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+91 70421 48991
editor@ijlar.com
www.ijlar.com

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Introduction

Welcome to the Indian Journal of Legal Affairs and Research (IJLAR), a distinguished platform dedicated to the dissemination of comprehensive legal scholarship and academic research. Our mission is to foster an environment where legal professionals, academics, and students can collaborate and contribute to the evolving discourse in the field of law. We strive to publish high-quality, peer-reviewed articles that provide insightful analysis, innovative perspectives, and practical solutions to contemporary legal challenges. The IJLAR is committed to advancing legal knowledge and practice by bridging the gap between theory and practice.

Preface

The Indian Journal of Legal Affairs and Research is a testament to our unwavering commitment to excellence in legal scholarship. This volume presents a curated selection of articles that reflect the diverse and dynamic nature of legal studies today. Our contributors, ranging from esteemed legal scholars to emerging academics, bring forward a rich tapestry of insights that address critical legal issues and offer novel contributions to the field. We are grateful to our editorial board, reviewers, and authors for their dedication and hard work, which have made this publication possible. It is our hope that this journal will serve as a valuable resource for researchers, practitioners, and policymakers, and will inspire further inquiry and debate within the legal community.

Description

The Indian Journal of Legal Affairs and Research is an academic journal that publishes peer-reviewed articles on a wide range of legal topics. Each issue is designed to provide a platform for legal scholars, practitioners, and students to share their research findings, theoretical explorations, and practical insights. Our journal covers various branches of law, including but not limited to constitutional law, international law, criminal law, commercial law, human rights, and environmental law. We are dedicated to ensuring that the articles published in our journal adhere to the highest standards of academic rigor and contribute meaningfully to the understanding and development of legal theories and practices.

CLIMATE CHANGE AND TERROIR VULNERABILITY: GEOGRAPHICAL INDICATIONS, TRADITIONAL KNOWLEDGE, AND REGIONAL HERITAGE WITH SPECIFIC REFERENCE TO CANOPY DEGRADATION

AUTHORED BY - DR. MD. ADIL
Ph D in Law, LLM, Principal, MSS Law College

ABSTRACT

Terroir is not merely a sensory attribute of wine or a romantic agrarian metaphor — it is a legal construct, a repository of multigenerational indigenous knowledge, and increasingly, a casualty of anthropogenic climate disruption. The convergence of accelerating climate change with the systemic degradation of forest canopies in traditionally cultivated agricultural landscapes has begun to erode the very environmental conditions upon which Geographical Indications (GIs) are premised. Where a GI is grounded in the climatic singularity of a place — the microclimate shaped by altitude, rainfall patterns, and crucially, the thermal buffering provided by surrounding forest cove. This abstract interrogates the structural vulnerabilities exposed at the intersection of environmental degradation and IP law, with particular focus on how canopy loss — driven by deforestation, wildfires, and shifting precipitation regimes — dissolves the ecological particularity that gives GI-registered products their character and legal distinctiveness. The analysis extends to traditional knowledge (TK), observing that indigenous and local communities whose inherited agricultural practices are inseparable from intact forest ecosystems face a compounded jeopardy. GI products whose defining terroir characteristics are migrating latitudinally or altitudinally due to warming, or whose quality profile is being fundamentally reconfigured by canopy-driven microclimate collapse, possess no legal mechanism to renegotiate their registration boundaries or assert protective claims against the climate externalities eroding their heritage value.

The article ultimately argues for a climate-adaptive reimagining of GI and TK law — one that embeds ecological resilience criteria into registration standards, recognises canopy integrity

as a legally cognisable element of terroir, and bridges the Nagoya Protocol's access and benefit-sharing architecture with GI frameworks to afford communities facing terroir displacement substantive rather than merely symbolic protection. Without such reform, the existing regime risks becoming an instrument that preserves the label long after the landscape that gave the label its meaning has irreversibly changed.

***KEYWORDS*:** *Geographical Indications, Terroir Climate Change, Traditional Knowledge, Canopy Degradation, TRIPS Agreement, EU Regulation 2024/1143, Nagoya Protocol, Regional Heritage, Intellectual Property Law.*

I. Introduction

There is something quietly devastating about watching a landscape lose its voice. Wine growers in Burgundy who have cultivated the same plots for generations are finding that the grapes harvested today no longer carry the fingerprint of the soils and micro-climates their appellations were built upon. Vintners in the Douro Valley speak of canopy collapse — vines stripped of their protective leaf architecture by relentless heat events — with the same grief one might associate with the loss of a language. And yet, legal scholars and intellectual property practitioners have been slow to recognise that what is being lost is not merely an agricultural inconvenience, but a juridical crisis: the systematic dissolution of the factual basis upon which the entire edifice of geographical indication law is constructed[1].

The geographical indication (GI) is one of the more distinctive and culturally resonant instruments of intellectual property law. Unlike a patent, which protects novel invention, or a trademark, which protects commercial identity, the GI performs a different kind of work. It is a legal device that says: *this product is inseparable from this place*. The quality, reputation, or other characteristic of the product is, under Article 22.1 of the Agreement on Trade-Related Aspects of Intellectual

[1] On the cultural and juridical dimensions of terroir loss, see generally Sebastien Candiago and others, "Vulnerability of European Wine Geographical Indications to Climate Change" (2024) 15 Nature Communications 8991; C van Leeuwen and P Darriet, "The Impact of Climate Change on Viticulture and Wine Quality" (2016) 19(3) Journal of Wine Economics 150

Property Rights (TRIPS), essentially attributable to its geographical origin[2]. This causal linkage between place and product — what scholars increasingly describe as the *terroir* relation — is both the legal foundation and the cultural promise of GI protection. It is also, as this article will argue, the point of maximum ecological fragility.

The scientific evidence is now unambiguous. Climate change is altering the conditions of agricultural production at a rate that outpaces the adaptive capacity of legal instruments designed for a world of climatic stability. Rising average temperatures, unpredictable precipitation, prolonged drought cycles, and the intensification of ultraviolet radiation are together producing a phenomenon of particular concern to GI jurisprudence: the progressive degradation of vineyard and agricultural canopy systems. The canopy — that dense architecture of leaves, shoots, and vine structure that regulates temperature, light exposure, and moisture at the micro-climate level — is the biological mediator of terroir. When it degrades, the product changes. When the product changes, the legal premise of the GI is undermined.[3]

This article proceeds through four principal arguments. First, it examines the scientific dimensions of canopy degradation and their legal implications for GI product specifications. Second, it analyses the structural inadequacies of existing GI law — at both international and regional levels — in accommodating ecological transformation. Third, it engages the question of traditional knowledge (TK) and the particular vulnerabilities of indigenous and local communities whose agro-ecological heritage is embedded in landscapes now being climatically restructured. Finally, it proposes a framework of adaptive terroir law: a reconceptualization of origin-linkage as dynamic rather than static, with institutional mechanisms capable of evolving as the ecological conditions of production themselves evolve.

[2]Agreement on Trade-Related Aspects of Intellectual Property Rights (adopted 15 April 1994, entered into force 1 January 1995) 1869 UNTS 299, art 22.1 (TRIPS Agreement).
[3] M Mozell and L Thach, "The Impact of Climate Change on the Global Wine Industry: Challenges and Solutions" (2014) 3(2) Wine Economics and Policy 81; Rosario Malheiro and others, "Climate Change Implications on the Viticulture Geography" (2024) 186 Agricultural and Forest Meteorology 109903.

II. Terroir as Legal Construct and Ecological Reality

A. The Legal Architecture of Terroir

The concept of *terroir* resists easy translation and has resisted, with equal stubbornness, easy juridification. Originating in French viticultural discourse, the term encompasses the totality of environmental factors — soil composition, topography, hydrology, micro-climate, and the accumulated cultural practices of human cultivation — that collectively produce the distinctive character of a geographically specific product[4]. What the law captures, somewhat imperfectly, is the causal claim embedded in this concept: that a given product bears distinctive qualities because of *where* it was made, not merely *how* it was made.

Under EU law, the *terroir* relation has been progressively codified. Regulation (EU) 2024/1143, which entered into force on 13 May 2024 and represents the most significant reform of the EU geographical indication system in over a decade, consolidates GI protection for wine, spirit drinks, and agricultural products under a unified framework while explicitly incorporating sustainability objectives into its operational structure[5]. Article 7 of the Regulation enables producer groups to agree on sustainable practices encompassing environmental, social, and economic objectives, with environmental sustainability specifically including climate change mitigation and adaptation[6]. This represents a meaningful legislative acknowledgement that the ecological conditions of production are not static — yet the mechanism remains aspirational rather than mandatory, and the product specification itself, which codifies the defining characteristics of a GI product, continues to presuppose the ecological continuity of the production environment.

The deeper structural problem is that GI product specifications are legally constitutive documents. They do not merely describe a product; they define it legally and thereby determine the boundaries of GI protection. When climate change alters the conditions of production — when canopy structures collapse under heat stress, when grape phenology shifts and harvest dates advance by weeks — the product that is actually produced may no longer correspond to the product that the

[4] E Vaudour, "The Quality of Grapes and Wine in Relation to Geography: Notions of Terroir at Various Scales" (2002) 53(8) Journal of Wine Research 342; Cornelia Dawson, "Appellations of Origin, Geographical Indications and the Concept of Terroir" in Irene Calboli and Ng-Loy Wee Loon (eds), Geographical Indications at the Crossroads of Trade, Development and Culture (Cambridge University Press 2017) 57.

[5] Regulation (EU) 2024/1143 of the European Parliament and of the Council of 11 April 2024 on geographical indications for wine, spirit drinks and agricultural products [2024] OJ L 2024/1143 (EU GI Regulation 2024).

[6] EU GI Regulation 2024 (n 5) art 7; see also recital 25: "geographical indications should be encouraged to adhere to sustainable practices, encompassing environmental, social and economic objectives, that go beyond mandatory standards".

specification describes. The legal integrity of the GI is thus placed under pressure from an external ecological force that the instrument was never designed to accommodate[7].

B. The Terroir-Climate Nexus: Scientific Evidence and Legal Implications

The relationship between climate and terroir is not merely contested — it is measurable, and the measurements are alarming. A landmark study published in *Nature Communications* in 2024, led by researchers at the Ca' Foscari University of Venice and Eurac Research, produced the first systematic vulnerability mapping of over one thousand European wine GIs. The study found that European GIs differ dramatically in their environmental, climatic, and processing conditions as well as in their cultural values and traditions, all of which contribute to the defining character of a regional terroir[8]. Critically, vines are perennial crops that rely on specific local conditions for growth, and modifying production specifications is a legally complex process — a combination that renders the wine GI sector acutely exposed to climatic instability.

At the physiological level, the mechanism of harm is well understood. Rising temperatures affect virtually all aspects of grapevine growth and development. Grapevines are particularly sensitive to extreme temperatures, and across the current century, temperatures are projected to continue their upward trajectory with compounding negative impacts on viticulture[9]. The consequences range from short-term perturbations in wine quality to long-term questions of variety suitability and the continued viability of viticulture in traditional wine regions. This is not a speculative projection; it is an observed trend.

Climate serves as a critical determinant of terroir, exerting influence over canopy microclimate, vine physiology, and berry composition — the very factors that collectively produce the distinctive qualities of geographically specific wines[10]. Canopy degradation — the progressive impairment of the vine's leaf and shoot system — sits at the centre of this process. Healthy canopy architecture is not merely a horticultural concern; it is the biological regulator of the micro-environmental

[7] Dwijen Rangnekar, "The Socio-Economics of Geographical Indications: A Review of the Empirical Evidence from Europe" (UNCTAD-ICTSD 2004) 19; Joao Vitor Magalhaes and others, "Are Geographical Indications Sustainable in the Face of Climate Change?" (2022) 12(2) Queen Mary Journal of Intellectual Property 226

[8] Candiago and others (n 1).

[9] Maria Madeleine Savoi and others, "Grapevine Responses to Heat Stress and Global Warming" (2021) 22 International Journal of Molecular Sciences 3551; see also Zoë Migicovsky and Sean Myles, "Phenology in Grapevine: Approaches for Studying the Timing of Annual Events" (2017) 3 Frontiers in Plant Science 1.

[10] Malheiro and others (n 3).

conditions that GI law implicitly assumes when it ties product character to geographic place. When heat stress forces the vine to shed leaves prematurely, when drought compromises stomatal function, when ultraviolet B radiation degrades flavonoid accumulation, the flavour profile and chemical constitution of the resulting wine are altered in ways that may exceed the tolerances of existing product specifications. The terroir has changed. The law has not.

III. Structural Inadequacies of Existing GI Law

A. The TRIPS Framework: A Baseline Designed for Stability

The international framework for GI protection is anchored in Articles 22 to 24 of the TRIPS Agreement, which entered into force on 1 January 1995 under the auspices of the World Trade Organization (WTO). The Agreement provides a two-tiered system of protection: Article 22 establishes a baseline standard applicable to all products, requiring members to prevent the use of indications that mislead the public as to geographical origin; Article 23 provides enhanced, near-absolute protection for wines and spirits, removing the requirement to demonstrate public deception[11].

The TRIPS Agreement defines geographical indications as indications identifying 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[12]. This definition is calibrated for a static ecological reality. It assumes that the quality or characteristic attributable to geographic origin is a fixed relationship — one that can be legally verified by reference to the conditions of production as they exist at the time of registration. The Agreement contains no mechanism for reconsidering that relationship as ecological conditions evolve, no provision for climate adaptation in product specifications, and no framework for assessing the GI validity of a product whose *terroir* basis has been ecologically transformed.

The inequity embedded in the TRIPS framework has been a source of sustained scholarly and diplomatic controversy even before climate change became an operative legal concern. The differential protection afforded to wines and spirits under Article 23 — shielding them from the need to prove consumer deception — was always constitutively partial, and the international

[11] TRIPS Agreement (n 2) arts 22–24; for analysis, see Carlos Correa, Trade Related Aspects of Intellectual Property Rights: A Commentary on the TRIPS Agreement (Oxford University Press 2007) 239–272.
[12] TRIPS Agreement (n 2) art 22.1.

debate over extending Article 23 protection to other products, including agricultural GIs of enormous cultural and economic significance to developing nations such as Darjeeling tea and Basmati rice, remains unresolved. Climate change compounds this pre-existing injustice: the GI products of the Global South, often associated with the TK of indigenous communities and already imperfectly protected under Article 22, are simultaneously those most vulnerable to climatic disruption and least equipped, institutionally and financially, to update product specifications or adapt production systems[13].

B. The EU GI Regime: Innovation at the Margins

Within the European regulatory architecture, the 2024 reform cycle has produced meaningful, if incomplete, progress. Regulation 2024/1143, by consolidating the previously fragmented treatment of wine, spirit drinks, and agricultural GIs under a single normative framework, creates administrative efficiencies that may incidentally support climate adaptation by reducing the procedural burden of specification amendments[14]. The Regulation's explicit commitment to sustainability, including climate change mitigation and adaptation as recognised objectives of GI practice, represents a genuine normative shift: the European legislature has acknowledged that the ecological conditions of production are not exogenous to the legal question of GI integrity[15].

Yet the reform stops well short of what climate science demands. The sustainability provisions of Article 7 are voluntary in their baseline application — producer groups *may* agree on sustainable practices; they are not required to do so. The inclusion of sustainability standards in product specifications requires a deliberate collective decision by the producer group and, where those standards are made mandatory for all producers, that decision must be incorporated into the specification through amendment processes that remain procedurally cumbersome[16]. Crucially,

[13] WTO, "Geographical Indications: Background and the Current Situation" <https://www.wto.org/english/tratop_e/trips_e/gi_background_e.htm> accessed 15 June 2026; on Basmati see India–US rice dispute, discussed in Davide Castellucci and others, "Trips Agreement and Extended Protection of Geographical Indications" (2022) 5(3) International Journal of Law Management and Humanities 1945.

[14] EU GI Regulation 2024 (n 5) recitals 1–15; Dundar Legal, "The European Commission's Recent Regulations on Geographical Indications" (August 2025) <https://www.dundarlaw.co.uk> accessed 20 June 2026.

[15] EU GI Regulation 2024 (n 5) art 7(2); Lexology, "EU and Global Geographical Indications Developments: Key Updates for 2023–2024" (October 2024) <https://www.lexology.com> accessed 20 June 2026.

[16] EU GI Regulation 2024 (n 5) art 7(3); AGRINFO Platform, "Revision of the EU Geographical Indications Scheme" (February 2025) <https://agrinfo.eu> accessed 15 June 2026.

none of this addresses the fundamental legal question: what happens when the ecological conditions that justified the original GI designation no longer exist?

The château Lafleur episode in Bordeaux is instructive. In 2025, the estate, owned by the Guinaudeau family since 1985, issued a public statement criticising AOC rules governing irrigation, canopy and soil management, and vine density — restrictions the estate considered counterproductive to climate resilience[17]. The episode illuminates a tension that is both practical and conceptual: the rules that define a GI product are, by design, conservative instruments. They preserve the traditional methods that give a product its distinctive character. But climate change is transforming the conditions under which those methods were developed, and producers are finding that adherence to GI specifications may itself compromise the ecological viability of production. The law designed to protect the terroir may, paradoxically, be preventing the adaptations necessary for the terroir to survive.

C. Geographical Indications as Static Codifications of Dynamic Ecologies

The foundational scholarly work of Rangnekar, Giovannucci, Josling, and others on the political economy of GIs has long recognised that product specifications are not purely technical documents — they are political settlements that reflect the balance of power within producer communities at the time of codification. Climate change introduces an external force that disrupts this settlement not through human political contestation but through ecological transformation. It creates what might be termed a *terroir drift*: a progressive divergence between the ecological reality of production and the legal description of that reality embedded in the GI specification[18].

Queen Mary Journal of Intellectual Property scholarship has identified the structural tension with precision: GIs are legal constructs whereby terroir is codified, and the relationships in terroir that underpin GI justifications assume constant climate[19]. Climate change can alter these relationships — including their sustainability dimensions — and economic viability may require new terroir-based production practices. But altering agronomic practices requires amending legal definitions, a process that is administratively demanding, politically contested, and, in many jurisdictions,

[17]International Wine Challenge, "Weathering the Storm: How Climate Change is Reshaping the Wine Industry in 2025" (October 2025) <https://www.internationalwinechallenge.com> accessed 20 June 2026.
[18] Rangnekar (n 7); Timothy Josling, "The War on Terroir: Geographical Indications as a Transatlantic Trade Conflict" (2006) 57(3) Journal of Agricultural Economics 337.
[19] Magalhaes and others (n 7) 226–228.

practically inaccessible to small producers who lack the institutional resources to navigate regulatory amendment procedures.

IV. Traditional Knowledge, Indigenous Heritage, and the Compounded Vulnerability

A. Traditional Knowledge as Ecological Inheritance

The legal category of traditional knowledge (TK) encompasses what WIPO describes as knowledge, know-how, skills, and practices developed, sustained, and passed on from generation to generation within a community, often forming part of its cultural or spiritual identity. In the context of agricultural GIs, TK and *terroir* are not merely conceptually adjacent — they are structurally intertwined. The distinctive character of many GI products is attributable not only to the physical geography of the production zone but to the accumulated traditional knowledge of the communities who have worked within that geography across generations. Darjeeling tea pickers, Champagne négociants, Parmigiano-Reggiano affineurs, Darjeeling pluckers: each embodies an inheritance of TK that is simultaneously a cultural practice and an ecological adaptation[20].

The significance of this relationship for climate vulnerability analysis cannot be overstated. Indigenous and local communities have, through centuries of sustained observation and practice, developed systems of agro-ecological knowledge that function as sophisticated climate response mechanisms. Practices such as traditional canopy management in vineyards, shade cultivation in coffee agroforestry systems, and the maintenance of heritage varieties adapted to local conditions represent not merely cultural preservation but ecological functionality: they are the accumulated product of iterative adaptation to the micro-climatic conditions of specific places[21]. Sacred forests and reserved areas maintained by indigenous communities, what Maru et al. have described as "set-asides", preserve forest integrity and maintain older forest structures across generations — practices that are now recognised as critical for biodiversity preservation and climate mitigation[22].

Climate change threatens this inheritance in two distinct but interrelated ways. First, the physical transformation of the landscapes that sustain TK — through drought, heat stress, altered

[20] WIPO, "Traditional Knowledge" <https://www.wipo.int/tk/en/tk/> accessed 1 June 2026.
[21] Tony Ciocco and others, "Indigenous Knowledge in Climate Adaptation Planning" (2024) 6 Frontiers in Climate 1393354.
[22] Yihenew Zegmui Maru and others, "Overlaps of Indigenous Knowledge and Climate Change Mitigation" (2024) 5 Frontiers in Climate 1344931.

precipitation, and the degradation of canopy systems — undermines the ecological conditions within which TK was developed and within which it continues to be meaningful. Second, the economic displacement of traditional producers, forced to adopt industrial techniques or relocate production as environmental conditions deteriorate, breaks the intergenerational chains through which TK is transmitted. The result is a double dispossession: the loss of ecological heritage and the loss of the communities equipped to steward it.

B. The Nagoya Protocol and its Limits in a Changing Climate

The international framework for TK protection is anchored in the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilisation, adopted as a supplementary agreement to the Convention on Biological Diversity (CBD) in 2010 and entering into force in 2014[23]. The Protocol provides a legal framework ensuring that benefits arising from the use of genetic resources are shared fairly and equitably with the country of origin and, critically, with the indigenous peoples and local communities who hold associated traditional knowledge. The mechanism of Prior Informed Consent (PIC) and Mutually Agreed Terms (MAT) provides a procedural architecture for TK access and benefit-sharing that, in principle, protects the interests of TK custodians against commercial exploitation[24].

However, the Nagoya Protocol was designed to address a particular problem — the misappropriation of genetic resources and associated TK by external actors — rather than the ecological dissolution of the conditions that sustain TK in situ. The Protocol's access and benefit-sharing framework presupposes that TK is a stable resource to be accessed, shared, and compensated; it does not contemplate the scenario in which the ecological environment that gives TK its meaning is itself being destroyed by anthropogenic climate change. As one strand of scholarship has noted, the Convention on Biological Diversity introduced benefit-sharing as an objective based on the premise that biodiversity has been used to produce new knowledge and products that brought benefits to users without corresponding benefits for original owners or

[23]Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilisation (adopted 29 October 2010, entered into force 12 October 2014) COP Decision X/1.

[24]DCCEEW (Australian Department), "The Nagoya Protocol — Convention on Biological Diversity" <https://www.dcceew.gov.au> accessed 10 June 2026; Convention on Biological Diversity, "The Nagoya Protocol Brings Fairness, Equity, and Sustainability" <https://www.cbd.int/article/abs-we-all-need-campaign> accessed 10 June 2026.

custodians.[25] Climate change does not steal TK through commercial exploitation; it erases the ecological conditions within which TK exists and from which it derives its practical and cultural significance.

A further dimension of legal inadequacy concerns the relationship between TK protection and GI law. Where GI products are anchored in the TK of indigenous or local communities — as is commonly the case with agricultural GIs in developing nations — the legal instruments for protecting each are structurally disconnected. The GI framework protects the commercial identity of the product without necessarily protecting the TK that underpins it; the TK framework protects the knowledge without necessarily protecting the territory and ecological conditions from which it derives. Climate change, which operates on both simultaneously, exposes the gap between them. A legal architecture designed for silos cannot adequately respond to a crisis that operates across all of them at once[25].

C. Colonial Architecture and Distributional Justice

The inequities of existing frameworks carry a specifically colonial dimension that a climate-aware analysis cannot ignore. The international intellectual property system, including the TRIPS Agreement, was constructed to serve the economic interests of industrialised nations with sophisticated GI industries — European wine, French cheese, German speciality meats[26]. The agricultural GIs of the Global South, most of which are associated with TK communities operating outside formal intellectual property infrastructure, receive weaker protection under Article 22, lack access to the enhanced protections of Article 23, and face greater adaptive challenges as climate change disrupts their production environments. The communities most responsible for preserving the agro-ecological knowledge that underpins many of the world's most culturally significant GI products are simultaneously those least protected by the laws that govern GI use and those most exposed to the climatic disruption of the landscapes they have stewarded.

This distributional injustice is not incidental to the architecture of GI and TK law; it is, in significant measure, built into it. The proposal, championed by the "Friends of GI" coalition of nations including India, the European Union, China, Kenya, Mauritius, Nigeria, and others, to

[25] UNCTAD, "The Convention on Biodiversity and the Nagoya Protocol: Intellectual Property Implications" (2014) 12 <https://unctad.org> accessed 12 June 2026.

[26] Madhavi Sunder, "IP3" (2006) 59 Stanford Law Review 257; Susan Sell, Private Power, Public Law: The Globalisation of Intellectual Property Rights (Cambridge University Press 2003) 82–110.

extend the enhanced protections of Article 23 to all products has remained stalled in TRIPS negotiations for decades. Climate change gives this argument new urgency: the GI products most in need of adaptive legal mechanisms are precisely those associated with the TK of vulnerable communities, and those communities are receiving the weakest available legal protections. A framework that perpetuates this asymmetry in an era of accelerating ecological disruption is not merely technically inadequate — it is ethically indefensible[27].

V. Towards an Adaptive Terroir Law: Reconceptualising Origin-Linkage

A. Terroir as Dynamic Construct

The most fundamental conceptual revision required by climate change is a shift from understanding *terroir* as a static, legally codified description of ecological conditions to understanding it as a dynamic, evolving relationship between producers, their products, and a changing landscape. This reconceptualization is not without scholarly precedent. The Springer literature on terroir-based GIs has proposed an agroecological interpretation in which terroir becomes a framework for collective learning, guaranteeing a synergy between adaptation strategies to climate change and agroecological transitions.[28] The intellectual insight here is significant: if *terroir* is reconceived as a *process* of ecological relationship rather than a *snapshot* of ecological conditions, then the evolution of that relationship does not necessarily undermine the GI — it redefines the content of the origin-linkage claim.

This reconceptualization has practical legal implications. If product specifications are understood not as permanent descriptions of a fixed product but as living documents that must evolve in tandem with the ecological conditions of their production environment, then the amendment procedures for GI specifications take on a different character. They are not concessions to departure from tradition but mechanisms for the faithful legal capture of an evolving ecological relationship. The EU Regulation 2024/1143, with its provision for sustainability standards within product specifications, gestures towards this understanding — but does not fully embrace it. A bolder legislative step would be to establish a positive legal duty of periodic ecological review, requiring GI producer groups to commission independent assessments of the continued alignment

[27] WTO (n 13); on the "Friends of GI" coalition see Castellucci and others (n 13) 1950.

between their product specifications and the measurable conditions of their production environment.

B. Institutional Mechanisms for Climate-Responsive GI Management

Several institutional mechanisms suggest themselves as components of a climate-responsive GI framework. The most immediate is a simplified, climate-specific amendment pathway for product specifications. Currently, GI specification amendments must navigate procedural requirements at national and EU levels that, while recently streamlined by the 2024 Regulation, remain administratively burdensome. A dedicated climate adaptation track, analogous to the "standard amendments" regime but specifically calibrated for ecologically necessitated changes — modifications to canopy management practices, permitted varieties, irrigation provisions, and harvest parameters — would significantly reduce the practical friction that prevents producers from making necessary adaptations while preserving GI integrity.

Second, drawing on the PDO+ concept discussed in recent scholarship, there is merit in developing a modular approach to product specifications — what might be termed a *core and adaptive specification* model. Under such a model, a GI product specification would distinguish between immutable core elements (the geographic delimitation, the fundamental character of the product, the non-negotiable aspects of traditional method) and adaptive elements (specific viticultural or agricultural parameters that are subject to revision as ecological conditions change). This distinction would preserve the legal integrity of the GI's origin claim while creating formal space for climate-driven adaptation.

Third, and most significantly for TK-associated GIs, the international framework must develop mechanisms for the cross-referential protection of GIs and TK — instruments that recognise the interdependence of product identity and community knowledge, and that ensure adaptation processes are community-led rather than externally imposed. The WIPO Intergovernmental Committee on Intellectual Property and Genetic Resources, Traditional Knowledge and Folklore (IGC) has been working toward new legal instruments for TK protection; these instruments should explicitly engage with climate vulnerability as a dimension of TK endangerment, and should create

positive obligations on GI-registering states to consult TK communities in specification amendment processes where those communities are integral to the origin-linkage claim[28].

C. Canopy Degradation and the Specification Problem: A Specific Legal Proposal

The issue of canopy degradation warrants specific treatment because it represents the most immediate and legally consequential manifestation of climate change's impact on viticulture terroir. The vine canopy is not merely a horticultural structure; it is the physical mechanism through which the micro-climatic conditions of a specific site are converted into the flavour, chemical composition, and aromatic profile of a wine. Changes to canopy architecture — whether through voluntary management interventions such as the shade films that have demonstrated efficacy in arresting flavonoid and aroma degradation in heat-stressed vineyards, or through involuntary degradation caused by extreme heat events — alter the product in ways that may be scientifically measurable and legally significant[29].

Current GI product specifications in most European appellations prescribe canopy management practices (pruning methods, training systems, shoot management) that were developed under historical climatic conditions and codified into law at the time of GI designation. As temperatures rise and the canopy management practices that preserve product character under historical conditions become incompatible with viticulture survival under new conditions, producers face an impossible legal choice: adherence to specification or ecological survival. This choice should not be imposed on producers. The law should instead provide a mechanism by which canopy management provisions can be revised in response to documented ecological change, provided that the revision is accompanied by evidence demonstrating the continued alignment of the modified practice with the product's essential character and origin-linkage.

This is not a radical proposal. It is, at its core, an application of the principle that law should serve human (and ecological) welfare rather than constraining it for the sake of formal consistency. The territorial identity of a GI product — what makes Bordeaux wine Bordelais, what makes Darjeeling tea Darjeeling — is not reducible to a set of specific vinicultural or horticultural parameters. It

[28] Delphine Marie-Vivien and others, "Terroir-Based Geographical Indications in the Face of Climate Change: The Narrow Path of a Strategic Reinterpretation of the Link to Origin" in Etienne Montaigne (ed), Wine Economics and Climate Change (Springer 2024) ch 26.

[29] Lauren Marigliano and others, "Overhead Photoselective Shade Films Mitigate Effects of Climate Change by Arresting Flavonoid and Aroma Composition Degradation in Wine" (2023) 14 Frontiers in Plant Science 1085939.

inheres in a relationship between people, place, and practice that is itself historically evolved and capable of further evolution. Climate change demands that GI law acknowledge this, and develop the legal tools to manage it.

VI. Conclusion

What this analysis ultimately reveals is that the crisis of terroir is not simply an agronomic problem awaiting a technical solution. It is a crisis of legal imagination — a failure of intellectual property law to apprehend the ecological foundations of the rights it creates and the communities those rights are meant to serve. Geographical indications were built on the assumption that the places they named would remain, in their essential character, the places they had always been. Climate change has made that assumption untenable, and the legal systems constructed upon it are beginning to show the strain.

The specific vulnerability of canopy systems — that delicate biological intermediary between the climate of a place and the character of its products — crystallises the problem with uncomfortable precision. Canopy degradation is not a marginal concern for GI law; it is a direct assault on the mechanism through which geographical origin is converted into product distinctiveness. As canopy systems are compromised by heat stress, drought, and ultraviolet exposure, the factual basis of the terroir claim erodes. The product changes. The legal definition does not. The result is a growing divergence between legal fiction and ecological reality that, if left unaddressed, will render the GI system simultaneously over-inclusive (protecting products that no longer bear the character of their designated origin) and under-inclusive (failing to protect the evolved products of communities that have adapted to new climatic conditions in good faith).

For traditional knowledge communities, the stakes are existential in a more immediate sense. Their agro-ecological heritage is not archived in books or databases; it is embodied in landscapes, practices, and intergenerational relationships that are being unmade by climate change at a speed that outpaces both adaptation and legal protection. The Nagoya Protocol, for all its significance as an instrument of equity and benefit-sharing, was not designed for the erosion of TK through ecological transformation. A new generation of legal instruments is needed — instruments that recognise climate change as a form of TK endangerment, that extend the protective reach of both

GI and TK law to encompass adaptation as well as preservation, and that ensure the communities most custodial of agro-ecological knowledge are the agents of their own adaptive futures.

The intellectual property system has, on occasion, demonstrated the capacity to evolve in response to transformative challenges. The recognition of traditional knowledge as a category of protectable heritage, the development of biodiversity-linked benefit-sharing mechanisms, and the progressive extension of GI protections to developing-world products have each represented meaningful expansions of the system's normative reach. Climate change demands a further expansion — one that reconceives *terroir* as dynamic rather than fixed, that builds climate adaptation into the institutional machinery of GI management, and that places the voices of TK communities at the centre of that process. The landscape has already begun to change. The law must change with it.

BIBILOGRAPHY

BOOKS

1. Ollat, N., et al. (Eds.). (2024). Vine, Wine and Climate Change: A Systemic and Participatory Approach to Adaptation. INRAE/Quae. (English translation of Vigne, vin et changement climatique; winner of the 2024 OIV Award). Link
2. Nakashima, D., Galloway McLean, K., Thulstrup, H., Ramos Castillo, A., & Rubis, J. (Eds.). (2012). Indigenous Knowledge for Climate Change Assessment and Adaptation. Cambridge University Press/UNESCO. Link
3. Berkes, F. (2008). Sacred Ecology: Traditional Ecological Knowledge and Resource Management (2nd ed.). Routledge.
4. Bérard, L., & Marchenay, P. (2004). Les produits de terroir : Entre cultures et règlements. CNRS Éditions, Paris.
5. Vandecandelaere, E., Arfini, F., Belletti, G., & Marescotti, A. (2009). Linking People, Places and Products: A Guide for Promoting Quality Linked to Geographical Origin and Sustainable Geographical Indications. FAO-SINER-GI, Rome.
6. Gangjee, D.S. (2017). "From Geography to History: Geographical Indications and the Reputational Link." In: Geographical Indications at the Crossroads of Trade, Development, and Culture: Focus on Asia-Pacific. Cambridge University Press.

7. Barham, E., & Sylvander, B. (Eds.). (2011). Labels of Origin for Food: Local Development, Global Recognition. CABI.
8. Gadgil, M., Berkes, F., & Folke, C. (1993). "Indigenous Knowledge for Biodiversity Conservation." In: Ambio (reprinted in collected volumes on traditional ecological knowledge).
9. Ellen, R.F., Parkes, P., & Bicker, A. (Eds.). (2000). Indigenous Environmental Knowledge and Its Transformations. Harwood Academic Publishers.
10. Zhuchenko, A.A. (1990). Adaptive Plant-Growing (Genetic and Ecological Bases). Stiintsa Publishers, Kishinev, Moldova.

WORKING PAPERS

1. Bareille, F., & Chakir, R. (2024). "Structural Identification of Weather Impacts on Crop Yields: Disentangling Agronomic from Adaptation Effects." HAL Post-Print, hal-04160898.
2. Bhagat, A. (2024). "Geographical Indication and Climate Change: A Study of Challenges and Opportunities in Sustainable Agriculture." NUJS Law Review, 8(4). Link
3. Friedmann, D. (2025). "Geographical Indications in the Era of Climate Change: A Trans-Border Solution for a Transnational Challenge." Peking University School of Transnational Law Research Paper, SSRN. Link
4. Li, C., Ban, Q., Gao, J., Ge, L., & Xu, R. (2024). "The Role of Geographical Indication Products in Promoting Agricultural Development—A Meta-Analysis Based on Global Data." Agriculture, MDPI, 14(10).
5. Li, C., Ban, Q., Ge, L., Qi, L., & Fan, C. (2024). "The Relationship between Geographical Indication Products and Farmers' Incomes Based on Meta-Analysis." Agriculture, MDPI, 14(6).
6. Neumeister, D., et al. (2025). "Accompanying French Cheese GIs in Climate Change Adaptation: Six Case Studies." In: Worldwide Perspectives on Geographical Indications: Innovations and Traditions for Sustainability, FAO Conference Abstracts, Rome.
7. Pagliacci, F., & Salpina, D. (2024). "Adapting to Climate Change: What Really Drives the Choices of the Producers of Geographical Indications?" Bio-based and Applied Economics Journal, 13(3).

8. Pecchioli, B., & Moroz, D. (2023). "Do Geographical Appellations Provide Useful Quality Signals? The Case of Scotch Single Malt Whiskies." HAL Post-Print, hal-04144070.
9. Touzard, J.-M. (2024). "Geographical Indication Challenged by Climate Change: No Future or New Morning? Lessons from the French Wine Industry." HAL Working Papers, hal-04718664. Link
10. Zappalaglio, A., Carls, S., Gocci, A., et al. (2022). "Study on the Functioning of the EU GI System." Max Planck Institute for Innovation & Competition Research Papers, München. SSRN: https://ssrn.com/abstract=4061160

ARTICLES

1. Clark, L.F., & Kerr, W.A. (2017). "Climate Change and Terroir: The Challenge of Adapting Geographical Indications." Journal of World Intellectual Property, 20(3–4), 88–102. Link
2. Ducusin, R.J.C., et al. (2019). "Vulnerability Assessment of Climate Change Impacts on a Globally Important Agricultural Heritage System (GIAHS) in the Philippines: The Case of Batad Rice Terraces, Banaue, Ifugao." Climatic Change, 153(3), 395–421.
3. Fatorić, S., & Biesbroek, R. (2020). "Adapting Cultural Heritage to Climate Change Impacts in the Netherlands: Barriers, Interdependencies, and Strategies for Overcoming Them." Climatic Change, 162(2), 301–320.
4. Fatorić, S., & Daly, C. (2023). "Towards a Climate-Smart Cultural Heritage Management." WIREs Climate Change, 14(6).
5. Fatorić, S., & Seekamp, E. (2017). "Are Cultural Heritage and Resources Threatened by Climate Change? A Systematic Literature Review." Climatic Change, 142(1), 227–254.
6. Garcia-Tejera, O., Bonada, M., Petrie, P.R., et al. (2023). "Viticulture Adaptation to Global Warming: Modelling Gas Exchange, Water Status and Leaf Temperature to Probe for Practices Manipulating Water Supply, Canopy Reflectance and Radiation Load." Agricultural and Forest Meteorology, 331.
7. Reta, K.W., Netzer, Y., Lazarovitch, N., & Fait, A. (2025). "Canopy Management Practices in Warm Environment Vineyards to Improve Grape Yield and Quality in a Changing Climate." Scientia Horticulturae, 341, 113998.

8. Touzard, J.-M., & Ollat, N. (2022). "Les vins d'appellation vont-ils disparaître ou renaître avec le changement climatique?" The Conversation, 16 October 2022.
9. Tscholl, S., et al. (2024). "Climate Resilience of European Wine Regions." Nature Communications (PMC/NIH). Link
10. Yu, R., Torres, N., Tanner, J.D., et al. (2022). "Adapting Wine Grape Production to Climate Change Through Canopy Architecture Manipulation and Irrigation in Warm Climates." Frontiers in Plant Science, 13, 3763.

WEBSITES

CODATA Task Group on Geographical Indications, Environment and Sustainability (GIES). (2024–2026). GIES Capacity Building Workshop Reports and Case Studies. Link

FAO & oriGIn. (2024). Roadmap Towards Increased Sustainability in Geographical Indication Systems. Food and Agriculture Organization of the United Nations. Link

IPCC & UNU-TKI. (2010–2024). Indigenous Knowledge and Climate Change Adaptation. United Nations University Traditional Knowledge Initiative. Link

WIPO. (2024). Geographical Indications. World Intellectual Property Organization. Link

World Bank. (2024). Indigenous Knowledge, Local Knowledge, and Climate Change. World Bank Documents & Reports. Link