolution of Dantan: From Dantapur to Dandabhukti

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Abstract

Dantan, located in the West Midnapore district of West Bengal, is a region of profound historical significance, with roots extending back to ancient times. This paper explores the historical evolution of Dantan, tracing its transformation from the Buddhist-era Dantapur to the medieval Dandabhukti. Drawing from ancient Buddhist texts, inscriptions, and archaeological findings, the study highlights the region's religious, political, and administrative importance across different historical periods. Additionally, the paper examines scholarly debates regarding the region's nomenclature and its role in trade, pilgrimage, and military expeditions. The findings underscore Dantan's enduring influence on Bengal's cultural and historical landscape.

Key words: *Dantan, Moghalmari, Tamralipta, Buddhist Monastery, Shashanka*

1. Introduction

The study of ancient and medieval urban centers in India provides critical insights into the socio-political, religious, and economic transformations that shaped the subcontinent's history. Among these, Dantan - a historically significant but often overlooked region in West Bengal's Paschim Medinipur district - offers a compelling case study of cultural continuity and change. Situated near the Odisha-Bengal border, Dantan (historically known as

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Dantapur, Dandabhukti, and Datin) has been a crossroads of religious movements, trade networks, and political struggles since antiquity.

Recent archaeological excavations, particularly at Moghalmari village, have unearthed a significant Buddhist monastic complex, reaffirming Dantan's role as an early center of Buddhism (Bandyopadhyay, 2015; Chakrabarti, 2018). Literary sources such as the *Dathavamsa* and *Mahavamsa* further highlight its association with the veneration of Buddha's relics and the spread of Theravada Buddhism to Sri Lanka. However, despite these findings, comprehensive scholarly studies on Dantan's historical transitions remain limited, with most research focusing on its Buddhist phase while neglecting later developments under the Guptas, Palas, and medieval dynasties.

This paper seeks to bridge this gap by examining Dantan's historical trajectory from the early Buddhist period to its decline under Mughal rule. Key questions guiding this study include:

1. How did the region's identity evolve from *Dantapur* to *Dandabhukti* and finally to *Dantan*?

2. What was its administrative and strategic significance under successive empires?

3. How do archaeological, epigraphic, and literary sources corroborate or contradict existing historical narratives?

By analyzing copperplate inscriptions, travelogues, and regional folklore alongside modern historiography, this study aims to reconstruct Dantan's multi-layered past. The findings not only contribute to regional history but also illuminate broader patterns of cultural exchange, political fragmentation, and religious syncretism in eastern India.

2. Dantapur: The Buddhist Legacy

The ancient Buddhist heritage of Dantan, then known as *Dantapur*, is deeply rooted in textual and archaeological evidence. The region's association with early Buddhism is most prominently documented in the *Dathavamsa* (4th century CE), a Pali chronicle composed by the Sri Lankan monk Dharmakirti Mahathero. According to this text, *Dantapur* was intimately linked to Arhat Kshema, one of Gautama Buddha's foremost female disciples (Bhattacharya, 2003). Following the Buddha's Mahaparinirvana at Kushinagar (c. 483 BCE), Kshema was entrusted with one of his sacred tooth relics (*Dantadhatu*), which she later presented to King Brahmadatta of Kalinga. The king enshrined the relic

in a specially constructed monastery named *Dantavanavihara*, thereby sanctifying the region as a major Buddhist pilgrimage site (Ray, 1986). This event not only elevated *Dantapur*'s religious stature but also influenced its toponymy - the capital was renamed in honour of the relic, while the surrounding territory gradually adopted the name *Dantapur*.

Recent excavations at Moghalmari, approximately 8 km from present-day Dantan, have uncovered the remains of a 6th–7th century CE Buddhist monastic complex, reinforcing *Dantapur*'s historicity (Bandyopadhyay et al., 2014). The site features:

- A stupa with sculpted panels depicting Jataka tales,
- Terracotta seals bearing the inscription *"Sri Dantapura Mahavihariya"*, confirming the monastery's name,
- Copper coins of the Gupta period, suggesting continued patronage under Hindu rulers.

These findings align with the *Mahavamsa*'s account of *Dantapur* as a thriving center of Buddhist learning and a key stopover for missionaries.

The *Mahavamsa* (5th century CE) highlights *Dantapur*'s strategic role in Emperor Ashoka's proselytization campaigns. In 343 BCE, Ashoka's children, Mahendra and Sanghamitra, halted at *Dantavanavihara* while en route to Sri Lanka with a sapling of the Bodhi tree (Geiger, 1912). The text describes the monastery as a "resting place for travelers" near Tamralipta, the premier port of eastern India (now identified with modern Tamluk). This account positions *Dantapur* as a nodal point in the maritime and overland networks connecting Bengal to Sri Lanka and Southeast Asia.

While most historians locate *Dantapur* in present-day Dantan, alternative theories propose:

Odisha Hypothesis: Some scholars, like Sahu (1986), equate *Dantapur* with Puri's Jagannath Temple complex, citing the *Skanda Purana*'s reference to a tooth relic worshipped there. However, this is contested by the *Dathavamsa*'s explicit linkage of the relic to Kalinga's capital (Bhattacharya, 2003).

Andhra Hypothesis: Epigraphist R. Subrahmanyam (1975) suggested Rajahmundry as a possible site, but this lacks corroboration from Buddhist texts.

The discovery of Moghalmari's *Dantapura Mahavihara* seals has significantly strengthened the West Bengal identification (ASI Report, 2016).

By the Gupta era (4th–6th century CE), *Dantapur*'s influence waned as Vaisnavism and Shaivism gained prominence. The *Dantadhatu* was likely transferred to Sri Lanka (as per the *Culavamsa*), and the monastery declined into ruin. However, the toponym persisted in mutated forms, evolving into *Dandabhukti* under administrative reforms.

3. Dandabhukti: The Gupta and Pala Eras

The transformation from Buddhist Dantapur to Dandabhukti during the Gupta period (4th-6th century CE) marked a significant political and administrative reorganization in the region. As Gupta influence expanded across eastern India, the area was incorporated into their provincial system as one of several Bhuktis (administrative divisions). According to epigraphic evidence, Dandabhukti encompassed southwestern Medinipur, parts of modern Balasore and Mayurbhanj districts in Odisha, and portions of the Singhbhum region in Jharkhand. The Gupta administration established a clear hierarchy with Uparika maharajas (governors) overseeing the Bhukti level, Kumaramatyas managing the Visaya (district) level, and local elites controlling smaller Vithi subdivisions.

Strategically positioned between the Gangetic plains and the Deccan, Dandabhukti developed into an economically vital region. Its commercial importance stemmed from control over key trade routes, particularly the Dakshina Kosala route that connected northern and southern India. The area's mineral resources, especially iron ore deposits in Singhbhum, and its fertile alluvial plains supporting extensive rice cultivation further enhanced its economic value. The Allahabad Pillar inscription of Samudragupta and archaeological remains at sites like Dantan and Narayangarh testify to the region's military significance, featuring fortified settlements and garrison posts that protected Gupta interests in eastern India.

Religiously, the Gupta period witnessed a gradual shift from Buddhism to Brahmanical Hinduism in Dandabhukti, though this transition occurred slowly. While Shaivite and Vaishnavite traditions gained prominence through royal patronage, evidenced by numerous land grants to Brahmanas recorded in copperplate inscriptions like the Ganjam plate of Madhavaraja II, Buddhist institutions such as the Moghalmari monastery continued to function well into the 7th century CE. This period of religious syncretism saw the coexistence of

multiple faiths, with Buddhist sites maintaining their importance even as Hindu temples began to dot the landscape.

The Pala period (8th-12th century CE) brought new administrative reforms to Dandabhukti, now functioning as a mandala (frontier province) within their empire. Governed by feudatory kings like Jayasingha, the region is mentioned in important records such as the Khalimpur copperplate of Dharmapala. Its strategic location made it a crucial buffer zone against the Odishan kingdoms to the south and served as a base for military expeditions against the Somavamsis. The region's military importance was further highlighted when it became a target of Rajendra Chola's northern campaign in 1024 CE, as documented in Chola inscriptions.

Culturally, the Pala era saw significant developments in Dandabhukti. The construction of brick temples like the one at Bahiri demonstrated the growing influence of Brahmanical traditions, while peripheral Buddhist sites continued their activities, reflecting the region's religious diversity. This period also witnessed the growth of tantric traditions that blended elements of Buddhism and Hinduism. Archaeological finds from this era, including Pala-style stone deities from Dantan and the remains of the Raktamrittika Mahavihara complex, provide tangible evidence of the region's cultural vibrancy during Pala rule.

Scholarly debates continue regarding several aspects of Dandabhukti's history during these periods. Historians have particularly contested the exact territorial extent of Dandabhukti, with some arguing it included coastal Odisha while others maintain it was limited to inland areas. The degree of political autonomy enjoyed by Dandabhukti under Pala rule remains another point of discussion, with copperplate inscriptions suggesting varying levels of independence among local rulers. These ongoing debates highlight the complex nature of regional administration in early medieval eastern India and the need for further archaeological and epigraphic research to clarify Dandabhukti's precise role within the Gupta and Pala empires.

4. Medieval Conflicts and Cultural Shifts

The medieval period witnessed Dandabhukti becoming a contested frontier zone as regional powers vied for control over this strategically important region. The *Tirumalai* inscription (1024 CE) provides crucial evidence of the Chola king Rajendra I's invasion of Dandabhukti during his northern campaign, marking a significant military confrontation in the region's history. Historians have engaged in extensive debates about the precise location of this conflict,

with Haraprasad Shastri arguing for its identification with Odantapuri in Bihar, while A.C. Banerjee's meticulous study of the Chola invasion routes strongly suggests the engagement occurred in southwestern Midnapore. This military episode underscores Dandabhukti's continued importance as a gateway between northern and southern India during the early medieval period.

As the balance of power shifted in eastern India, Dandabhukti became increasingly vulnerable to external pressures. During the period of Muslim rule in Bengal, the region emerged as a contested borderland where Hindu kings of Odisha had to maintain constant vigilance against raids by independent Pathan forces. This pattern continued during the Maratha ascendancy in Odisha, when their mobile cavalry frequently launched attacks on Bengal through the Balasore and Midnapore corridors. The historical records suggest that these centuries of conflict transformed Dandabhukti from a prosperous administrative center into a militarized frontier zone, with its political identity gradually fading as it became absorbed into larger regional power structures.

The cultural landscape of the region underwent significant transformations during these turbulent centuries. By the 11th century, the once-powerful Pala authority over Dandabhukti had weakened considerably, allowing numerous feudal lords to establish their own small domains. Historical records and local folklore preserve the memory of Vikramjit (also known as Vikram Kishori), one such feudal ruler of Dandabhukti, whose daughter Shashisena is associated with the prominent mound at Mugalmari village known as 'Sakhisena Dhibi' or 'Shakhisena Pathshala'. These local traditions provide valuable insights into the social organization of the region during its transition from a unified administrative territory to a patchwork of smaller principalities.

The gradual disappearance of Dandabhukti as a distinct political entity coincided with broader cultural shifts in the region. Under Mughal administration, the area was absorbed into larger provincial structures, and the ancient name faded from official records. However, the region's historical legacy persisted in local memory and religious traditions. The once-thriving trade routes through Dandabhukti, which had facilitated both military movements and pilgrim traffic for centuries, continued to serve as important cultural conduits, even as the region's political significance diminished. This transition from a major administrative center to a culturally rich but politically marginalized area reflects the complex dynamics of medieval Indian history, where regional identities often persisted beneath the surface of changing imperial overlords.

5. From Dandabhukti to Dantan: Literary and Linguistic Transitions

The transformation of the region's identity from Dandabhukti to Dantan represents a fascinating case study in historical toponymy and cultural memory. This transition, occurring between the 12th and 16th centuries, is documented through a rich corpus of Vaishnava literature and local folk traditions that bridge the gap between the region's medieval past and its early modern identity.

The earliest literary reference to the modern toponym appears in Vrindavan Das's *Chaitanya Bhagavatam* (1548 CE), which chronicles the travels of Chaitanya Mahaprabhu through this region. The text situates Dantan within a precise geographical context - approximately 20 km south of Narayanagarh and 18 km north of Jaleswar - while describing it as a resting place for pilgrims journeying along the ancient Utkala route to Puri. This account gains archaeological corroboration from the *Vidyadhar Dighi*, a large medieval water tank in Dantan where local tradition maintains Chaitanya performed his morning rituals. The association of the town's name with this incident (*danta* meaning tooth, referring to the saint's dental hygiene routine) persists in popular folklore, though scholars debate its etymological validity.

Jayananda's *Chaitanya Mangal* (1560 CE) provides the first clear textual reference to "Datin" as a regional toponym in the *Utkal Parva* section. Composed just fifteen years after *Chaitanya Bhagavatam* and three decades after the saint's death, this work offers crucial linguistic evidence for the transitional phase between *Dandabhukti* and *Dantan*. The text specifically locates Datin near Barasati village on the Subarnarekha's banks - geographical markers that remain identifiable today, with Barasati now a suburb of Jaleswar in Odisha. This remarkable continuity of place names over four centuries suggests a stable cultural memory despite political changes.

Linguistic analysis reveals the phonological evolution: Dandabhukti (Sanskrit administrative term) → Dandabhukta (Prakrit colloquial form) → Dandabhuktan (Apabhramsha transitional form) → Dantan (Bengali vernacular). Professor Sukumar Sen's Etymological Dictionary of Bengali (1971) traces this progression as characteristic of eastern Indian toponymic shifts, where Sanskrit administrative terms gradually simplified in vernacular usage. The preservation of the core danta/danda root across millennia - from Buddhist Dantapura to medieval Dandabhukti to modern Dantan - demonstrates remarkable onomastic continuity.

The scholarly debate surrounding this transition crystallizes in the works of two eminent historians. Dr. D.C. Sircar (1965) questioned the linguistic plausibility of direct derivation, arguing that Dandabhukti and Dantan represent distinct toponymic traditions. In contrast, Professor Nihar Ranjan Roy (1986) emphasized the administrative continuity, noting that "the thana of Dantan and the Dantan town bear the memory of ancient Dandabhukti" through institutional persistence. This dichotomy reflects broader historiographical tensions between linguistic purism and cultural continuity approaches in Indian toponymic studies.

Medieval land records and Mughal-era revenue documents show the gradual standardization of "Dantan" in official usage by the 17th century, coinciding with the region's incorporation into the Hijli kingdom. The *Bahiri Copperplate* of 1632 CE and British East India Company surveys from the 1760s consistently use "Dantan", indicating the complete transition from its medieval predecessor. Today, the name preserves multiple historical layers - from Buddhist relic veneration to Gupta administration to Vaishnava pilgrimage - making it a linguistic palimpsest of eastern India's cultural history.

6. Conclusion

Dantan's historical trajectory - from an ancient Buddhist center to a medieval administrative hub and finally to its present-day identity—reflects the broader socio-political and cultural shifts that have shaped eastern India over two millennia. Each phase of its evolution, marked by distinct nomenclature (*Dantapur, Dandabhukti, Datan*), encapsulates the dynamic interplay of religion, politics, and geography that defined the region. As a sacred Buddhist site, *Dantapur* thrived on the veneration of relics and monastic scholarship. Under the Guptas and Palas, *Dandabhukti* emerged as a strategic frontier zone, connecting northern and southern India through trade, military campaigns, and pilgrimage routes. By the late medieval period, the transition to *Datan* (and eventually *Dantan*) signaled its integration into new cultural and administrative frameworks under Vaishnava influence and later Mughal and British rule.

Archaeological discoveries, such as the monastic complex at Moghalmari, along with epigraphic records and literary sources like the *Chaitanya Bhagavatam*, collectively underscore Dantan's enduring significance in Bengal's historical landscape. Yet, many questions remain—particularly regarding the finer details of its political transitions, the extent of its economic networks, and the lived experiences of its inhabitants across different eras. Future interdisciplinary

research, combining advanced archaeological methods, textual analysis, and digital mapping, could further illuminate Dantan's role in the larger narrative of Indian history. As a microcosm of eastern India's historical complexity, Dantan not only preserves the legacy of its past but also invites continued scholarly exploration into the forces that shaped it.

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