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Editor In chief – Assistant Professor Mr. Janmejay Singh

Publisher & Founder – Vaibhav Sangam Mishra

Frequency – Quarterly (4 Issue Per year)

ISSN: 2583-6323 (Online)

THE ROLE OF BLOCKCHAIN IN PROTECTING GEOGRAPHICAL INDICATIONS WORLDWIDE

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Received on 7 April 2025, Accepted on 9 April 2025, Published on 29 April 2025

ABSTRACT:

Geographical Indications (GIs) serve as crucial intellectual property rights that protect the unique identity and quality of region-specific products. However, GI violations, including counterfeiting and false representation of origin, pose significant threats to both producers and consumers. Blockchain technology has emerged as a transformative solution for ensuring transparency, authenticity, and traceability in GI-protected products. This paper explores how blockchain can safeguard GIs by offering immutable ledgers, decentralized authentication, and smart contract-based enforcement. It also discusses case studies, challenges, and future prospects of integrating blockchain for global GI protection.

Keywords: Blockchain, Geographical Indications (GIs), Intellectual Property Rights, Smart Contracts, Supply Chain Transparency, Anti-Counterfeiting

INTRODUCTION:

Geographical Indications (GIs) represent a form of intellectual property that links products to their specific geographical origins, ensuring that their unique qualities and their unique regional attributes, thus their reputations, are preserved. Examples include Champagne (France), Darjeeling Tea (India), Parmigiano-Reggiano (Italy), etc. Geographical Indications (GIs) serve as a powerful tool for distinguishing products. These labels assure consumers of quality while preserving traditional practices and fostering economic growth in specific regions. However, counterfeit products and false representations of origin significantly harm the economic value and credibility of GI-certified goods.[1]

[1] Daniel Gervais, *Traditional Innovation and the Ongoing Debate on the Protection of Geographical Indications*, 58 J. WORLD INTELL. PROP. 21, Research gate (April 6, 2025, 8:00 P.M.), Traditional Innovation and the Ongoing Debate on the Protection of Geographical Indications.

With the rise of global trade and e-commerce, enforcing GI rights has become increasingly challenging. Traditional verification systems, such as certification labels and government regulations, often fail to prevent fraud. In this context, blockchain technology presents an innovative solution for ensuring product authenticity and preventing GI violations. By creating a decentralized, immutable, and transparent ledger, blockchain enhances supply chain traceability and enables real-time authentication of GI-certified products.[2]

Understanding Geographical Indications (GIs) and Their Challenges:

Definition and Importance of GIs

Geographical Indications are a subset of intellectual property rights (IPRs) that certify products originating from a specific region with distinct qualities and reputations. These products often carry cultural and economic significance, benefiting local farmers, artisans, and industries.[3]

> ***"Geographical indications are, for the purposes of this Agreement, indications which identify a good as originating in the territory of a member, or a region or locality in that territory, where a given quality, reputation, or other characteristic of the good is essentially attributable to its geographical origin."*** [4]
>
> ***"A name which identifies a product as originating in a specific place, region, or country, where a given quality, reputation, or characteristic of the product is essentially due to its geographical origin."***[5]

Key Benefits of GIs:

- Preservation of Cultural Heritage: Protects traditional knowledge and practices.

Geographical Indications (GIs) play a vital role in preserving cultural heritage by protecting traditional knowledge and practices that define the identity of a region and its people. Many artisanal techniques, agricultural methods, and craftsmanship skills have been passed down

[2] Michael Blakeney, *The Protection of Geographical Indications: Law and Practice*, 6 INTELL. PROP. Q. 12 (2019), EElgar (April 6, 2025, 8:00 P.M.), The Protection of Geographical Indications.
[3] European Commission, *Geographical Indications: A European Treasure*, EUR. COMM'N REP. (2020), EUROPE (April 6, 2025, 8:00 P.M.), https://ec.europa.eu/geographical-indications.
[4] Article 22(1), *Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS)*, WTO (1994) (April 6, 2025, 8:00 P.M.), https://www.worldtradelaw.net/document.php?id=uragreements/tripsagreement.pdf&mode=download.
[5] EU Regulation No. 1151/2012 on quality schemes for agricultural products and foodstuffs, EU Lex (April 6, 2025, 8:00 P.M.), Regulation - 1151/2012 - EN - EUR-Lex.

through generations, forming an essential part of a community's cultural legacy. Without legal protection, these traditions face the threat of being lost due to industrialization, commercialization, and imitation. GIs ensure that only producers from a specific region, using time-honoured methods, can market their products under a recognized name, thereby safeguarding the authenticity of traditional practices.[6]

This protection encourages artisans and farmers to continue their heritage-based production methods instead of shifting to modern, mass-produced alternatives. For example, the traditional weaving techniques of Kashmiri Pashmina or the indigenous fermentation processes of Korean Kimchi are safeguarded through GIs, preventing dilution or exploitation by non-authentic producers. By formalizing the connection between cultural knowledge and economic value, GIs not only preserve the legacy of traditional craftsmanship but also ensure that the skills, rituals, and expertise associated with these practices remain intact for future generations.[7]

- Economic Value: Ensures premium pricing for authentic GI-certified goods.

Geographical Indications (GIs) enhance the economic value of traditional products by ensuring premium pricing for authentic, GI-certified goods, as they signify quality, origin, and authenticity. Consumers are often willing to pay higher prices for products with a GI certification because they associate them with superior craftsmanship, unique characteristics, and a rich cultural heritage. This premium pricing directly benefits local producers, artisans, and farmers by providing them with a competitive advantage in both domestic and international markets. By differentiating authentic goods from mass-produced imitations, GIs help sustain traditional industries and boost rural economies. For example, Parmigiano-Reggiano cheese from Italy, Champagne from France, and Basmati rice from India command significantly higher prices than non-GI alternatives due to their recognized authenticity and adherence to strict production standards. Additionally, GI protection reduces market competition from counterfeit products, preventing price undercutting and ensuring that economic benefits remain within the communities that have historically produced these goods. This financial incentive encourages the continuation of traditional production methods and contributes to regional development, employment, and long-term economic sustainability for local industries.[8]

- Consumer Trust: Guarantees quality and authenticity.

[6] World Intellectual Property Organization (WIPO), *Blockchain Technologies & Geographical Indications: Challenges & Opportunities*, WIPO TECH (April 6, 2025, 8:00 P.M.), Blockchain and Intellectual Property.
[7] *Id at* 2266
[8] Shubha Ghosh, *Blockchain and Intellectual Property: The Future of Geographical Indications*, 27 BERKELEY TECH. L.J. 203 (April 6, 2025, 8:00 P.M.), Intellectual Property by Shubha Ghosh | Open Library.

Geographical Indications (GIs) play a crucial role in building consumer trust by guaranteeing the quality and authenticity of products associated with a specific region. GI certification assures buyers that the product has been produced using traditional methods, adheres to strict quality standards, and originates from its designated geographical area. This assurance is particularly important in markets where counterfeit or mass-produced imitations often compromise quality and mislead consumers. By providing a verified link between a product's origin and its unique characteristics, GIs help consumers make informed purchasing decisions with confidence. For instance, a GI-certified Darjeeling Tea or Roquefort Cheese ensures that the product has been cultivated or processed under specific conditions that contribute to its distinct flavour, aroma, and texture. This reliability fosters strong brand loyalty, as consumers develop trust in GI-labelled products over time, knowing they are purchasing goods that meet high standards of authenticity. Furthermore, this trust enhances the reputation of traditional industries, making GI-certified products more desirable in both local and international markets, ultimately benefiting producers and strengthening cultural heritage preservation.[9]

Challenges in Protecting GIs:

Despite regulatory frameworks such as the WTO's Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), enforcing GI protection remains difficult due to:

- Counterfeit Products: Fake GI-labelled products flood global markets.

Counterfeit GI-labelled products pose a significant threat to authentic goods by flooding global markets with imitations that deceive consumers and undermine the economic value of genuine geographical indication (GI) products. These fake products are often mass-produced using inferior materials and lack the traditional techniques, quality, and authenticity that define GI-certified goods. As a result, they not only mislead buyers but also damage the reputation of the original producers who have spent generations perfecting their craft. For example, imitation Basmati rice, fake Parmigiano-Reggiano cheese, and counterfeit Champagne have become common in international markets, often sold at lower prices, thereby reducing the competitiveness of genuine products. This widespread counterfeiting leads to economic losses for local farmers and artisans, as they struggle to compete against cheaper, non-authentic alternatives. Moreover, it erodes consumer trust, as buyers may unknowingly purchase low-

[9] Vaishali Tripathi, *Analysing the Role of Legal Protection for Trademarks and Geographical Indications in Preserving Cultural Heritage and Enhancing Global Trade*, JLIPR (April 6, 2025, 8:00 P.M.), 6_JLIPR_Vol 1 No 1_Dec 2024.pdf.

quality substitutes that fail to meet the expected standards. Governments and international organizations are increasingly enforcing stricter regulations and legal protections to combat this issue, but counterfeit GI products remain a persistent challenge, highlighting the need for stronger monitoring and consumer awareness to protect both producers and buyers from fraudulent goods.[10]

- Complex Supply Chains: Difficulty in tracking the origin of goods.

Complex supply chains pose a significant challenge in tracking the origin of goods, particularly for Geographical Indication (GI) products that rely on authenticity and strict production standards. As GI-certified goods pass through multiple intermediaries, including farmers, processors, distributors, and retailers, maintaining transparency and ensuring compliance with GI regulations becomes increasingly difficult. This complexity opens the door to fraud, mislabelling, and adulteration, where non-GI products may be mixed with authentic ones or falsely marketed under a prestigious GI label.

For example, in the global trade of GI-certified foods like Basmati rice or Kona coffee, unauthorized blending with lower-quality varieties often occurs, deceiving consumers and diluting the value of genuine products. Additionally, the lack of efficient tracking mechanisms makes it challenging to verify whether the production processes adhere to traditional methods and regional specifications, which are essential for maintaining GI integrity. In response, advanced technologies such as blockchain and digital traceability systems are being explored to enhance transparency, allowing consumers and regulators to trace the journey of GI goods from their origin to the final market. However, without standardized enforcement and stronger monitoring systems, the complexity of supply chains continues to threaten the credibility and economic value of GI-labelled products.[11]

- Lack of Consumer Awareness: Buyers struggle to distinguish genuine from fake products.

Lack of consumer awareness is a major challenge in the protection of Geographical Indication (GI) products, as many buyers struggle to distinguish genuine items from counterfeit or non-GI alternatives. While GI certification guarantees authenticity, quality, and adherence to traditional production methods, consumers often lack sufficient knowledge about these

[10] Faster capital, Geographical Indications: Protecting Intellectual Property and Cultural Heritage - FasterCapital (last visited April 6, 2025).

[11] Stephanie Aronzon, *Blockchain and Geographical Indications: A Natural Fit?*, King's College London Law School Graduate Student Research Paper No. 2018/19-02 (2019) SSRN (April 6, 2025, 8:00 P.M.), Blockchain and Geographical Indications: A Natural Fit? by Stephanie Aronzon :: SSRN.

protections, making them vulnerable to purchasing fake or mislabelled goods. This issue is particularly prevalent in international markets, where GI-labelled products may not have strong legal recognition or where counterfeit products are widely available at lower prices. For example, a consumer purchasing "Parmesan" cheese outside Europe may not realize that it differs significantly from the authentic GI-certified Parmigiano-Reggiano produced in Italy. Similarly, fake Darjeeling tea or imitation Pashmina shawls often flood global markets,[12] misleading buyers who are unaware of the strict production criteria that define genuine GI products. Without proper education and labelling transparency, consumers may unknowingly support counterfeit markets, which in turn harms authentic producers and weakens the overall value of GI protections. Raising awareness through labelling initiatives, certification marks, and consumer education campaigns is essential to ensuring that buyers can make informed choices and support genuine GI-certified goods.[13]

- Weak Enforcement Mechanisms: Legal disputes and jurisdictional conflicts slow down protection efforts.

Weak enforcement mechanisms pose a significant challenge to the protection of Geographical Indications (GIs), as legal disputes, jurisdictional conflicts, and inconsistent regulatory frameworks often slow down efforts to safeguard authentic products. Many GI protections are enforced at the national level, leading to discrepancies in how different countries recognize and uphold these rights, making it easier for counterfeit products to enter markets without legal consequences. For example, while the European Union has strong GI regulations that prevent unauthorized use of protected names like Champagne or Roquefort, other regions may lack strict enforcement, allowing imitation products to be sold freely. Additionally, legal disputes over GI ownership, such as the long-standing debate between India and Pakistan over Basmati rice, further complicate the protection process, delaying the implementation of clear and enforceable regulations. Even when legal action is taken against violators, the complexity of international trade laws and the slow pace of litigation make it difficult for authentic producers to secure timely justice. As a result, counterfeiters continue to exploit weak enforcement systems, undermining the credibility and economic value of GI-certified goods. Strengthening international cooperation, harmonizing legal standards, and implementing stricter monitoring

[12] Laws and more, Understanding Geographical Indications: Legal Perspectives and Impacts - Laws & More (last visited April 6, 2025).

[13] Federico Domenico Enrico De Silvo, *Brief Notes on the European Geographical Indication Law: Among Sustainability Implications and Artificial Intelligence Applications*, 13 INT'L J. MGMT., KNOWLEDGE & LEARNING 105 (2024), IJMKL (April 6, 2025, 8:00 P.M.), 13.105-111.pdf

systems are essential to overcoming these enforcement challenges and ensuring that GI protections are effectively upheld.[14]

These challenges highlight the need for a secure, transparent, and tamper-proof system—a role that blockchain can effectively fulfil.

Blockchain Technology: An Overview

Blockchain is a decentralized, digital ledger technology that records transactions in a secure, transparent, and tamper-proof manner. Unlike traditional databases that rely on a central authority, blockchain operates on a distributed network of computers, where each participant has access to an identical copy of the ledger. Transactions are grouped into blocks, which are then cryptographically linked to form a continuous chain—hence the name "blockchain." Each block contains a unique code called a cryptographic hash, as well as the hash of the previous block, ensuring the integrity of the entire chain. Once recorded, data on the blockchain cannot be altered or deleted without consensus from the network, making it highly secure against fraud and hacking. This technology underpins cryptocurrencies like Bitcoin and Ethereum but has far-reaching applications beyond digital currencies, including supply chain management, financial transactions, healthcare, and intellectual property protection. By enabling such transactions where participants do not need to rely on intermediaries, blockchain enhances security, transparency, and efficiency in various industries, offering a revolutionary approach to data management and authentication.[15]

The key attributes of blockchain that make it suitable for GI protection include:

1. Decentralization: No single entity controls the data, reducing fraud.
2. Immutability: Once recorded, data cannot be altered.
3. Transparency: Anyone in the network can verify transactions.
4. Smart Contracts: Self-executing contracts enforce compliance automatically.

Types of Blockchain Networks

- Public Blockchain: Open to everyone

[14] *Id at* 2270

[15] Bindhiya Upputuri et al., *Blockchain-Enabled QR Verification System for Authenticating GI-Tagged Products in E-Commerce*, *in* 2024 International Conference on IoT Based Control Networks and Intelligent Systems (ICICNIS) 306 (2024) (April 6, 2025, 8:00 P.M.), https://ieeexplore.ieee.org/abstract/document/10823127

A public blockchain is a fully decentralized network where anyone can join, read, write, and validate transactions. It operates on a consensus mechanism like Proof of Work (PoW) or Proof of Stake (PoS) to ensure security and prevent unauthorized modifications. Public blockchains are transparent and immutable, making them ideal for applications that require trust and security without central control. Example: Bitcoin.[16]

- Private Blockchain: Restricted access, used by businesses.

A private blockchain is a restricted and permissioned network where only authorized participants can join, read, and validate transactions. It is usually controlled by a single entity or organization, making it more efficient and scalable than public blockchains. However, since it lacks full decentralization, it relies on trust in the governing entity. Example: Hyperledger fabric.

- Consortium Blockchain: Semi-decentralized, controlled by a group of stakeholders.

A consortium blockchain is a semi-decentralized network where multiple organizations collectively manage the blockchain. Unlike a private blockchain controlled by a single entity, consortium blockchains distribute control among multiple participants, improving transparency and security while maintaining efficiency. Example: The Energy Web Chain

For GI protection, a consortium blockchain involving producers, certifying bodies, government agencies, and consumers is the most viable option.[17]

Blockchain for GI Protection: Use Cases and Applications:

1. Enhancing Traceability in Supply Chains

Blockchain enables end-to-end traceability, allowing stakeholders to track GI products from production to distribution. By scanning a QR code or NFC chip, consumers can verify:

- Product Origin (e.g., vineyard location for Bordeaux wine).
- Certification Details (e.g., GI registration number).
- Processing Information (e.g., storage conditions).

Example: IBM Food Trust is already using blockchain to trace coffee, which can be applied to GI-certified products.

2. Preventing Counterfeiting and Fraud

[16] Ceol, CEEOL - Article Detail (last visited April 6, 2025).
[17] Aaronhall, False Designation of Origin: Trademark Perspective - Attorney Aaron Hall (last visited April 6, 2025).

Fake GI-labelled products undermine trust and profits. Blockchain's immutability ensures that once a product is recorded, its authenticity cannot be tampered with. Example: Provenance, a blockchain-based platform, helps verify the authenticity of luxury goods and can be adapted for GI protection.

3. Smart Contracts for Automated Compliance

Smart contracts ensure the automatic execution of rules set by regulatory bodies. They can:

- Deny transactions involving non-certified producers.
- Trigger alerts if a counterfeit product enters the supply chain.
- Automate royalty payments to GI producers.[18]

Example: Ethereum-based smart contracts could be programmed to verify compliance with GI regulations before allowing product trade.

4. Strengthening Legal Enforcement

Blockchain creates a permanent and auditable record, making it easier for legal bodies to prosecute GI violators. This is especially useful in:

- Cross-border trade where jurisdictional issues arise.
- E-commerce platforms that struggle with GI violations.

Example: The European Union Intellectual Property Office (EUIPO) is exploring blockchain for enforcing GI rights.[19]

Challenges and Limitations of Blockchain Adoption for GIs:

The adoption of blockchain technology for the protection and management of Geographical Indications (GIs) presents several challenges and limitations that need to be addressed for effective implementation. These challenges span technological, regulatory, and adoption-related barriers, which can hinder the widespread integration of blockchain in GI protection systems.

Technological Barriers:

One of the most significant technological challenges in implementing blockchain for GI protection is the high cost of implementation. Many GI-certified products originate from small-

[18] Sherilyn Beall, How Is Blockchain Immutable, Robots (April 6, 2025, 8:00 P.M.), How Is Blockchain Immutable | Robots.net

[19] Vaishali Tripathi, *Analysing the Role of Legal Protection for Trademarks and Geographical Indications in Preserving Cultural Heritage and Enhancing Global Trade*, 1 J. L. & INTELL. PROP. RTS. 50 (2024) (April 6, 2025, 8:00 P.M.), 6_JLIPR_Vol 1 No 1_Dec 2024.pdf

scale farmers, artisans, and local producers who may not have the financial resources to integrate blockchain-based tracking and verification systems. Blockchain requires investment in digital infrastructure, training, and ongoing maintenance, which can be prohibitive for smaller producers in developing regions. Without financial support or government incentives, these producers may struggle to adopt blockchain, limiting its effectiveness in ensuring GI authenticity.[20] Another critical issue is scalability. Public blockchains, which are often preferred for their transparency and security, can face transaction speed limitations as the number of participants increases. Since GI supply chains involve multiple stakeholders, including farmers, processors, distributors, and retailers, a blockchain network must be capable of handling high transaction volumes efficiently. However, many blockchain networks, such as Bitcoin and Ethereum, have struggled with congestion and high transaction fees, making them less suitable for large-scale adoption in GI supply chains. While newer blockchain technologies are improving scalability, widespread adoption remains a challenge.

Regulatory and Legal Challenges:

The lack of global standards for GI protection complicates the implementation of blockchain across different jurisdictions. GI regulations vary significantly between countries, with some nations offering strong legal protections while others lack comprehensive frameworks. This inconsistency makes it difficult to develop a unified blockchain system that is compatible with international trade laws. For instance, while the European Union has stringent GI regulations, other regions may not enforce GI protections as strictly, leading to potential disputes and difficulties in cross-border authentication of GI products using blockchain.[21] Additionally, data privacy concerns pose a major legal challenge. Blockchain's fundamental characteristic of transparency means that all transaction records are visible to participants in the network. While this feature enhances trust and traceability, it may conflict with data protection laws like the General Data Protection Regulation (GDPR) in Europe, which grants individuals the right to control and erase personal data. If blockchain records sensitive supply chain information, such as producer identities or transaction details, ensuring compliance with privacy regulations becomes a complex issue. Implementing privacy-focused solutions like permissioned

[20] *Id at* 2273

[21] Webasha, Beyond Cryptocurrencies | How Blockchain is Revolutionizing Industries with Real-World Applications - Web Asha Technologies (last visited April 6, 2025).

blockchains or zero-knowledge proofs could address this challenge, but they may add additional complexity and cost.

Adoption Challenges:

Another major hurdle in blockchain adoption for GIs is limited awareness among both producers and consumers. Many traditional producers, particularly in rural areas, may not fully understand how blockchain works or how it can benefit them in protecting their products from counterfeiting. Educating producers about blockchain's role in ensuring product authenticity, securing fair prices, and preventing market dilution is essential for successful adoption. Likewise, consumers need awareness campaigns to recognize and trust blockchain-verified GI products, encouraging them to support authentic goods over counterfeit alternatives.

Furthermore, resistance from traditional supply chain intermediaries can slow down blockchain implementation.[22] Many GI products are distributed through complex supply chains involving middlemen, traders, and wholesalers who play a crucial role in connecting producers to markets. Blockchain's transparency and direct traceability can reduce the need for intermediaries, potentially leading to opposition from those who perceive it as a threat to their business model. If middlemen fear losing control or profits due to blockchain-based systems, they may resist their adoption or attempt to undermine its effectiveness. Overcoming this resistance requires collaborative efforts between governments, industry stakeholders, and supply chain participants to ensure that blockchain benefits all parties involved.

Future Prospects and Recommendations:

As blockchain technology continues to evolve, its integration with emerging technologies, government support, and consumer awareness initiatives can significantly enhance its effectiveness in protecting Geographical Indications (GIs). To ensure successful adoption, strategic steps must be taken to overcome existing challenges while leveraging innovative solutions.[23]

[22] Satish Kumar, Weng Marc Lim, Uthayasankar Sivarajah, Jaspreet Kaur, Artificial Intelligence and Blockchain Integration in Business: Trends from a Bibliometric-Content Analysis, PMC (April 6, 2025, 8:00 P.M.), Artificial Intelligence and Blockchain Integration in Business: Trends from a Bibliometric-Content Analysis - PMC.

[23] Jonathan Wu, How Does a Blockchain Establish Trust and Transparency? Key Mechanisms Explained, Block chain PMC (April 6, 2025, 8:00 P.M.), How Does a Blockchain Establish Trust and Transparency? Key Mechanisms Explained - Blockchain UBC.

Integration with Emerging Technologies:

The combination of Artificial Intelligence (AI) and blockchain presents a promising opportunity for strengthening GI protection. AI can analyze vast amounts of blockchain data to identify fraud patterns, detect suspicious transactions, and predict counterfeit activities before they become widespread. By leveraging machine learning algorithms, AI can continuously monitor blockchain networks for anomalies, such as inconsistencies in supply chain records or sudden changes in product origins. For instance, if counterfeit Darjeeling tea or Bordeaux wine enters the supply chain, AI-powered analytics can flag these irregularities, enabling authorities to take swift action. This proactive approach can significantly reduce GI fraud and ensure the integrity of authentic products[24]. Another transformative integration is the Internet of Things (IoT) with blockchain, which can enhance the traceability of GI products through real-time monitoring. IoT sensors and RFID (Radio Frequency Identification) tags can be embedded in GI-certified goods to track crucial factors such as temperature, humidity, and geographical location. This is particularly beneficial for perishable GI products, such as Parmigiano-Reggiano cheese or Champagne, which require strict storage and transportation conditions to maintain quality. By recording real-time data on blockchain, IoT ensures that any deviation from optimal conditions is instantly traceable, helping producers and regulators maintain product integrity. If a shipment of Kobe beef is stored at an incorrect temperature, blockchain-registered IoT sensors can immediately flag the issue, preventing substandard products from reaching consumers.

Government and Industry Collaboration:

For blockchain to be effectively implemented in GI protection, collaboration between governments and private blockchain firms is essential. Governments should actively partner with blockchain developers, supply chain companies, and regulatory bodies to create standardized, blockchain-powered GI protection frameworks. Public-private partnerships can provide financial and technical support to small-scale producers who may struggle with blockchain adoption. Governments can also incentivize blockchain integration through subsidies, grants, and policy initiatives that encourage the digitization of GI supply chains.[25]

[24] IP Law Mastery, Geographical Indications and Environmental Sustainability: A Synergy for a Greener Future - IP Law Mastery (last visited April 6, 2025).
[25] MDPI, Blockchain-Driven Food Supply Chains: A Systematic Review for Unexplored Opportunities (last visited April 6, 2025).

Beyond individual partnerships, the formation of GI Blockchain Consortia—where industry stakeholders collectively adopt and manage blockchain networks—can enhance protection efforts. When an entire industry unites under a single blockchain framework, it ensures widespread adoption and maximizes the effectiveness of the system. For example, wine producers from different regions could form a blockchain consortium to authenticate their products collectively, preventing fraudulent labelling in global markets. The consortium model allows for shared governance, reducing the dominance of any single entity while maintaining decentralized, transparent GI verification processes.[26]

Consumer Awareness Initiatives:

Empowering consumers to verify GI product authenticity is a crucial step in blockchain adoption. One effective method is the implementation of QR code verification on GI-certified products. Each product can be assigned a unique QR code linked to a blockchain record that consumers can scan using their smartphones. This would provide instant access to verified information about the product's origin, production process, and authenticity certification. For example, a customer purchasing Roquefort cheese or Colombian coffee could scan the QR code and see the blockchain-verified details, ensuring they are buying a genuine product rather than a counterfeit. To maximize impact, governments and industry players should launch educational campaigns to teach consumers how to use these QR code verification systems effectively.[27] Additionally, blockchain-backed certification labels similar to organic or fair-trade labels can help consumers identify authentic GI products at a glance. These certification labels would indicate that a product's authenticity has been verified through blockchain, reinforcing consumer trust. When shoppers see a "Blockchain-Certified GI Product" label on goods like Iberian ham or Basmati rice, they can confidently purchase them, knowing the product has undergone transparent and tamper-proof verification. Over time, such labels could become a standard indicator of quality and authenticity, further discouraging counterfeit products from entering the market.[28]

CONCLUSION:

[26] Rapidi, Smart Contracts in Supply Chain: Benefits, Use Cases, and Examples (last visited April 6, 2025).
[27] Federico Domenico Enrico De Silvo, *Brief Notes on the European Geographical Indication Law: Among Sustainability Implications and Artificial Intelligence Applications*, 13 INT'L J. MGMT., KNOWLEDGE & LEARNING 105 (2024) (April 6, 2025, 8:00 P.M.), 13.105-111.pdf
[28] *Id* at 2276.

The integration of blockchain technology into the protection and management of Geographical Indications (GIs) represents a groundbreaking solution to longstanding challenges in authenticity verification, supply chain transparency, and counterfeit prevention. By leveraging blockchain's decentralized and tamper-proof nature, GI-certified products can be securely traced from their origin to the consumer, ensuring that traditional producers receive the recognition and economic benefits they deserve. However, widespread adoption faces hurdles, including high implementation costs, scalability concerns, regulatory inconsistencies, and resistance from traditional supply chain actors. Despite these challenges, the future prospects of blockchain for GI protection are highly promising. The convergence of Artificial Intelligence (AI) and blockchain can strengthen fraud detection, while Internet of Things (IoT) integration can enhance real-time monitoring of GI products, safeguarding their quality throughout the supply chain. Moreover, government and industry collaboration, through public-private partnerships and blockchain consortia, can drive adoption and create standardized frameworks for GI verification. On the consumer front, QR code-based authentication systems and blockchain-backed certification labels can empower buyers to make informed purchasing decisions, further discouraging counterfeit goods in the global market.

Ultimately, blockchain has the potential to revolutionize the way GIs are protected, offering a transparent, secure, and scalable solution that benefits producers, regulators, and consumers alike. To fully unlock its potential, stakeholders must address adoption challenges through financial support, regulatory alignment, technological innovation, and widespread education initiatives. If successfully implemented, blockchain can serve as a powerful guardian of cultural heritage, preserving the authenticity of traditional products while fostering fair trade and economic growth for GI-certified producers worldwide.