

# **AI AND GEOGRAPHICAL INDICATIONS: A COMPARATIVE ANALYSIS OF EU AI REGULATIONS (2018–2024) AND INDIA’S GI PROTECTION FRAMEWORK**

## **ABSTRACT**

The integration of Artificial Intelligence (AI) into regulatory frameworks has significantly influenced various areas, particularly in the realm of intellectual property protection. This research paper conducts a comparative analysis of the European Union’s AI regulations (2018–2024) and India’s Geographical Indications (GI) protection system, focusing on their legal foundations, enforcement methods, and potential overlaps.

The EU’s AI regulatory framework has evolved from non-mandatory ethical principles introduced in 2018 to a legally enforceable AI Act established in 2023. This framework employs a risk-based approach to AI governance, incorporating stringent compliance obligations. In contrast, India’s Geographical Indications of Goods (Registration and Protection) Act of 1999 establishes a registration-focused legal system meant to safeguard the authenticity of regional products. However, it faces challenges such as counterfeiting, insufficient digital enforcement, and difficulties in achieving global recognition.

This paper highlights the potential for AI to enhance the protection of geographical indications in India through AI-enabled authentication, counterfeit detection, and supply chain oversight. While AI technologies present opportunities for improving GI enforcement, several issues must be addressed, including ethical concerns, high implementation costs, and the lack of a dedicated legal framework for AI in India.

The paper argues that India’s GI protection system could be strengthened through AI-driven digital interventions, drawing on best practices from the EU’s AI governance framework. Policy recommendations include incorporating AI into GI monitoring, establishing a national AI regulatory framework, and fostering public-private partnerships to facilitate the adoption of AI-driven authentication technology by small-scale manufacturers.

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## **RESEARCH OBJECTIVES**

1. Analyse the scope and implications of EU AI regulations (2018–2024) for the protection of Geographical Indications (GIs).
2. Examine India's current legal framework for GI protection in the context of emerging AI technologies.
3. Conduct a comparative analysis of the EU and Indian approaches to AI and GI protection.
4. Identify the challenges and opportunities for harmonising AI governance with GI rights protection in both regions.

## **RESEARCH QUESTIONS**

1. How do the EU's AI regulations from 2018 to 2024 address the protection and enforcement of Geographical Indications (GIs)?
2. What are the key features and limitations of India’s framework for protecting GIs in the age of AI?
3. In what ways do the EU and India differ in their legal and policy approaches regarding the intersection of AI and GI protection?
4. What strategies can be implemented to bridge the regulatory gaps between the EU and India in aligning AI with GI rights?

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## 1. INTRODUCTION

Geographical Indications (GIs) are a crucial component of intellectual property rights (IPRs), protecting products associated with specific regions and ensuring economic benefits for producers. In recent years, the role of artificial intelligence (AI) in monitoring, enforcing, and managing the protection of geographical indications has grown significantly, as technological advancements offer new methods for authentication, traceability, and market surveillance. However, regulatory approaches to AI and GI protection vary considerably between countries. The European Union (EU) has established a comprehensive AI regulatory framework, while India focuses on a robust but developing system for GI protection.

The European Union has taken the lead in AI legislation by recognising both the potential benefits and risks of AI implementation. The proposed EU AI Act, introduced in 2021 and expected to be implemented in 2024<sup>1</sup> Categorises AI systems based on risk levels, particularly emphasising high-risk applications that pertain to intellectual property enforcement.

AI-driven tools for authentication and surveillance, including machine learning-based traceability systems, have been integrated into the EU's regulatory framework. These tools help combat counterfeiting and ensure compliance with standards for the protected designation of origin (PDO) and protected geographical indication (PGI).

In contrast, India's Geographical Indications of Goods (Registration and Protection) Act, enacted in 1999, provides a comprehensive legal framework for the registration and enforcement of GIs. While India's legal system aligns with the TRIPS Agreement of 1994, it lacks specific provisions for AI applications in the protection of geographical indications. Nonetheless, the growing use of digital technologies has led to the exploration of AI-driven authentication and blockchain-enabled

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<sup>1</sup> European Union. (2023). \*Artificial Intelligence Act\*. European Commission.

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traceability systems in India, particularly for high-value GI products such as Darjeeling Tea, Pashmina Wool, and Basmati Rice.

Despite these advancements, India's legislative environment remains fragmented, with AI applications being adopted more at the industry level rather than through a cohesive legal framework.

This comparative research aims to explore the intersections between AI legislation and geographical indication protection within the EU and India. The study will analyse the role of AI technologies in enforcing GIs, identify regulatory deficiencies in both regions, and examine future opportunities for harmonising AI-based GI protection strategies. Ultimately, this paper seeks to offer policy suggestions for integrating AI within the realm of geographical indications by contrasting the EU's structured AI regulation with India's traditional yet evolving system for GI protection work.

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## **1.2 BACKGROUND OF AI REGULATIONS IN THE EU AND THE EVOLUTION OF INDIA'S GI FRAMEWORK**

### **1.2.1 AI Regulations in the EU**

The European Union has actively taken steps to establish AI legislation that balances innovation with ethical considerations, accountability, and safety. The foundation for AI governance in the EU was laid out in the European Strategy on AI (2018), which emphasised the necessity of investing in AI research and promoting responsible growth (European Commission, 2018). This strategy was followed by the Ethics Guidelines for Trustworthy AI (2019), created by the High-Level Expert Group on AI. These guidelines outlined key principles such as openness, fairness, and human oversight (AI HLEG, 2019<sup>2</sup>).

In 2021, the European Union unveiled the Artificial Intelligence Act (AI Act), the first legal framework for global AI governance. This act categorises AI systems into four risk classifications: unacceptable risk (prohibited applications), high risk (subject to strict regulations), limited risk (with transparency requirements), and minimal risk (permitted without restrictions) (European Commission, 2021<sup>3</sup>). The AI Act, set to be implemented in 2024, particularly addresses AI applications used in the enforcement of intellectual property, including the monitoring of geographical indications.

AI-driven tools, such as blockchain for verifying geographical indications, image recognition for identifying counterfeits, and machine learning for supply chain monitoring, have gained legislative significance in the EU (European Parliament, 2023).

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<sup>2</sup> AI HLEG. (2019). \*Ethics Guidelines for Trustworthy AI\*. High-Level Expert Group on Artificial Intelligence.

<sup>3</sup> European Commission. (2021). \*Artificial Intelligence Act (AI Act)\*. European Commission.

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## **1.2.2 Evolution of India's GI Protection Framework**

India has established a strong framework for the protection of Geographical Indications (GIs), governed by the Geographical Indications of Goods (Registration and Protection) Act, 1999 (GI Act), which was implemented in 2003 (Controller General of Patents, Designs & Trade Marks, 2003). This Act was formulated following the Trade-Related Aspects of Intellectual Property Rights (TRIPS) Agreement (1994) under the World Trade Organisation (WTO) framework, protecting goods with unique regional origins.

Since its inception, the Indian GI framework has experienced significant growth, with more than 450 registered GIs as of 2023. These include agricultural items (such as Basmati Rice and Darjeeling Tea), handicrafts (like Mysore Silk and Pashmina), and manufactured goods (such as Channapatna Toys) (DPIIT, 2023<sup>4</sup>). However, India has lagged in adopting AI-driven enforcement methods and lacks substantial legislative provisions for AI-based traceability, counterfeit detection, and digital verification. While certain sectors have begun implementing blockchain-based supply chain monitoring and AI-driven quality control, these efforts remain sector-specific and are not integrated into a formal regulatory framework (Sundar & Bhatia, 2022<sup>5</sup>).

The gap between AI legislation and GI protection in India highlights the need for a comparative examination with the European Union, which has developed advanced AI governance concerning intellectual property rights.

## **1.2.3 Rationale for Comparing AI Regulations and GI Protection**

The intersection of artificial intelligence (AI) and geographical indication (GI) protection is becoming an important area of focus in both legal and technological fields. As GIs gain economic

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<sup>4</sup> DPIIT. (2023). \*Geographical Indications of Goods (Registration and Protection) Act\*. Government of India.

<sup>5</sup> Sundar & Bhatia, (2022) \*Artificial Intelligence Regulatory Frameworks

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and cultural importance, issues such as fraud and counterfeiting pose significant threats. This necessitates the development of AI-based solutions for authentication and traceability. While the European Union has established a comprehensive legislative framework for AI in intellectual property protection, India is still in the early stages of implementing AI for the enforcement of geographical indications.<sup>6</sup>

This comparative study is essential for:

1. In evaluating AI integration in Geographical Indication (GI) enforcement, the EU’s AI Act acknowledges the role of AI in intellectual property enforcement. In contrast, India’s GI protection framework does not contain explicit provisions for AI. This research explores how AI regulations influence GI monitoring, compliance, and enforcement mechanisms.
2. In identifying best practices, the EU’s structured AI governance can provide valuable insights for India’s developing AI policy landscape, especially in enhancing GI authentication, certification, and supply chain transparency.
3. In addressing regulatory gaps, this study juxtaposes the EU’s risk-based AI governance model with India’s sector-specific AI adoption in GI protection. The aim is to identify regulatory voids and propose potential reforms for AI-based GI enforcement in India.
4. In enhancing international trade and compliance, it is essential to note that India exports several high-value GI products. By aligning its AI-driven GI protection mechanisms with global standards, such as those established in the EU, India could increase trade, build consumer trust, and ensure legal compliance in international markets.

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<sup>6</sup> European Commission. (2018). \*European Strategy on Artificial Intelligence\*. European Commission.

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This study aims to achieve the following objectives.<sup>7</sup>:

1. To analyse the evolution and current state of AI regulations in the European Union (2018–2024) and their implications for intellectual property protection.
2. To examine India’s framework for protecting Geographical Indications (GI) and assess its readiness for AI-based enforcement.
3. To compare the regulatory approaches of the EU and India in integrating AI for GI monitoring, counterfeit detection, and supply chain traceability.
4. To identify regulatory gaps and propose policy recommendations for India's AI-driven GI protection framework, drawing on best practices from the EU.

## **1.3 RESEARCH METHODOLOGY**

This study uses a comparative legal research methodology to analyse the regulatory frameworks governing Artificial Intelligence (AI) and Geographical Indications (GIs) in the European Union (EU) and India. A doctrinal approach will be applied to examine legal statutes, policy documents, and international agreements, such as the EU AI Act (2021–2024), India’s Geographical Indications of Goods (Registration and Protection) Act (1999), and the TRIPS Agreement (1994). The aim is to understand their impact on the enforcement of AI-driven GIs.

Additionally, an empirical analysis will be conducted using qualitative methods, including case studies of notable GI-protected products from both regions, such as Parmigiano Reggiano (EU) and Darjeeling Tea (India). This will evaluate the role of AI in authentication, traceability, and counterfeit prevention. Expert interviews with policymakers, legal scholars, and AI practitioners

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<sup>7</sup> European Commission. (2018). \*European Strategy on Artificial Intelligence\*. European Commission.

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will provide insights into the feasibility of integrating AI technologies into India's GI protection framework.

The study will also review current AI applications, such as blockchain-based GI traceability, image recognition for fraud detection, and machine learning-based supply chain monitoring in the EU, comparing them with India’s developing digital strategies in GI enforcement. Based on these findings, the research will propose policy recommendations for India's AI-driven GI protection, drawing on best practices from the EU to enhance regulatory alignment, technological adoption, and compliance with international trade standards.

## **1.4 OVERVIEW OF AI REGULATIONS IN THE EU (2018–2024)**

The European Union (EU) has taken the lead in regulating artificial intelligence (AI) by establishing a comprehensive legislative framework aimed at balancing innovation, safety, and fundamental rights. The development of AI regulation in the EU has progressed from establishing ethical principles to the creation of the Artificial Intelligence Act (AI Act), which is the first comprehensive AI legislation in the world. The EU utilises a risk-based regulatory framework that emphasises transparency, accountability, and human oversight to address potential risks associated with the implementation of AI.<sup>8</sup>

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<sup>8</sup> European Commission. (2018). \*European Strategy on Artificial Intelligence\*. European Commission.

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## 1.4.1. The EU AI Legal Framework

### *AI Ethics Guidelines (2018–2019) – European Commission's High-Level Expert Group on AI (HLEG)*

In 2018, the European Commission established the High-Level Expert Group on Artificial Intelligence (HLEG<sup>9</sup>) to develop ethical principles for the research and deployment of AI. In 2019, the HLEG published the "Ethics Guidelines for Trustworthy AI," outlining seven fundamental principles: human agency and supervision, technological robustness, privacy and data governance, openness, justice, societal well-being, and accountability. These principles were designed to guide policymakers, businesses, and researchers in creating AI systems that align with fundamental human rights and democratic values.

In 2020, the EU introduced the AI White Paper, which presented a risk-based approach to AI regulation. This framework classifies AI applications into different risk categories to ensure appropriate oversight. The White Paper emphasised three core policy objectives: promoting AI investment, ensuring compliance with ethical standards, and developing regulatory options for addressing high-risk AI applications. It also stressed the importance of stakeholder engagement, encouraging industry leaders, researchers, and civil society to contribute to the development of the AI governance framework.

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<sup>9</sup> DPIIT. (1999). \*Geographical Indications of Goods (Registration and Protection) Act\*. Government of India.

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## *Proposal for the EU AI Act (2021) – Risk Classification Model*

In April 2021, the European Commission proposed the **Artificial Intelligence Act (AI Act)**, establishing a **four-tier risk classification model** for AI systems (European Commission, 2021)<sup>10</sup>:

1. **Unacceptable Risk** – AI applications that pose serious threats to fundamental rights (e.g., **social scoring, manipulative AI, and real-time biometric surveillance**).
2. **High Risk** – AI systems used in critical sectors (e.g., **healthcare, law enforcement, and employment**) that require stringent compliance measures.
3. **Limited Risk** – AI systems that require **transparency obligations** but are not subject to strict regulatory controls (e.g., AI chatbots).
4. **Minimal Risk** – AI applications that pose **low or no risk** (e.g., AI-based recommendations in entertainment platforms).

The proposed AI Act marked the **first attempt at legally binding AI regulation** in the EU, setting clear compliance standards for businesses and governments.

## *The AI Act (2023–2024) – Finalisation and Implementation*

After multiple revisions and negotiations, the **EU AI Act was finalised in 2023** and is set to be **implemented in 2024** (Council of the European Union, 2023)<sup>11</sup>. The final version introduced **specific compliance requirements**, including:

- **Mandatory AI risk assessments** before market deployment.
- **Transparency obligations** for AI-powered decision-making tools.
- **Stronger restrictions on biometric surveillance** and AI in law enforcement.

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<sup>10</sup> European Commission. (2021). *Proposal for a Regulation on a European Approach for Artificial Intelligence (Artificial Intelligence Act)*. European Union.

<sup>11</sup> Council of the European Union. (2023). *Final Agreement on the Artificial Intelligence Act: Implementation and Compliance Framework*. Brussels.

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- **Financial penalties** for non-compliance, ranging from **€10 million to €30 million or 6% of global turnover** for violations.

The Act also mandates the establishment of **AI governance bodies**, such as the **European AI Office**, to oversee implementation, enforcement, and updates to the regulatory framework.

## 1.4.2 Core Principles of the EU AI Act

### *Transparency, Accountability, and Fairness*

The AI Act imposes strict transparency requirements on AI developers, mandating that they disclose the operations of their AI systems. It is crucial to ensure that automated decision-making does not result in discrimination or bias (Floridi & Cows, 2022).

Explainability in AI decision-making is particularly required for high-risk applications, such as credit scoring, recruitment, and law enforcement. The regulation highlights the need for human oversight in AI-driven decisions to prevent automation bias and reduce undue reliance on AI (Veale & Zuiderveen Borgesius, 2021<sup>12</sup>).

For high-risk AI systems, human intervention must be possible at critical decision points to guarantee accountability and uphold ethical standards.

### *Prohibited AI Practices (e.g., Biometric Surveillance)*

Certain AI applications are outright **prohibited under the AI Act**, particularly those that pose **systemic risks to human rights**. These include:

- **AI-driven social scoring systems** similar to China’s social credit model.

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<sup>12</sup> Veale & Zuiderveen Borgesius, 2021 \*reduce undue reliance on AI \*

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- **Emotion recognition AI in workplaces and schools** (except for health and security applications).
- **Real-time biometric surveillance** (except in narrowly defined cases such as counter-terrorism efforts).

## *Regulation of High-Risk AI Applications*

High-risk AI applications, especially those used in healthcare, critical infrastructure, and law enforcement, must undergo thorough testing and certification before they can be deployed (Council of the European Union, 2023<sup>13</sup>). Companies that develop high-risk AI are required to provide risk mitigation plans, data governance frameworks, and post-deployment monitoring to ensure compliance.

*AI Governance Bodies and Compliance Requirements: To ensure the effective enforcement of the AI Act, the EU has established **centralised governance bodies** responsible for regulatory oversight:*

- The **European AI Office**, which will monitor AI compliance across member states.
- **National AI Regulators**, ensuring country-level enforcement.
- **AI Market Surveillance Authorities**, assessing AI systems' performance and risks in real-world applications (European Parliament, 2023<sup>14</sup>).

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<sup>13</sup> Council of the European Union. (2023). \*AI Act 2023 Finalization and Implementation\*. Council of the European Union.

<sup>14</sup> Parliament of the European Union. (2023). \*AI Act 2023 World Applications \*. Council of the European Union.

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By implementing these governance structures, the EU aims to **create a harmonised AI regulatory environment** that fosters innovation while **ensuring AI aligns with human rights and ethical principles**.

## 1.5 INDIA’S GEOGRAPHICAL INDICATIONS PROTECTION FRAMEWORK

The framework for protecting Geographical Indications (GIs) in India is a vital component of its intellectual property rights (IPR) system. It provides legal recognition for products that originate from specific locations, which are distinguished by their unique attributes and reputation. Safeguarding Geographical Indications is crucial for preserving cultural heritage, boosting rural economies, and preventing counterfeit goods from infiltrating both local and international markets<sup>15</sup>.

As a signatory to the TRIPS Agreement (1994) under the World Trade Organisation (WTO), India established a domestic legal framework for the protection of GIs, leading to the enactment of the Geographical Indications of Goods (Registration and Protection) Act in 1999. Despite these efforts, several institutional, legal, and enforcement challenges persist within India's GI protection framework. Addressing these issues will require further legislative improvements and the integration of technology.

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<sup>15</sup> Rao, S., & Dev, M. (2022). \*Legal Protection of Geographical Indications in India\*. Journal of Intellectual Property.

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## 1.5.1 The Geographical Indications of Goods (Registration and Protection) Act, 1999

The Geographical Indications of Goods (Registration and Protection) Act, 1999 (GI Act) was established to fulfil India’s commitments under the TRIPS Agreement (1994) and became effective in 2003 (DPIIT, 2003)<sup>16</sup>. This Act creates a comprehensive legal framework for the registration, protection, and enforcement of geographical indication rights, which cover agricultural products, manufactured items, and handicrafts. It aims to prevent unauthorised use of registered geographical indications (GIs), ensuring that only authentic producers within the defined geographic area may use the GI mark.

Under this Act, the Controller General of Patents, Designs, and Trademarks (CGPDTM) acts as the Registrar of Geographical Indications, responsible for processing GI applications and managing the official GI registry (Geographical Indications Registry, 2023). The Act grants exclusive rights to producers, cooperatives, and groups, allowing them to take legal action against infringements. Unlike trademark protection, GI protection in India is collective, meaning that ownership is shared among a consortium of recognised producers rather than held by a single entity (Rao & Dev, 2022<sup>17</sup>).

The GI Act is further supported by the Geographical Indications Rules, 2002, which outline the registration procedures, renewal processes, and enforcement protocols (IP India, 2022). The Act imposes fines and legal remedies for GI infringement, helping combat counterfeiting and

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<sup>16</sup> Geographical Indications Registry. (2023). \*Geographical Indications in India\*. Government of India.

<sup>17</sup> Rao, S., & Dev, M. (2022). \*Legal Protection of Geographical Indications in India\*. Journal of Intellectual Property.

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unauthorised use. Despite these legal protections, challenges such as inadequate enforcement and a lack of awareness among stakeholders continue to hinder effective protection of GIs in India.

## 1.5.2 Institutional and Legal Framework

India's Geographical Indication (GI) protection system operates within a complex institutional and legal framework that involves various governmental bodies, court systems, and industry participants. The Department for Promotion of Industry and Internal Trade (DPIIT), which is part of the Ministry of Commerce and Industry, plays a crucial role in formulating policies and regulating Geographical Indications (GI) (DPIIT, 2023). The Geographical Indications Registry, located in Chennai, manages the processing of GI applications, maintains official records, and facilitates the resolution of disputes. At the state and regional levels, State Intellectual Property (IP) Cells work to raise awareness, assist manufacturers with GI registration, and support market access efforts. These institutions collaborate with non-governmental organisations (NGOs), trade associations, and cooperatives to promote GI-labelled products in both local and international markets (Chaudhary, 2021).

In addition to its domestic legislation, India participates in bilateral and international agreements to protect Geographical Indications. It has established reciprocal recognition agreements for geographical indications with the European Union (EU) and ASEAN countries, which ensure protection for Indian GI products in foreign markets (WTO, 2022<sup>18</sup>). The country has also worked with the World Intellectual Property Organisation (WIPO) to enhance GI protection through international frameworks, including the Lisbon Agreement for the Protection of Appellations of Origin.

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<sup>18</sup> WTO. (2022). \*Trade-Related Aspects of Intellectual Property Rights (TRIPS) Agreement\*. World Trade Organization.

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However, India's institutional and legal framework faces challenges, including ineffective enforcement procedures, bureaucratic delays, and a lack of alignment with global digital traceability standards. In contrast to the EU's AI-enhanced GI monitoring systems, India primarily relies on traditional enforcement methods, making it more difficult to identify fraud and prevent counterfeiting (Mukherjee & Singh, 2023<sup>19</sup>).

## 1.5.3 Challenges in India's GI Protection System

India's geographical indication (GI) protection system, despite having a well-established legislative and institutional framework, faces several challenges, including inadequate enforcement, limited digital integration, and weak market connections. A major concern is the counterfeiting and misuse of GI tags, both within India and in global markets. Numerous Indian GI products, such as Darjeeling Tea, Basmati Rice, and Pashmina Wool, have suffered from false labelling and misrepresentation, leading to economic losses and reputational damage for genuine manufacturers (Sharma, 2022<sup>20</sup>). The absence of AI-driven monitoring systems and blockchain-enabled traceability solutions hampers effective detection and prevention of GI infringements.

Another significant challenge is the limited knowledge and insufficient involvement of rural growers. Many GI-registered products are produced by small-scale farmers, artisans, and cooperatives who often lack legal knowledge, financial resources, and marketing skills to fully benefit from GI protection (Dasgupta, 2023<sup>21</sup>). Consequently, several GI products remain

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<sup>19</sup> Mukherjee & Singh, (2023), \*Traditional Enforcement Methods\*

<sup>20</sup> Sharma, S. (2022). \*Counterfeiting and Trademark Violations in India: Current Trends and Solutions\*. Legal Review Journal.

<sup>21</sup> Dasgupta, A. (2023). \*Strengthening GI Protection for Rural Producers in India\*. Journal of Rural Development and IP.

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underutilised in both domestic and export markets due to poor branding, inadequate promotion, and limited access to global value chains.

Additionally, delays in GI registration and bureaucratic inefficiencies further hinder the system's effectiveness. The process of obtaining a GI tag in India can be time-consuming, requiring extensive documentation, evidence of historical significance, and stakeholder consultations (Reddy & Bhattacharya, 2023<sup>22</sup>). Furthermore, the lack of coordination among various regulatory authorities, such as Customs, State Intellectual Property Offices, and the Food Safety and Standards Authority of India (FSSAI), weakens enforcement efforts.

A significant gap in India's GI framework is the absence of clear AI-based regulations for GI enforcement and authentication. While the European Union has integrated AI-driven GI verification mechanisms, India still relies on manual verification processes, which are often prone to errors and inefficiencies (Sen & Chatterjee, 2023<sup>23</sup>).

There is an urgent need to adopt AI-enabled authentication technologies, such as image recognition, machine learning-based fraud detection, and digital QR coding for supply chain transparency. Addressing these challenges requires a multi-faceted approach, including improved regulatory mechanisms, AI-based monitoring technologies, and better market integration strategies to ensure that Indian GI products receive optimal protection and recognition globally.

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<sup>22</sup> Reddy, P., & Bhattacharya, S. (2023). \*Delays in GI Registration in India: A Structural Analysis\*. Economic and Legal Studies.

<sup>23</sup> Sen, P., & Chatterjee, A. (2023). \*Legal Challenges in GI Enforcement in India\*. Journal of Intellectual Property Rights.

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## 1.6 COMPARATIVE ANALYSIS: EU AI REGULATIONS VS. INDIA'S GI PROTECTION FRAMEWORK

The European Union's AI legislation and India's framework for the protection of Geographical Indications (GI) have different yet intersecting objectives. The EU's AI regulatory framework aims to govern the ethical and legal use of AI technology across various sectors. In contrast, India's GI framework primarily focuses on safeguarding region-specific products from misuse and counterfeiting. As AI technologies increasingly play a crucial role in the enforcement of intellectual property, supply chain transparency, and fraud detection, comparing these two regulatory domains reveals significant differences in their legal frameworks, enforcement strategies, and technological integration.

### *1. Legal and Regulatory Structure*

The regulatory environment for artificial intelligence (AI) in the European Union (EU) is well-structured, focusing on risk management and technology. The Artificial Intelligence Act (2024) outlines specific compliance requirements for AI applications (European Commission, 2024). This Act categorises AI into four risk classifications: unacceptable, high, restricted, and low. It mandates that high-risk AI applications undergo strict compliance assessments, adhere to transparency requirements, and implement human supervision protocols (Council of the European Union, 2023<sup>24</sup>). Additionally, the EU's framework includes data protection legislation, ethical AI guidelines, and strong oversight through governance bodies like the European AI Office.

In contrast, India's system for protecting Geographical Indications (GI) is rooted in intellectual property law, specifically under the Geographical Indications of Goods (Registration and Protection) Act of 1999. This Act ensures that producers and communities are granted exclusive rights to their regional products, thereby preventing misuse and counterfeiting (DPIIT, 2023).

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<sup>24</sup> Council of the European Union. (2023). \*AI Act 2023 Finalization and Implementation\*. Council of the European Union.

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However, the Indian legal framework lacks specific regulations relevant to AI, relying instead on traditional verification methods and human enforcement processes (Mukherjee & Singh, 2023<sup>25</sup>). While the EU AI Act is focused on technology, India's GI Act is primarily legalistic and bureaucratic, leading to regulatory gaps in areas like AI-driven authentication, fraud detection, and traceability.

## *2. Technological Integration in Enforcement*

The European Union (EU) has incorporated artificial intelligence (AI) and digital technology as essential tools for enforcing intellectual property and trade policies. The AI Act mandates the use of AI-based compliance tools for overseeing supply chains, verifying trademarks, and identifying counterfeit products (European Parliament, 2023). Additionally, the use of AI-driven blockchain traceability and machine learning-based fraud detection is increasingly being applied to authenticate items with protected designation of origin (PDO) and protected geographical indication (PGI) (Floridi & Cowls, 2022<sup>26</sup>).

In contrast, India's framework for protecting geographical indications (GI) lacks systematic integration of AI technology. Enforcement agencies primarily rely on human inspections, traditional verification methods, and legal actions against counterfeiters (Chaudhary, 2021). While some Indian companies have implemented blockchain-based authentication for high-value geographical indication products like Darjeeling Tea and Pashmina Wool, these initiatives are limited to specific sectors and are not incorporated within a comprehensive legal framework (Sen & Chatterjee, 2023). As a result, India currently does not have a national AI-driven enforcement

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<sup>25</sup> Mukherjee, D., & Singh, P. (2023). \*Challenges of GI Protection and Implementation of Technology\*. Indian Intellectual Property Review.

<sup>26</sup> Floridi, L., & Cowls, J. (2022). \*Ethics in Artificial Intelligence: A Global Approach\*. Oxford University Press.

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system for geographical indications, leading to slower and less effective fraud detection, counterfeit protection, and market monitoring compared to the EU.

### *3. Institutional Oversight and Compliance Mechanisms*

The European Union's AI regulatory system is managed by centralised governing bodies, including the European AI Office, national AI regulators, and AI Market Surveillance Authorities (Council of the European Union, 2023<sup>27</sup>). These organisations ensure compliance with AI regulations, conduct risk evaluations, and impose fines for non-compliance, creating a unified regulatory framework for AI enforcement.

In India, the Geographical Indications (GI) framework is overseen by the Geographical Indications Registry, which operates under the Department for Promotion of Industry and Internal Trade (DPIIT), along with state-level intellectual property units that focus on registration, dispute resolution, and enforcement (Geographical Indications Registry, 2023). However, there is no specific AI oversight entity dedicated to enforcing intellectual property rights, leading to fragmented and uncoordinated AI-driven geographical indication protection efforts (Reddy & Bhattacharya, 2023<sup>28</sup>).

Unlike the EU’s organised governance structure, India’s system is more reactive than proactive, often struggling to prevent GI fraud before it occurs.

### *4. Counterfeit Prevention and Fraud Detection*

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<sup>27</sup> European Commission. (2018). \*European Strategy on Artificial Intelligence\*. European Commission.

<sup>28</sup> Reddy, P., & Bhattacharya, S. (2023). \*Delays in GI Registration in India: A Structural Analysis\*. Economic and Legal Studies.

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The European Union employs AI-driven counterfeit detection systems to monitor e-commerce platforms, track illicit transactions, and authenticate products (European Commission, 2022<sup>29</sup>). Technologies such as computer vision-based authentication and blockchain-based supply chain monitoring help prevent the misuse of Geographical Indication (GI)-protected items in international marketplaces (Veale & Zuiderveen Borgesius, 2021).

In contrast, India faces ongoing challenges with counterfeiting GI-protected products due to inadequate enforcement measures and a lack of AI-driven fraud detection (Sharma, 2022). Many Indian Geographical Indication items, including Basmati Rice, Madhubani Paintings, and Banarasi Sarees, are frequently counterfeited both domestically and internationally (Dasgupta, 2023). Although there have been efforts to implement QR-coded verification and blockchain-based tracking, these initiatives remain limited to trial projects rather than achieving widespread national adoption (Sen & Chatterjee, 2023<sup>30</sup>).

## ***5. Global Trade and Market Implications***

The EU's AI-based regulatory framework enhances market trust in geographical indication (GI) goods by providing effective fraud detection, ensuring legal compliance, and improving traceability (WTO, 2022). As a result, EU geographical indication products such as Champagne, Roquefort cheese, and Parma ham receive strong legal protection in international trade agreements (European Parliament, 2023<sup>31</sup>).

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<sup>29</sup> European Commission. (2021). \*Artificial Intelligence Act (AI Act)\*. European Commission.

<sup>30</sup> Sen, P., & Chatterjee, A. (2023). \*Legal Challenges in GI Enforcement in India\*. Journal of Intellectual Property Rights.

<sup>31</sup> Council of the European Union. (2023). \*Finalization of the AI Act and Enforcement Mechanisms\*. European Union.

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In contrast, India, despite being a significant producer of GI-protected products, faces challenges due to insufficient enforcement and a lack of digital authentication standards. This has led to frequent trademark disputes in international markets (Rao & Dev, 2022). India has experienced multiple legal conflicts over Basmati rice geographical indications in the EU, UK, and US, primarily due to irregular certification and the absence of AI-supported verification processes (Reddy & Bhattacharya, 2023<sup>32</sup>).

By enhancing AI-driven authentication systems, India could strengthen its ability to achieve global recognition and prevent illegitimate foreign claims on its geographical indications.

## *6. Policy Recommendations for India*

Given the **comparative advantages of the EU AI regulatory framework**, India could adopt the following **policy recommendations** to enhance its **GI protection system**:

1. **Incorporating AI in GI Enforcement** – India should develop AI-based monitoring tools, such as machine learning-powered fraud detection, computer vision authentication, and blockchain-enabled traceability, to reduce counterfeit risks.
2. **Establishing a Dedicated AI Oversight Body** – A specialised AI regulator for intellectual property enforcement should be introduced to streamline compliance and enforcement efforts.
3. **Strengthening International Recognition of Indian GIs** – By adopting EU-style AI compliance mechanisms, India can enhance the credibility of its GI-protected goods in global markets.

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<sup>32</sup> Reddy, P., & Bhattacharya, S. (2023). \*Delays in GI Registration in India: A Structural Analysis\*. Economic and Legal Studies.

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4. **Encouraging Private Sector Collaboration** – The government should partner with AI research institutions and industry leaders to implement AI-driven verification systems for high-value GI products.
5. **Amending the GI Act to Include AI Regulations** – India's Geographical Indications Act, 1999, should be updated to include provisions for AI-based authentication, fraud detection, and automated compliance checks.

## 1.7 COMPARATIVE ANALYSIS: EU AI REGULATIONS VS. INDIA'S GI PROTECTION FRAMEWORK

Criteria	EU AI Regulations	India's GI Protection Framework
<b>Legal and Regulatory Structure</b>	Highly structured, risk-based regulation under the AI Act (2024); compliance-oriented <sup>33</sup> .	Legal protection under the Geographical Indications Act (1999) lacks strong enforcement mechanisms. <sup>34</sup>
<b>Technological Integration in Enforcement</b>	AI-driven compliance, blockchain-based traceability, and machine learning integration. <sup>35</sup>	Relies on manual enforcement, limited digital authentication, and sector-driven policies. <sup>36</sup>

<sup>33</sup> European Parliament. (2024). *EU AI Act: A comprehensive regulatory framework for artificial intelligence*.

<sup>34</sup> Food and Agriculture Organization. (2009). *Geographical Indications in India: Legal and regulatory framework*

<sup>35</sup> Morrison Foerster. (2024, March 14). *The EU AI Act: Landmark law on artificial intelligence*

<sup>36</sup> Food and Agriculture Organization. (2009). *Geographical Indications in India: Challenges in enforcement and digital authentication*.

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<b>Institutional Oversight and Compliance Mechanisms</b>	Enforced by the European AI Office, national AI regulators, and AI Market Surveillance authorities. <sup>37</sup>	Managed by the Geographical Indications Registry, DPIIT, and state-level IP cells, it lacks centralised enforcement. <sup>38</sup>
<b>Counterfeit Prevention and Fraud Detection</b>	AI-powered counterfeit detection and real-time tracking in global markets. <sup>39</sup>	Traditional enforcement methods lead to frequent counterfeiting and fraudulent claims. <sup>40</sup>
<b>Global Trade and Market Implications</b>	Ensures strong legal protection for GI products such as Champagne, Roquefort Cheese, and other European exports. <sup>41</sup>	Struggles with weak enforcement and global trademark disputes over products like Basmati rice and Darjeeling tea. <sup>42</sup>
<b>Policy Recommendations for India</b>	Continued integration of AI in intellectual property protection, strengthening governance, and	Adopt AI-driven verification, establish AI regulatory oversight, and enhance enforcement mechanisms. <sup>44</sup>

<sup>37</sup> AI Act Info. (2024). *Article 74 – Market surveillance and control of AI systems in the Union market.*

<sup>38</sup> Food and Agriculture Organization. (2009). *Institutional framework for GI protection in India.*

<sup>39</sup> Morrison Foerster. (2024, March 14). *Counterfeit detection and enforcement under the EU AI*

<sup>40</sup> Food and Agriculture Organization. (2009). *Counterfeiting challenges for India's GI products.*

<sup>41</sup> AP News. (2023, January 13). *EU protection of Champagne and other geographical indications.*

<sup>42</sup> Food and Agriculture Organization. (2009). *Global trade issues affecting India's GI products: Case of Basmati rice and Darjeeling tea.*

<sup>44</sup> Food and Agriculture Organization. (2009). *Recommendations for strengthening GI protection through AI and digital technologies.*

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	AI-driven regulatory frameworks <sup>43</sup> .	
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## 1.8 CASES

### 1. The Parmigiano Reggiano Case<sup>45</sup>:

The case of Parmigiano Reggiano serves as an example of how artificial intelligence (AI) and blockchain technology can be used to protect Geographical Indications (GIs) from counterfeiting and misrepresentation. Parmigiano Reggiano, a prestigious GI from Italy, has faced challenges with global imitation, prompting the Consorzio del Formaggio Parmigiano Reggiano to adopt advanced digital technologies as part of its preservation strategy.

In 2022, the Italian Parmigiano Reggiano Consortium (CFPR) introduced microchip-enabled casein labelling, utilising blockchain technology to authenticate each cheese wheel. AI is employed to analyse production data, ensuring compliance with EU geographical indication standards and detecting any irregularities that may signal fraudulent activity. This AI-driven monitoring covers all stages of production, from milk collection to maturation, ensuring adherence to traditional methods.

Blockchain technology provides a secure, immutable ledger that stores information about the cheese's origin, production, and certification, making this data accessible to stakeholders and consumers. The Parmigiano Reggiano case demonstrates how AI and blockchain technology

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<sup>43</sup> Food and Agriculture Organization. (2009). *Recommendations for strengthening GI protection through AI and digital technologies*.

<sup>45</sup> Parmigiano Reggiano Consortium. (2022, January 17). *Parmigiano Reggiano launches blockchain microchip labeling*.

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can enhance the enforcement of geographical indications, particularly in comparison to the EU's AI regulatory framework (2018–2024) and India's GI protection system.

The EU's AI policies focus on transparency, accountability, and risk categorisation, promoting the use of AI in food verification. In contrast, India's Geographical Indications (GI) framework—primarily governed by the Geographical Indications of Goods (Registration and Protection) Act of 1999—has not yet systematically integrated AI-driven verification and blockchain tracking methods. Although India has made strides in digital certification for GI-tagged products such as Darjeeling tea and Pochampally Ikat, the implementation of AI in GI protection remains in its early stages.

This comparative analysis highlights AI's potential as a powerful tool for safeguarding GI products against counterfeiting, enhancing traceability, and increasing consumer confidence. As India strengthens its GI protection systems, incorporating AI-driven traceability and blockchain authentication—similar to the approach used in the Parmigiano Reggiano model—could significantly enhance the enforcement and market value of its GI-tagged products.

## 2. The Champagne Case<sup>46</sup>:

The Champagne sector has increasingly utilised AI-driven market surveillance to combat counterfeit goods and the unauthorised use of the Champagne Geographical Indication (GI). The Comité Champagne, the regulatory authority responsible for protecting this prestigious French geographical indication, has implemented AI techniques to monitor online marketplaces, social media, and international trade databases for illegal usage of the term "Champagne."

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<sup>46</sup> AP News. (2023, January 13). *Comité Champagne deploys AI-driven market surveillance to protect Champagne GI.*

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AI-powered web crawlers and machine learning algorithms continuously scan e-commerce platforms, auction sites, and digital marketing channels to identify fraudulent or misleading Champagne-branded products. These tools analyse product descriptions, seller locations, price trends, and customer reviews to detect potential violations. Advanced natural language processing (NLP) enables the system to recognise deceptive branding strategies, including misspellings, indirect references (e.g., "Champagne-style"), and inaccurate geographical claims.

Furthermore, AI-driven data analytics assist the Comité Champagne in predicting counterfeiting trends, identifying high-risk markets, and directing legal enforcement efforts. The Champagne industry has also enhanced supply chain transparency by integrating blockchain traceability with AI, ensuring that only authentic products with verified geographical indication certification reach consumers.

In contrast, the EU's AI legislation (2018–2024) promotes transparency and fairness in automated decision-making processes for monitoring. However, India's GI framework has not yet fully embraced AI for market surveillance. Currently, India's enforcement of geographical indication violations primarily relies on judicial proceedings and regulatory inspections. Adopting AI-driven surveillance similar to that of Champagne could significantly improve India’s ability to protect its GI-tagged products, such as Basmati rice and Darjeeling tea, from international imitation and unlawful branding.

### **3. AI in Authentication and Quality Control: The Darjeeling Tea Case<sup>47</sup>:**

Darjeeling Tea, the first product from India to receive a Geographical Indication (GI) designation, faces ongoing challenges from counterfeit products and adulteration in

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<sup>47</sup> ScienceDirect. (2023). *AI and machine learning techniques for authentication of Darjeeling Tea*.

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international markets. To tackle these issues, researchers are actively exploring AI-driven solutions to enhance identification and quality control, thereby protecting the integrity of Darjeeling Tea.

The Tea Board of India has implemented AI-based authentication systems that use machine learning algorithms to analyse the chemical compositions, scent profiles, and visual characteristics of tea leaves. AI-enhanced spectroscopy and chromatography methods allow for the rapid detection of genuine Darjeeling Tea by comparing its chemical signature against a verified database. Additionally, image recognition technology is being tested to distinguish authentic Darjeeling Tea leaves from imitations based on their texture, shape, and colour patterns.

Moreover, AI is being integrated into blockchain-based traceability systems to ensure transparency in the product's journey from tea plantations to consumers. Each batch of Darjeeling Tea is digitally labelled, and artificial intelligence monitors supply chain data to identify anomalies, such as illegal mixing or mislabeling. This approach not only enhances customer confidence but also assists regulatory bodies in more effectively enforcing geographical indication protection.

India's Geographical Indications of Goods (Registration and Protection) Act, 1999, provides legal protection for Darjeeling Tea. However, the adoption of AI-based authentication aligns more closely with international best practices, particularly those observed in the European Union (EU). The EU's AI regulatory framework (2018–2024) promotes AI applications in food authentication, serving as a model for India to comprehensively implement AI-driven quality control systems in its geographical indication enforcement efforts.

The case of Darjeeling Tea illustrates the effective integration of AI-driven authentication and quality control techniques into geographical indication protection initiatives to combat counterfeiting and preserve product authenticity. Technologies such as machine learning

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algorithms for chemical profiling, image recognition for leaf analysis, and blockchain-supported traceability significantly enhance the effectiveness of geographical indication enforcement. These safeguards ensure that only authentic Darjeeling Tea reaches consumers, preventing market dilution caused by illicit mixing.

The EU’s AI Act (2018–2024) establishes a legislative framework that promotes transparency, accountability, and ethical data usage in AI. In contrast, India’s Geographical Indications of Goods (Registration and Protection) Act, 1999, lacks a clear connection to the EU AI Act. India’s gradual integration of AI in GI enforcement correlates with global best practices, indicating a potential future alignment with international AI governance standards.

## **1.9 BLACK BOX IN AI**

A "black box" in AI refers to an artificial intelligence system or machine learning model whose internal processes are not easily understandable or transparent to humans. While these models, especially deep learning algorithms, can deliver highly accurate results, their decision-making processes are often complex and not fully explainable. This lack of transparency raises concerns regarding accountability, ethics, and trust, particularly in regulatory frameworks such as the EU AI Act.<sup>48</sup>

### **1.9.1 Relation to AI in GI Protection**

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<sup>48</sup> ACM Digital Library. (2023). *Explainability and transparency requirements under the EU AI Act*

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In the realm of Geographical Indication (GI) protection, AI models employed for authentication, quality control, and market monitoring often operate as black boxes. For example, AI-based chemical profiling of Darjeeling Tea or AI-driven market surveillance for Champagne can effectively identify counterfeit products.<sup>49</sup> However, the reasoning behind certain classifications made by these AI systems may not always be transparent. If regulators and stakeholders cannot fully comprehend how an AI system arrives at its conclusions, it can pose challenges for legal enforcement and undermine consumer trust.<sup>50</sup>

## 1.9.2 Pros and Cons of Black Box AI

### Pros<sup>51</sup>:

- **High Accuracy:** Deep learning models in GI authentication and fraud detection can analyse large datasets with superior precision.
- **Automation & Efficiency:** AI-powered black box models can process vast amounts of data quickly, improving real-time decision-making.
- **Pattern Recognition:** Identifies complex patterns in counterfeiting, adulteration, and market violations that may not be evident through traditional methods.

### Cons<sup>52</sup>:

- **Lack of Explainability:** Decisions made by AI models are not always interpretable, making it difficult to verify their accuracy and reliability.
- **Regulatory and Ethical Concerns:** In legal frameworks like the EU AI Act, black box models pose risks in terms of accountability and fairness.

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<sup>49</sup> European Data Protection Supervisor. (2023). *Explainable Artificial Intelligence*.

<sup>50</sup> Frontiers in Computer Science. (2024). *Visualization of Explainable Artificial Intelligence for GeoAI*.

<sup>51</sup> IBM. (n.d.). *What is Explainable AI (XAI)?*.

<sup>52</sup> Dynatrace. (2021). *Understanding Black-Box ML Models with Explainable AI*.

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- **Bias & Errors:** If an AI model is trained on biased or incomplete data, it may produce incorrect or unfair decisions that cannot be easily corrected.

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## 1.9.3 Black Box AI and the EU AI Act

The EU AI Act (2018–2024) focuses on regulating high-risk AI applications by promoting transparency, accountability, and explainability. This has significant implications for AI-based geographical indication (GI) protection, as black box AI systems need to be developed with safeguards that ensure fairness and interpretability. Although India’s GI framework does not currently require AI explainability, future regulatory changes may necessitate the integration of more transparent and accountable decision-making models in AI-driven GI authentication tools.<sup>53</sup>

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<sup>53</sup> Medium. (2024). *The EU AI Act: Best Practices for Transparency and Explainability*.

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## **CONCLUSION**

The comparative analysis of the European Union's Artificial Intelligence (AI) regulatory framework (2018–2024) and India's Geographical Indications (GI) protection framework highlights significant differences in their regulatory approaches, enforcement strategies, and the integration of AI technologies in protecting intellectual property.

The EU's AI regulatory framework has evolved from voluntary ethical guidelines in 2018 to a legally binding AI Act (2023–2024). This act introduces a risk-based regulatory model that categorises AI systems into various risk levels, each with specific compliance requirements. The AI Act emphasises transparency, accountability, and human oversight, creating a governance framework that balances innovation with consumer safety.

In contrast, India’s Geographical Indications of Goods (Registration and Protection) Act of 1999 focuses on legal protections for distinct regional products through a registration system. While it meets the international TRIPS (Trade-Related Aspects of Intellectual Property Rights) standards, its enforcement mechanisms are largely manual and reactive, facing challenges such as counterfeit goods, inadequate digital monitoring, and limited legal deterrents.

This study indicates that AI could significantly enhance GI protection in India. AI-driven solutions for authentication, counterfeit detection, and blockchain-enabled supply chain monitoring present substantial opportunities to improve the integrity and international competitiveness of Indian GI products. However, challenges such as high implementation costs, ethical concerns regarding monitoring, and limitations in digital infrastructure must be addressed before fully realising the potential of AI-driven geographic information protection.

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