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CIVIL-LAW PROTECTION OF GREEN BIOTECHNOLOGY IN UZBEKISTAN

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ABSTRACT

Green biotechnology is central to Uzbekistan's agricultural modernisation agenda, yet the civil-law framework governing it remains fragmented and internally inconsistent. This article examines Uzbekistan's existing legislation — including the Civil Code, the Law on Selection Achievements, the Law on Organic Products (2022), and relevant presidential decrees — and identifies four structural problems. First, the absence of dedicated biotechnology legislation forces reliance on general civil-law rules not designed for self-replicating biological subject matter. Second, a direct conflict exists between Presidential Decree PQ-4899 (2020), which promotes genetic engineering, and the Law on Organic Products, which prohibits GMO use in organic production, with no mechanism to allocate liability where transgenic gene flow damages certified organic farms. Third, gene-editing technologies such as CRISPR-Cas9 fall outside current patentability criteria, creating investment uncertainty. Fourth, mandatory GMO labelling is absent. Drawing on comparative analysis of EU, U.S., and other countries, the article proposes a comprehensive Biotechnology Act, a strict-liability regime for transgenic contamination, mandatory environmental insurance, and GMO labelling rules.

Keywords: green biotechnology; genetically modified organisms; plant breeders' rights; precision breeding; transgenic contamination; civil liability; biotechnology legislation; Uzbekistan.

1. INTRODUCTION

1.1 Research Context and Relevance

The combination of population growth, climate-induced agricultural stress, and persistent food-security deficits has made green biotechnology — the application of molecular and cellular biology to plant and animal production systems — a central topic in agricultural policy worldwide. Empirical studies show that GM crop adoption can increase yields by 6–25%, substantially reduce pesticide use, and improve nutritional content, particularly in resource-constrained farming systems (Klümper & Qaim, 2014; Qaim, 2020). At the macroeconomic level, the McKinsey Global Institute (2020) projects that the broader bioeconomy could generate USD 2–4 trillion in annual global value over the next two decades, making biotechnology governance a strategic, not merely technical, challenge for governments.

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Uzbekistan has explicitly positioned green biotechnology as a driver of structural economic transformation. President Mirziyoyev's Address to the Oliy Majlis of 26 December 2025 designated bioengineering in agriculture as one of the primary instruments for reaching a GDP target of USD 240 billion, a goal embedded in the Uzbekistan-2030 Development Strategy (Presidential Decree PF-158, 2023). Presidential Decree PQ-4899 of 25 November 2020 established a comprehensive action plan for biotechnology development and biological security. These policy commitments send a credible signal to the market. However, as Drahos (2010, p. 23) argues, the economic returns to biotechnology depend directly on the reliability of the underlying legal framework: without enforceable intellectual property rights, clear liability rules, and coherent regulatory boundaries, private investment will remain suboptimal regardless of the scale of public-sector promotion.

A review of Uzbekistan's legislation reveals a significant mismatch between the ambition of its biotechnology policy and the sophistication of its civil-law framework. Governance of green biotechnology is distributed across the Civil Code, several sector-specific statutes, and a series of executive decrees — an arrangement that produces both normative gaps (matters entirely unaddressed by law) and normative conflicts (matters addressed by mutually contradictory rules). The most consequential of these conflicts — between PQ-4899 and the Law on Organic Products (2022) — has not, to the author's knowledge, been identified or analysed in prior academic work.

1.2 Research Objectives and Questions

This article has three objectives: (i) to map the civil-law framework applicable to green biotechnology in Uzbekistan and assess its adequacy; (ii) to identify and analyse normative gaps and conflicts, with particular attention to their liability consequences; and (iii) to propose concrete reforms drawing on comparative analysis of established regulatory models. The study addresses three research questions: (RQ1) To what extent does Uzbekistan's civil-law framework effectively govern the distinctive properties of green biotechnology products? (RQ2) What are the legal and practical consequences of the conflict between biotechnology-promotion instruments and the Law on Organic Products? (RQ3) What normative changes are needed to build a coherent, investment-ready biotechnology law regime in Uzbekistan?

1.3 Literature Review

The literature on biotechnology intellectual property law has developed around several core debates. The foundational question of patentability was settled in Diamond v. Chakrabarty, 447 U.S. 303 (1980), where the U.S. Supreme Court held that human-made living organisms are patentable subject matter — a ruling that directly enabled the modern biotechnology industry. A subsequent refinement came in Association for Molecular Pathology v. Myriad Genetics, 569 U.S. 576 (2013), which held that naturally occurring DNA sequences are not patentable, whereas synthetically constructed complementary DNA (cDNA) is. Holman (2012) traces how these precedents shaped global biotechnology patent law and identifies the interpretive problems posed by synthetic biology — problems that remain unresolved in many jurisdictions, including Uzbekistan.

Heller and Eisenberg (1998) introduced the concept of 'patent thickets' (which they termed the 'anticommons') to biotechnology law, showing that when intellectual property rights in upstream research tools are fragmented among multiple holders, the transaction costs of assembling all necessary licences can effectively block downstream innovation. Contreras (2019) applied this analysis to agricultural biotechnology specifically, documenting how overlapping patents on plant

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genomes, transformation technologies, and trait-enabling sequences create real barriers to new crop variety development. Correa (2000) argues from a development-law perspective that the TRIPS Agreement leaves important policy space for developing countries in designing plant breeders' rights regimes, but that this space is rarely used effectively.

On GMO regulation, the comparative literature distinguishes the EU's hazard-based, precautionary model from the U.S. product-based, risk-proportionate model (Pew Initiative, 2001). Falck-Zepeda, Traxler, and Nelson (2000) document how the welfare effects of GM crop introduction in developing countries depend heavily on seed market structure and the strength of competing intellectual property claims — a finding directly relevant to Uzbekistan's smallholder agricultural sector. Rimmer (2015) provides a comprehensive treatment of the intersection between biodiversity law and plant variety protection, while Stasi and Biryukova (2016) document how the institutional capacity of patent and plant variety offices in transition economies affects the enforceability of biotechnology rights in practice. Academic work specifically addressing biotechnology civil law in Uzbekistan is sparse, and the present article addresses that gap.

2. METHODOLOGY

The study combines three methodological approaches. The first is systematic legal analysis: the Civil Code of Uzbekistan (1996), the Law on Inventions, Utility Models, and Industrial Designs (1994, as amended 2024), the Law on Selection Achievements (1996, as amended 2002), the Law on Trade Secrets (2014), the Law on Organic Products (2022), Presidential Decree PQ-4899 (2020), Cabinet of Ministers Resolution No. 535 (2024), and the Uzbekistan-2030 Development Strategy (2023) are examined both individually and as a system, with attention to coherence, hierarchical consistency, and coverage of biotechnology-specific legal relationships. Where provisions are ambiguous in their application to biotechnology subject matter, normative-dogmatic interpretation is used to identify the legally defensible reading.

The second approach is comparative legal analysis. Three jurisdictions are selected: the European Union, as the exemplar of a precautionary, rights-intensive regulatory model; the United States, as the exemplar of a product-based, innovation-permissive model; and India, as a developing-country comparator with documented experience of large-scale GM crop adoption in a smallholder agricultural economy structurally similar to Uzbekistan's. The common evaluative standard applied to all three jurisdictions and to Uzbekistan is whether the regulatory framework (a) provides clear and enforceable intellectual property rights for biotechnology innovations; (b) allocates civil liability for unintended ecological consequences, particularly transgenic gene flow; and (c) protects consumer informational rights without imposing disproportionate burdens on innovators.

The third approach is contextual-empirical analysis: data from the Intellectual Property Agency of the Republic of Uzbekistan, UPOV reports, and OECD bioeconomy statistics are used to situate the doctrinal analysis in the operational realities of Uzbekistan's agricultural and innovation system. Scenario analysis — including the transgenic contamination hypothetical developed in Section 4.1 — is used to test the adequacy of existing liability rules under realistic fact patterns.

3. RESULTS

3.1 Intellectual Property Protection: Scope and Structural Gaps

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Uzbekistan's patent system, established by the Law on Inventions (1994, as amended 2024), excludes from patentability 'all varieties and breeds of living organisms and purely biological methods of obtaining them' while allowing the patenting of new microorganism strains, recombinant genetic constructs, enzyme preparations, and diagnostic procedures. This exclusion structure broadly mirrors Article 53(b) of the European Patent Convention and was adequate for the biotechnology landscape of the 1990s. Its application to organisms produced by modern gene-editing platforms — principally CRISPR-Cas9, TALENs, and base-editing systems — is, however, legally unclear.

The core difficulty is this. Gene-edited varieties produced by site-directed nuclease technologies introduce targeted, heritable modifications at defined genomic loci, often producing outcomes indistinguishable from natural mutation or classical mutagenesis. The EU Court of Justice in Confédération paysanne v. Premier ministre, Case C-528/16 (2018), held that organisms produced by such new mutagenesis techniques fall within the scope of the GMO Directive. The European Patent Office, by contrast, has accepted patents on some CRISPR-derived traits where the inventive step requirement is satisfied. Uzbekistan's statute contains neither a definition of 'biological method' that distinguishes precision mutagenesis from selective breeding, nor any guidance on the legal status of gene-edited varieties that do not involve the stable integration of foreign genetic material. The result is a patentability vacuum for a category of agricultural innovation that already encompasses commercially important drought-tolerant and disease-resistant varieties. Investors and breeders operating under this uncertainty bear a risk premium that functions, in Drahos's (2010) terms, as an implicit tax on innovation.

The plant breeders' rights regime under the Law on Selection Achievements (1996, as amended) and Civil Code Articles 1091–1094 provides protection broadly consistent with the UPOV 1978 Act, including the breeders' exemption and the farmers' privilege. A critical ambiguity, however, remains unresolved: neither instrument specifies whether the farmers' privilege — the right to retain seed from a protected variety for replanting — applies to transgenic varieties, where such retention directly replicates the proprietary genetic construct. In Canadian patent law, this issue was litigated in Monsanto Canada Inc. v. Schmeiser, 2004 SCC 34, where the Supreme Court of Canada found patent infringement when a farmer deliberately selected and replanted GM canola plants he knew contained Monsanto's patented gene. The case was decided on patent infringement grounds, not plant breeders' rights; but it illustrates how the interaction between patent protection and seed-saving practices generates legal uncertainty that, without statutory clarification, can only be resolved through costly litigation. In Uzbekistan, no such judicial clarification exists, leaving both rights-holders and farmers without a clear legal position.

A further structural problem concerns patent thickets. A single commercially deployable GM variety may require licences covering multiple patented transformation technologies, selectable marker genes, trait-enabling sequences, and field application methods. Resolution No. 535 (2024) provides a methodology for calculating damages in patent infringement proceedings but offers no mechanism — compulsory licensing, patent pools, or fair-reasonable-and-non-discriminatory (FRAND) licensing obligations — for managing this kind of rights accumulation in the agricultural biotechnology context (Contreras, 2019). This gap distinguishes Uzbek law from approaches taken in India, where the Competition Commission of India has, under the Competition Act (2002), investigated and constrained the licensing practices of multinational seed companies to prevent the exploitation of smallholder farmers through excessive royalty demands.

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3.2 Contractual Framework: Licensing, Supply Agreements, and State Support

Licensing contracts are the primary vehicle through which biotechnology intellectual property is commercially exploited. The Civil Code provides general rules on licensing agreements, distinguishing exclusive, non-exclusive, and sub-licences, and permitting royalty structures calibrated to output, sales volume, or lump-sum payment. These rules are functionally adequate for standard intellectual property transactions but fall short for biotechnology licensing, which presents several distinctive challenges.

First, the biological properties of living licensed subject matter — self-replication, phenotypic expression varying with soil chemistry and climate, and susceptibility to gene flow — make standard fitness-for-purpose warranties and quality-guarantee provisions under Civil Code Article 469 difficult to apply in a transparent way. A GM seed variety may perform well under the conditions specified in the regulatory approval but behave differently in micro-climatic variations not anticipated by the licensee. Second, field-of-use restrictions — contractual limits on the geographic area, crop application, or end use of a licensed GM variety — are standard in international biotechnology licensing but are not explicitly addressed in Uzbek contract law, creating uncertainty about their enforceability. Third, there is no Uzbek equivalent of the anti-competitive licensing clause blacklists found in the EU Guidelines on Technology Transfer Agreements (2014), meaning that potentially exploitative licensing terms imposed on domestic agricultural cooperatives have no statutory backstop.

On the public investment side, Resolution No. 18 (January 2024) designates food-sector biotechnology as a priority area for the Industrial Development Fund, and PQ-4899 establishes a 50% co-financing mechanism for pilot biotechnology manufacturing operations under public-private partnership arrangements. These are meaningful commitments. Their effectiveness depends, however, on the availability of a reliable contractual and liability environment for downstream commercialisation — a condition not yet fully met by the existing framework.

3.3 Civil Liability: Patent Infringement, Transgenic Contamination, and Consumer Protection

Civil liability in the green-biotechnology context operates across three distinct domains: infringement of biotechnology patents and plant breeders' rights; unintended ecological harm, principally transgenic gene flow; and regulatory liability for failing to meet consumer information requirements. Each domain presents specific problems under current Uzbek law.

Patent infringement liability was significantly strengthened by Resolution No. 535 (2024), which establishes a graduated schedule of compensatory payments ranging from 20 to 1,000 times the base calculation unit and provides a methodology for computing lost profits from infringement. This is an important procedural advance. However, the Resolution operates within a standard compensation paradigm and does not address the multi-dimensional harm caused by, for example, the unauthorised seed reproduction of a GM variety. Such infringement produces not only economic loss to the rights-holder but also potentially irreversible ecological consequences — including contamination of adjacent non-GM plantings and disruption of local biodiversity — and social consequences through the erosion of traditional seed-saving practices. A damages framework that captures only the foregone royalty income systematically undervalues the total harm and therefore fails to deter infringement adequately. A multi-dimensional damages methodology, drawing on the approach of EU Directive 2004/48/EC on intellectual property enforcement, is needed.

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Transgenic gene flow — the unintended transfer of transgenic sequences to non-GM or organic crops through pollen drift, seed admixture, or volunteer plant populations — represents arguably the most consequential gap in Uzbek biotechnology law. Civil Code Chapter 57 (Articles 985–1004) governs tortious liability under a fault-based standard, requiring the claimant to prove causation, damage, and fault on the part of the defendant. Each element is difficult to establish in transgenic contamination cases: causation requires molecular genetic analysis of the contaminated crop and the putative source population; damage is complicated by the progressive, multi-season nature of contamination and its effects on organic certification status; and attributing fault to a specific GM crop operator is often impossible where multiple such operators are present in the area. Under these conditions, the fault-based tort framework provides wholly inadequate protection to organic farmers whose certification — and the associated price premium — is destroyed by a contamination event they had no means to prevent.

Consumer protection in relation to GMO-derived foods is governed generically by the Law on Consumer Rights Protection, which requires accurate and complete product information. Uzbekistan has not, however, enacted mandatory GMO labelling, leaving it without the informational infrastructure that the EU implemented through Regulation 1830/2003 and that would allow consumers, retailers, and food manufacturers to make informed choices. The absence of a traceability system also creates practical obstacles to monitoring GM crop cultivation areas and enforcing organic certification standards.

3.4 Consolidated Inventory of Normative Gaps

The analysis identifies six categories of normative gap in Uzbekistan's green-biotechnology civil-law framework:

1. No dedicated biotechnology legislation: governance relies on general civil-law rules and sector-specific instruments that, taken together, neither form a coherent system nor provide complete coverage for biotechnology-specific legal relationships.
2. Unresolved conflict between GMO-promotion instruments and the Law on Organic Products: no bridging provision defines the regulatory boundary between the two production systems or allocates liability for cross-boundary contamination.
3. No patentability criteria for precision-breeding technologies: the legal status of gene-edited varieties produced by CRISPR-Cas9 and similar platforms is indeterminate, deterring investment in this fast-growing segment of agricultural biotechnology.
4. Failure to distinguish transgenic varieties from conventionally bred cultivars for liability purposes: this absence prevents development of a differentiated liability regime calibrated to the specific risks of transgenic subject matter.
5. No mandatory GMO labelling or traceability requirements: this gap compromises both consumer informational rights and the enforcement infrastructure of organic certification.
6. Non-implementation of the Budapest Treaty biological material deposit system: Uzbekistan is a contracting party but has not established a recognised depositary authority, which weakens the disclosure function of the patent system for microbiological inventions.

4. DISCUSSION

4.1 The GMO–Organic Conflict: Analysis and Liability Scenarios

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The normative conflict identified in Section 3.3 deserves close doctrinal attention because it is not a mere overlap or ambiguity — it is a direct, categorical contradiction between two instruments of equal statutory rank. Presidential Decree PQ-4899 designates genetic engineering as a state development priority and commits public funds to its commercialisation. The Law on Organic Products (Article 8) categorically prohibits the use of genetic engineering methods, transgenic organisms, and products derived from them in organic production. Neither instrument refers to the other. Because both are of equal rank in the hierarchy of normative acts, no hierarchical rule can resolve the conflict; because they address the same factual situation from opposite directions, no interpretive technique can reconcile them. Resolution requires deliberate legislative intervention.

The practical consequences become clear through a specific liability scenario that will arise with increasing frequency as GM crop areas expand under PQ-4899. An organic farmer, certified under the Law on Organic Products, cultivates a field adjacent to a GM cotton or alfalfa field established with state co-financing. Wind-borne pollen from the GM field pollinates the organic farmer's crop; subsequent laboratory testing detects transgenic sequences above the EU de minimis threshold of 0.9%, triggering loss of organic certification and the associated price premium. The organic farmer seeks compensation.

Under current Uzbek law, three doctrinal routes are available — and all are problematic. An unjust-enrichment claim under Civil Code Article 972 fails because gene flow does not enrich the GM operator: there is no enrichment at the organic farmer's expense. A tortious claim under Civil Code Articles 985–1004 requires proof of fault; as discussed, fault attribution in gene-flow cases is technically difficult and routinely contested in litigation. A claim grounded in Civil Code Article 1032 — which establishes the independence of intellectual property rights from rights in the physical object — provides no cause of action to the contaminated organic farmer. The result is that a legally operating and state-promoted activity (GM crop cultivation) causes documented economic harm to another legally operating activity (organic farming), but the victim has no effective civil remedy. This is a straightforward failure of civil-law design.

Comparative law points toward a practical solution. Austria, Germany, and Switzerland have enacted coexistence legislation providing strict liability or fault-presumption rules for GM-induced organic contamination, accompanied by mandatory insurance and minimum separation-distance requirements between GM and non-GM fields. The EU Commission Recommendation 2003/556/EC on coexistence provides a flexible framework allowing Member States to adapt coexistence rules to local agricultural conditions. Falck-Zepeda, Traxler, and Nelson (2000) show empirically that the welfare effects of GM crop adoption are most equitably distributed when liability rules prevent the externalisation of gene-flow costs onto non-GM producers. These precedents, applied to Uzbekistan's conditions, indicate that a strict-liability rule for transgenic gene-flow damage, combined with mandatory environmental insurance and statutory separation distances, would resolve the normative conflict by establishing clear boundaries and accountability between the two production systems.

4.2 The Case for a Comprehensive Biotechnology Act

Whether a dedicated Biotechnology Act is necessary — or whether the identified gaps can be addressed through targeted amendments to existing statutes — is a question that has been debated in comparative biotechnology law for two decades. Correa (2000) and Drahos (2010) argue for minimal intervention: they hold that general civil-law and intellectual property frameworks, if competently

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applied, can accommodate biotechnology without dedicated legislation, and that technology-specific statutes risk becoming obsolete as the technology advances. Rimmer (2015) and Stasi and Biryukova (2016) argue for dedicated legislation: they contend that biotechnology's distinctive features — self-replication, gene flow, and the direct interface with biodiversity — place it beyond the effective reach of frameworks designed for non-living commercial goods.

Four features of the Uzbek context support the dedicated-legislation position. First, the normative conflict between PQ-4899 and the Law on Organic Products cannot be resolved by interpretation: no canon of statutory construction can reconcile an absolute prohibition with an affirmative promotion mandate. Only a statute with explicit priority rules, or a freestanding coexistence framework, can achieve resolution. Second, the self-replicating nature of GM subject matter generates liability needs — strict liability for gene flow, mandatory insurance, statutory separation distances — that cannot be derived from the Civil Code's general tort provisions, which were designed for static, non-propagating goods. Third, gene-editing technologies require new patentability criteria that cannot be imported by analogy from existing patent law without generating unacceptable uncertainty; a statutory definition distinguishing gene-edited varieties from both classically bred cultivars and fully transgenic organisms is required. Fourth, the Budapest Treaty implementation gap can only be remedied by an enabling statute that designates a competent depositary authority and specifies its functions.

The standard objection against dedicated biotechnology legislation — that it will quickly become technologically obsolete — is answered by the EU experience. Directive 98/44/EC, now more than 25 years old, remains substantively applicable to gene-editing technologies through interpretive development, demonstrating that a principled framework statute does not inevitably fall behind technological change. A well-drafted Biotechnology Act for Uzbekistan would need to define biotechnology broadly, establish regulatory principles and institutional responsibilities, and delegate technical detail to subordinate legislation that can be updated more easily as the technology evolves.

4.3 Comparative Lessons

Each of the three jurisdictions studied offers a specific lesson for Uzbekistan. The EU model demonstrates that coherent multi-instrument regulation — where the biotechnology patentability directive, the GMO authorisation regulation, and the labelling regulation form an explicitly cross-referenced and internally consistent system — produces far greater legal certainty than piecemeal legislation. For Uzbekistan, drafting a Biotechnology Act must therefore be accompanied by coordinated amendments to the Law on Organic Products, the Law on Inventions, the consumer-protection statute, and the Civil Code's tort provisions, so that the resulting system is free of the conflicts that currently characterise it.

The U.S. model shows the importance of judicial doctrine as a complement to statute: Diamond v. Chakrabarty (1980) and Myriad Genetics (2013) shaped the global biotechnology patent landscape more profoundly than any piece of legislation. Uzbekistan lacks a doctrine of binding judicial precedent that would allow a single court ruling to provide sector-wide guidance. This institutional limitation reinforces the case for statutory specificity: where courts cannot fill doctrinal gaps through precedent-setting decisions, the legislature must provide the detail that common-law courts supply through case development.

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The Indian model, most directly comparable to Uzbekistan's agricultural structure, illustrates both the welfare benefits of GM crop adoption and the governance risks of weak regulation. Qaim's (2020) analysis of Bt cotton in India documents significant yield gains and insecticide reductions among adopting smallholders, alongside higher net incomes. However, without effective competition oversight, multinational seed companies were able to use their market position to impose excessive royalty terms — a problem addressed only after the Competition Commission of India investigated the matter under the Competition Act (2002). Uzbekistan, with a similar smallholder agricultural structure and comparable seed-market vulnerabilities, must design its biotechnology law regime with these distributional risks explicitly in mind.

4.4 Reform Proposals

Four interconnected reforms are proposed. They are mutually reinforcing: implementing any one in isolation will produce only partial improvement, while implementing all four together would establish a coherent and investment-ready biotechnology law regime.

Reform 1 — Enactment of a Comprehensive Biotechnology Act. The Act should: (a) define 'biotechnology product,' 'genetically modified organism,' 'gene-edited variety,' and 'precision breeding' in terms broad enough to accommodate future technological developments; (b) establish a central competent authority for biotechnology product authorisation, post-market monitoring, and liability adjudication, with clearly defined relationships to the Ministry of Agriculture, the Intellectual Property Agency, and the State Environmental Protection Committee; (c) codify patentability criteria for gene-editing technologies that distinguish gene-edited varieties from both conventionally bred cultivars and fully transgenic organisms; (d) establish a strict-liability regime for transgenic gene flow, accompanied by mandatory environmental insurance; and (e) specify coexistence rules, including statutory separation distances, that allow GM and organic production to operate simultaneously without either sector foreclosing the other.

Reform 2 — Resolution of the GMO–Organic Normative Conflict. The Law on Organic Products should be amended to add a coexistence provision stating that the prohibition on GMO use in organic production does not prohibit the cultivation of GM crops on adjacent non-organic land, but activates mandatory coexistence protocols — separation distances, buffer zones, and advance notification requirements — enforced through the Biotechnology Act's liability regime. This amendment would preserve the substantive integrity of the organic prohibition while removing the regulatory incoherence that leaves both GM operators and organic farmers without clear legal guidance.

Reform 3 — Mandatory GMO Labelling and Traceability. Consumer-protection and food-labelling legislation should be amended to require: (a) mandatory labelling of food products containing GM ingredients above a specified de minimis threshold, consistent with EU Regulation 1829/2003; (b) chain-of-custody traceability documentation for all authorised GM crop varieties from seed production through primary processing; and (c) a public registry of authorised GM crop varieties, accessible to farmers, processors, retailers, and consumers.

Reform 4 — Mandatory Environmental Insurance for Biotechnology Operators. Consistent with the 'polluter pays' principle in EU Directive 2004/35/EC, all operators cultivating authorised GM varieties should be required to maintain environmental liability insurance covering third-party claims arising from transgenic gene flow. An industry-wide guarantee fund, capitalised by a mandatory levy on GM seed sales, should serve as a backstop for claims exceeding individual policy limits.

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5. CONCLUSION

This article has conducted the first systematic civil-law analysis of green biotechnology governance in Uzbekistan. Four main conclusions emerge.

First, Uzbekistan's existing civil-law framework provides a formal but insufficient foundation for biotechnology governance. The Civil Code, the Law on Selection Achievements, and the Law on Inventions establish a recognisable rights architecture, but it was designed for non-living commercial subject matter and cannot, without significant reform, accommodate the legal challenges posed by self-replicating organisms, gene-editing technologies, and cross-boundary gene flow.

Second, the direct normative conflict between Presidential Decree PQ-4899 and the Law on Organic Products is the most urgent problem identified. It cannot be resolved through statutory interpretation, and it will generate a growing number of irresolvable civil disputes as GM crop areas expand. A dedicated coexistence framework, combined with a strict-liability regime for transgenic gene-flow damage and mandatory environmental insurance, is the only legally coherent solution.

Third, the comparative analysis of laws of developed countries shows that effective biotechnology governance requires, at minimum, three things: internally consistent multi-instrument regulation; a clear and predictable allocation of liability for cross-sector ecological harm; and institutional capacity for technical authorisation and post-market monitoring. Uzbekistan currently has the institutional foundations but lacks the legislative architecture that would connect them into a functioning system.

Fourth, a stand-alone Biotechnology Act is both legally necessary and institutionally feasible for Uzbekistan. The normative conflict, the gene-editing patentability vacuum, the transgenic contamination liability gap, and the Budapest Treaty implementation deficit together exceed what targeted amendments to existing statutes can address. A framework Act with broad definitions and flexible subordinate legislation can provide the needed coherence without becoming technologically obsolete.

Two limitations should be noted. First, the absence of published data on biotechnology-related civil disputes before Uzbek courts prevents empirical measurement of the real-world consequences of the identified gaps. A systematic review of commercial court records would be a valuable complement to this doctrinal analysis. Second, the article focuses on civil law and does not address the administrative-law and criminal-law dimensions of biotechnology enforcement. Three directions for subsequent research are indicated: an empirical study of Uzbek court practice in intellectual property disputes involving biological material; a technical feasibility study for Budapest Treaty implementation at the national level; and a study of Nagoya Protocol integration into Uzbek law, which would address the access-and-benefit-sharing dimension of green biotechnology that is the necessary counterpart to the intellectual property protections analysed here.

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