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ARTICLE

Designing Robust Ukrainian GMO laws for Post-War Recovery: Facilitation of International Trade and the Bioeconomy

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Abstract

This article explores the development of Ukraine's legal framework on genetically modified organisms (GMOs) in the context of European Union integration and post-war recovery. It analyses key regulatory challenges, including outdated biosafety laws, insufficient enforcement mechanisms and gaps in GMO detection and co-existence frameworks. Focus is placed on the 2023 Ukrainian GMO Law, which aligns with EU standards but is subject to delayed implementation. The article examines the legal tension between the EU's interpretation of the precautionary principle in GMO law and Ukraine's WTO obligations, highlighting the need for balanced, science-based regulation. In light of wartime agricultural disruption, the article argues that a robust, science-based GMO regulatory regime is essential for ensuring biosafety, facilitating market access and enabling the development of a resilient bioeconomy. GMO reform is thus positioned as a strategic necessity for Ukraine's legal modernisation, economic recovery and long-term integration into the European and global systems.

Keywords: agriculture; EU enlargement; food biotechnology; Genetically modified organisms; land use

1. Introduction

Ukraine has been described as a "buffer," constantly oscillating between Russia and the West.[1] As a result, domestic laws and regulations reflect the influence of both blocs. In this situation, and in light of the war initiated by Russia, Ukraine made a conscious choice to enter the European Union (EU) as a candidate country.[2] This is of particular importance for the area of agri-food, as Ukraine remains the third-largest supplier of agri-food products to the EU.[3] Facilitating trade by aligning Ukraine's agri-food laws in such a way that it aligns with international and European standards is hence an essential prerequisite of Ukraine's future place in the world.

[1] Graham T, Menon R and Snyder J, "Ukraine Between Russia and the West" (2017) 34(1) *World Policy Journal* 107.

[2] European Commission, *Ukraine's path towards EU accession* (2024) <https://commission.europa.eu/topics/eu-solidarity-ukraine/ukraines-path-towards-eu-accession_en> accessed 22 April 2025.

[3] European Commission, *EU trade relations with Ukraine* (2024) <https://policy.trade.ec.europa.eu/eu-trade-relationships-country-and-region/countries-and-regions/ukraine_en> accessed 22 April 2025.

The effective detection and identification of Genetically Modified Organisms (GMOs) are a major factor in global agri-food trade,[4] in terms of liability for food business operators (FBOs), and the EU is no exception in this.[5] Segregation between GMO and non-GMO in international trade are of major importance for the organic sector.[6]

Under EU law, GMO is defined in Article 2(2) of Directive 2001/18/EC as "an organism, with the exception of human beings, in which the genetic material has been altered in a way that does not occur naturally by mating and/or natural recombination."[7] Similarly, Ukrainian legislation defines GMOs in Article 1 of the Law of Ukraine "On the State System of Biosafety in Creating, Testing, Transportation and Use of Genetically Modified Organisms" (the 2007 GMO Law) as organisms "in which the genetic material has been changed using genetic engineering techniques."[8] These legal definitions form the basis for further extensive regulatory oversight, particularly regarding authorisation procedures, labelling obligations, risk analysis and liability in cases of unauthorised presence or mislabelling.

The development and use of GMOs have sparked significant debate at both scientific and policy levels. Its benefits for both food producers and consumers are accompanied by public concern regarding potential biomedical, environmental and ethical risks.[9] In the literature, emphasis is placed on GMO's potential to enhance crop yields, increase resistance to pests and diseases, reduce the need for chemical inputs, and improve food security, particularly in regions affected by climate change or food shortages.[10,11] At the same time, voices in the literature[12,13] are concerned about long-term environmental impact, potential risks to human health, socio-economic implications for small-scale farmers, and ethical questions about genetic manipulation. These diverging views have led to diverse regulatory approaches worldwide, ranging from permissive regimes to strict precautionary frameworks, such as those found in the EU and Ukraine.

In this context, the effective detection, identification and segregation of GMOs from conventional and organic products is not merely a technical issue but a legal requirement.

[4] Buiatti M, Christou P and Pastore G, "The application of GMOs in agriculture and in food production for a better nutrition: two different scientific points of view" (2013) 8(3) *Genes & Nutrition* 255.

[5] Hubar-Kołodziejczyk A and Purnhagen KP, "Regulatory Requirements for the Identification, Detection and Quantification of Gene-Edited Products in Light of the (R)evolution of New Genomic Techniques: State of the Art and Prospects for Changes" (2025) *European Journal of Risk Regulation* 1.

[6] Moschini GC, Bulut H and Cembalo L, "On the Segregation of Genetically Modified, Conventional, and Organic Products in European Agriculture: A Multi-market Equilibrium Analysis" (2005) 56(3) *Journal of Agricultural Economics* 347.

[7] Directive 2001/18/EC of the European Parliament and of the Council of 12 March 2001 on the deliberate release into the environment of genetically modified organisms and repealing Council Directive 90/220/EEC – Commission Declaration. [2001] OJ L106/1.

[8] Law of Ukraine "On the State System of Biosafety in the Creation, Testing, Transportation, and Use of Genetically Modified Organisms" No 1103-V (31 May 2007) <https://zakon.rada.gov.ua/laws/show/1103-16#Text> accessed 22 April 2025.

[9] Zhang C, Wohlhueter R and Zhang H, "Genetically modified foods: A critical review of their promise and problems" (2016) 5(3) *Food Science and Human Wellness* 116.

[10] Oliver MJ, "Why we need GMO crops in agriculture" (2014) 111(6) *Missouri Medicine* 492.

[11] Abdul Aziz M, Brini F, Rouached H and Masmoudi K, "Genetically engineered crops for sustainably enhanced food production systems" (2022) 13 *Frontiers in Plant Science* 1027828.

[12] Knight AJ, "Perceptions, knowledge and ethical concerns with GM foods and the GM process" (2009) 18 (2) *Public Understanding of Science* 177.

[13] Green NL, "An analysis of some ethical argumentation about genetically modified food" (2023) 15 (1) *Argument & Computation* 1.

In the EU, Regulations (EC) No 1829/2003[14] and (EC) No 1830/2003[15] establish strict labelling and traceability requirements, obliging FBOs to ensure that GMO-derived products can be identified at every stage of the supply chain. The requirement for segregation is particularly critical in the organic sector, where the presence of GMOs is principally prohibited under Regulation (EU) 2018/848.[16]

In this respect, maintaining robust segregation mechanism is not so much a matter of risk mitigation but rather critical for preserving consumer choice, protecting market integrity, and managing legal risks. In international trade, discrepancies in national GMO regulations can lead to disputes, delays at border controls, and potential breaches of contractual obligations. The ability to demonstrate due diligence in this regard is increasingly seen as a key component of regulatory risk management for agri-food operators across both the EU and Ukraine.

If FBOs from Ukraine would like to continue being recognised as reliable traders of agri-food (and with a view of Ukraine becoming a Member of the EU), Ukraine needs to make certain that its laws and legal practice are able to deliver on these requirements. At the same time, food technology innovations, which often involve a certain aspect of GMOs,[17] may play a decisive role in post-war recovery of Ukraine and contribute to the development of the global bioeconomy. This requires *inter alia* a robust and trustworthy GMO legal framework, which is internationally competitive. A comprehensive study of this issue to develop effective legal norms ensuring a proper regulatory mechanism for implementation is hence warranted.

Such a study is particularly challenging as Ukraine is in a special position as a post-Soviet society and as a country currently at war. As a post-Soviet society, it is defined by a rather fragile consolidation of its political system. This can be illustrated by the fact that in practice, decisions have been made not as much by institutions and structures foreseen by the law but by major figures and pressure groups in the economic and political spheres.[18,19] As a country currently at war, a consistent application of the law or any other authoritarian behaviour is rather difficult, as these can change at any time.

Investigating challenges for harmonising agri-food trade laws to meet international and EU standards must take this reality into account. Any investigation such as this one, may not investigate the letter of the law only, but needs to expand its study to the law in action[20,21] in Ukraine. Applying this law in action research is particularly difficult in war-torn countries like Ukraine.

Notwithstanding the severe limitations imposed by the ongoing war, several of the challenges associated with harmonising Ukraine's GMO-related agri-food legislation with

[14] Regulation (EC) No 1829/2003 of the European Parliament and of the Council of 22 September 2003 on genetically modified food and feed. [2003] OJ L268/1.

[15] Regulation (EC) No 1830/2003 of the European Parliament and of the Council of 22 September 2003 concerning the traceability and labelling of genetically modified organisms and the traceability of food and feed products produced from genetically modified organisms and amending Directive 2001/18/EC. [2003] OJ L268/24.

[16] Regulation (EU) 2018/848 of the European Parliament and of the Council of 30 May 2018 on organic production and labelling of organic products and repealing Council Regulation (EC) No 834/2007. [2018] OJ L150/1.

[17] Ronchetti F, Springer L and Purnhagen K, "The Regulatory Landscape in the EU for Diary Products Derived from Precision Fermentation – An Analysis on the Example of Cheese" (Springer 2024).

[18] O'Donnell G and Schmitter P C, "Transition from Authoritarian Rule: Tentative Conclusions about Uncertain Democracies" (Baltimore 1996).

[19] Tomenko M, "Real and Ostensible Conflicts in Power Structures" in The Demons of Peace and the Gods of War (Political Thought, Kyiv 1997).

[20] Pound R, "Law in Books and Law in Action" (1919) 12 *American Law Review*.

[21] Halperin JL, "Law in Books and Law in Action: The Problem of Legal Change" (2011) *Maine Law Review* 45.

EU and international standards are being addressed. New EU-oriented law on GMOs[22] has been adopted in 2023. It includes a three-year transitional period and will not enter into force until September 2026. Meanwhile, during this interim phase, Ukraine remains bound by a legal framework that is outdated and does not reflect the latest scientific developments, realities of enforcement, and compliance with international trade requirements. This legal dissonance creates regulatory uncertainty for FBOs and weakens the credibility of Ukraine's compliance with EU standards. Nevertheless, wartime conditions (though exceptionally challenging) do not preclude all progress. Even under conditions of institutional strain, disruption of administrative functions, and shifting legal priorities due to martial law, Ukraine can implement targeted approximation measures. These may include the adoption of secondary legislation, technical protocols aligned with the EU acquis, issuance of interpretative guidance by competent authorities, and reinforcement of GMO detection, traceability, and certification capacities. International technical assistance and donor-supported capacity-building programs can help compensate for institutional weaknesses and ensure continuity. Such a phased and pragmatic approach does not depend on full legislative reform but contributes meaningfully to regulatory convergence. It also demonstrates Ukraine's commitment to alignment with EU legal standards, even amid wartime disruption, and lays the necessary groundwork for deeper legal integration in the post-war recovery phase.

Considering all the above, we begin by examining the historic development and the current state of Ukrainian legislation concerning GMOs and the mechanisms in place for its enforcement. We then highlight the critical role Ukraine plays in the global food trade (particularly with the EU) and demonstrate why the establishment of a comprehensive and enforceable GMO regulatory framework is a fundamental prerequisite for continued integration into international markets, in particular with the World Trade Organization (WTO). Special emphasis is placed on the importance of effective detection and identification systems for GMO products, which are essential for the proper segregation of organic, conventional and genetically modified (GM) agricultural products and foods. Subsequently, we assess the potential contribution of usage of GM crops as an essential part of the bioeconomy to Ukraine's post-war economic recovery, underlining the necessity of a coherent and reliable legal framework for GMOs to support innovation and market access. The analysis concludes with a summary of key findings and a call for further improvement of Ukraine's GMO regulatory regime as an essential component of the country's broader post-war reconstruction and economic development strategy.

2. Ukraine's laws on GMO between trade, accession to the EU and war recovery

2.1. Historical aspects of legal regulation of GMOs in Ukraine

To determine the necessary measures for aligning Ukrainian legislation with that of the EU in the field of GMOs, it is essential to analyse both the historical development of Ukraine's legal framework governing GMOs and the current regulatory landscape in this area.

The rapid development of biotechnology and genetic engineering has fundamentally transformed modern agriculture and food production. Agriculture is the first sector that invested heavily in the use of genetic modifications.[23] As mentioned, GMOs have become a subject of global debate, raising questions about their risks (safety, environmental impact)

[22] Law of Ukraine "On State Regulation of Genetic Engineering Activities and State Control over the Placement of Genetically Modified Organisms and Products on the Market" No 3339-IX (23 August 2023) <https://zakon.rada.gov.ua/laws/show/3339-20?lang=en#Text> accessed 22 April 2025.

[23] Raman R, "The impact of Genetically Modified (GM) crops in modern agriculture: A review," (2017) 8(4) *GM Crops & Food* 195.

and benefits and their legal regulation at national,[24,25] at supranational[26,27] and at international level.[28] Scholarly discussions focus on balancing innovation and biosafety, aligning regulatory frameworks with evolving scientific knowledge and addressing public concerns related to health and environmental risks. In Ukraine, an agricultural powerhouse with a significant role in the global grain and oilseed markets, the issue of GMO regulation is particularly relevant.

One may distinguish two principal conceptual approaches to the legal regulation of GMOs.[29] The first approach treats the safety of food products derived through biotechnology (primarily involving GMOs) as an element of the broader notion of "food safety." This model is grounded in the doctrinal principle of *substantial equivalence*[30] and is extensively applied in the United States, where GM products are considered equivalent to their conventional counterparts.[31] The second approach, predominantly employed by the EU, is founded on the *precautionary principle.*[32] Under this principle, food products derived from GMOs may be subject to a distinct legal regime requiring pre-market authorisation, comprehensive risk assessment, labelling, monitoring and public transparency.

Importantly, the substantial equivalence model relies on scientific comparison between a GM product and its non-GM comparator, and authorisation is generally not required unless a specific safety concern is demonstrated. The EU precautionary model, by contrast, reverses this logic: no GMO may enter the market without a prior, science-based authorisation grounded in risk analysis. This divergence is critical for understanding the conceptual basis of Ukrainian reforms.

At present, Ukraine seeks to follow the latter approach to harmonise its regulatory framework with EU standards, adopting a cautious policy framework in line with public sensitivities concerning the environment. However, earlier legislation lacked coherence, precision and institutional enforcement mechanisms, falling short of effectively implementing a precautionary model in practice. Before the 2023 reform, Ukraine operated under a hybrid system: the 2007 GMO Law formally introduced the requirement of the state registration of GMOs, but it did not create the scientific, procedural, or institutional mechanisms needed to perform a genuine EU-style authorisation process. As a result, the system existed in law but not in practice.

In recent years and particularly following its designation as an EU candidate country, Ukraine has committed to harmonising its GMO regulation with the EU approach. This is evident in the adoption of the 2023 Law "On the State Regulation of Genetic Engineering Activities and State Control over the Circulation of Genetically Modified Organisms and Products," which mirrors key features of the EU system, including mandatory registration

[24] Kovalenko T, "Pravovi aspekty biologichnoyi bezpeky Ukrayiny" (2015) 4(20) *Publichne pravo* 17.

[25] Hryhorieva K, "GMO legislation of Ukraine: evolution, problems and prospects" (2024) 74(3) *Economics and Law* 16.

[26] Eriksson D, Custers R, Edvardsson Björnberg K, Hansson SO, Purnhagen K, Qaim M, Romeis J, Schiemann J, Schleissing S, Tosun J and Visser RGF, "Options to Reform the European Union Legislation on GMOs: Scope and Definitions" (2020) 38(2) *Trends in Biotechnology* 231.

[27] Zimny T, Sowa S, Tyczewska A and Twardowski T, "Certain new plant breeding techniques and their marketability in the context of EU GMO legislation - recent developments" (2019) 51 *New Biotechnology* 49.

[28] Strauss DM, "The International Regulation of Genetically Modified Organisms: Importing Caution Into the U.S. Food Supply" (2006) 61(2) *Food and Drug Law Journal* 167.

[29] Grossman MR, "Genetic Technology and Food Security" (2014) 62 *American Journal of Comparative Law* 273.

[30] Piddubnyi OYu, "Pravovi zasadu dosyagnennya ekolohichnoyi bezpeky u sferi biotekhnolohiy" in Kharitonova TYe and Karakash II (eds), *Aktualni problemy pravovoho rehulyuvannya agrarnykh, zemelnykh, ekolohichnykh ta pryrodoresursnykh vidnosyn v Ukrayini* (Helvetika Publishing House 2018).

[31] Giraldo PA, Shinozuka H, Spangenberg GC, Cogan NOI and Smith KF, "Safety Assessment of Genetically Modified Feed: Is There Any Difference from Food?" (2019) 10 *Frontiers in Plant Science* 1592.

[32] Guida A, "The precautionary principle and genetically modified organisms: A bone of contention between European institutions and member states" (2021) 8(1) *Journal of Law and the Biosciences* lsab012.

(functionally equivalent to EU authorisation), risk assessment procedures, public disclosure obligations and labelling requirements. While the Law will only enter into force in 2026, its structure demonstrates a clear policy shift toward alignment with the EU's precautionary framework. Nonetheless, significant challenges persist in achieving full alignment with EU requirements, particularly in addressing existing deficiencies within the national system.

For an extended period, Ukrainian authorities did not establish a systematic regulatory framework to ensure the safety of food products containing GMOs and/or genetically modified microorganisms. Following its Declaration of Independence in 1991, Ukraine was confronted with profound political, economic and institutional challenges. The 1990s represented a pivotal phase in the nation's development. However, the regulation of GMOs was not deemed a legislative or political priority.

During this time, state institutions were primarily preoccupied with fundamental issues of governance, including the implementation of privatisation processes, economic restructuring and currency stabilisation. In this context, the regulation of emerging biotechnologies, such as GMOs, which remained relatively novel in global markets, did not attract significant governmental attention or legislative action.

In the early 1990s, GM crops were only beginning to be commercialised globally. At the time, the global discourse surrounding the safety and regulation of GMOs was still in its formative stages, and Ukraine was not subject to significant external pressure to develop regulatory measures in this domain. During the Soviet era, biotechnology research in Ukraine remained comparatively underdeveloped, especially in contrast to strategically prioritised sectors such as military technology, metallurgy and nuclear energy.

In the 1990s, Ukrainian scientific institutions were generally ill-equipped (both in terms of technical capacity and financial resources) to undertake comprehensive risk assessments related to GMOs. Moreover, the absence of domestic biotechnology enterprises engaged in the commercialisation of GM seeds meant there was no immediate or perceived regulatory imperative to address GMO-related issues within the national legal framework.

With the large-scale cultivation of GM soybean, maize and cotton gaining momentum globally in the late 1990s and early 2000s, Ukraine was compelled to respond to the evolving international landscape, particularly in light of its status as a major agricultural producer.

One of Ukraine's initial steps toward establishing a regulatory approach to GMOs was the development of a legal framework in this sphere. In 2002, Ukraine acceded to the Cartagena Protocol on Biosafety (adopted on 29 January 2000, in Montreal),[33] thereby committing to the international standards governing the safe transboundary movement, handling and use of GMOs.

Article 7 of the Law of Ukraine "On the fundamentals of National Security of Ukraine" (19 June 2003)[34] highlighted an alarming depletion of biodiversity (genes and species) in the plant world, and linked this to the uncontrolled spread of GMOs and the increasing threat of genetic contamination, which allegedly followed from the inclusion of unregulated GMO imports and their harmful genetic effects on living organisms as ecological threats to Ukraine's national interests and security.

On 22 September 2004, the Cabinet of Ministers of Ukraine adopted a policy document entitled the Concept for the National Biodiversity Conservation Program for 2005–2025,[35]

[33] Cartagena Protocol on Biosafety to the Convention on Biological Diversity (adopted 29 January 2000, entered into force 11 September 2003) <https://zakon3.rada.gov.ua/laws/show/995_935/page> accessed 22 April 2025.

[34] Law of Ukraine "On the fundamentals of National Security of Ukraine" No 964-IV (June 19, 2003) <https://zakon.rada.gov.ua/laws/show/964-15#Text> accessed 22 April 2025.

[35] Cabinet of Ministers of Ukraine, "*Concept of the National Programme for the Conservation of Biodiversity for 2005–2025*," Resolution No 675-r (22 September 2004) <https://zakon.rada.gov.ua/laws/show/675-2004-p#Text> accessed 22 April 2025.

which set forth the foundational principles for biodiversity protection over a two-decade period. Acknowledging the risks associated with the uncontrolled spread of GMOs, the programme identified Ukraine's biodiversity as being in a critical state and in need of urgent intervention. Despite these intentions, the first phase of the program (2005–2010), which envisaged legislative reforms to harmonise Ukraine's legal framework with international standards, was never fully implemented.

The regulatory landscape for GMOs in Ukraine was further complicated by commitments undertaken in the context of Ukraine's accession to the WTO in 2006. As part of a bilateral agreement with the United States, Ukraine pledged to liberalise market access for GMO products. In fulfilment of its WTO obligations, the Verkhovna Rada of Ukraine adopted a package of eleven legislative acts on 31 May 2007, including the 2007 GMO Law.[36] This Law was the first attempt of Ukraine to create a unified biosafety framework. Substantively, it introduced:

(1) mandatory state registration of GMOs and GMO-derived products before their use, import, or placement on the market. Specifically, the Law required registration of:
   - agricultural plant varieties and animal breeds created using GMOs;
   - plant protection products obtained using GMOs;
   - GMO sources of food products, as well as foodstuffs, cosmetics and medicinal products that contain GMOs or are produced using GMOs;
   - GMO sources of feed, as well as feed additives and veterinary preparations that contain GMOs or are produced using GMOs.
(2) a formal distinction between GMOs used in closed systems (laboratories) and open systems (cultivation).
(3) basic requirements for risk assessment, though without specifying methodologies or institutional responsibilities.
(4) a multi-agency oversight model, assigning roles to several ministries, in particular Ministry of Education and Science of Ukraine, Ministry of Health of Ukraine, Ministry of Agro-Industrial Complex.
(5) general biosafety principles, including the need to protect human health and the environment, public availability of information about potential risks from the use of GMOs.

However, the Law did not establish the scientific procedures, institutional bodies, or detailed authorisation pathways required to implement these principles. It therefore created a nominal registration system without operational capacity.

The 2007 GMO Law also did not adopt the substantial equivalence model. Instead, it incorporated precautionary language but without instruments that the EU precautionary system requires (e.g., EFSA-style scientific opinions, centralised decision-making, monitoring, public consultation). Thus, Ukrainian early framework resembled an "empty shell" of a precautionary model: precaution in theory, but not in regulatory practice. The lack of an effective GMO legal framework materialised when the country opened its borders to GMO imports by ratifying the WTO Accession Protocol on 10 April 2008.[37]

Until 2009 (even despite adoption of the Law in 2007) GMO-related activities in Ukraine remained largely unregulated and uncontrolled. Recognising Ukraine's EU integration goals, the Cabinet of Ministers adopted the Regulation on GMO Labelling of Food

[36] Law of Ukraine "On the State System of Biosafety in the Creation, Testing, Transportation, and Use of Genetically Modified Organisms" No 1103-V (31 May 2007) <https://zakon.rada.gov.ua/laws/show/1103-16#Text> accessed 22 April 2025.

[37] Law of Ukraine "On Ratification of the Protocol on the Accession of Ukraine to the World Trade Organization" No 250-VI (10 April 2008) <https://zakon.rada.gov.ua/laws/show/250-17?lang=en> accessed 22 April 2025.

Products.[38] The initial threshold for mandatory labelling was set at 0.1% GMO content, later adjusted to 0.9%. This measure closely mirrored EU policy and was fully aligned with European regulatory standards in this area.

Further affirmation of the state's commitment to biosafety can be found in the Law of Ukraine "On the Basic Principles (Strategy) of the State Environmental Policy of Ukraine for the Period Until 2030." This strategic document designates biosafety and biosecurity as priority areas of national policy. It underscores the necessity of establishing and maintaining effective biosafety and biosecurity systems, including mechanisms for early detection and rapid response to the spread of particularly hazardous biological agents. The strategy also emphasises the importance of creating a safe environment for public health, preventing the unauthorised and illegal dissemination of GMOs and countering bioterrorism.[39]

Nevertheless, Ukraine's biosafety policy as articulated in this strategic framework remains largely declarative. While it outlines broad policy objectives and areas of concern, it lacks concrete implementation mechanisms, specific timelines and institutional responsibilities necessary for effective enforcement and practical realisation of its goals.

In an effort to address the challenges associated with the legal regulation of GMOs and to establish a comprehensive framework governing the legal and organisational aspects of genetic engineering activities, the Verkhovna Rada of Ukraine adopted the Law of Ukraine "On State Regulation of Genetic Engineering Activities and State Control over the Placement of Genetically Modified Organisms and Products on the Market" (the new GMO Law) on 23 August 2023.[40] This Law aims to enhance national food security by instituting mechanisms for state supervision and control over the use of GMOs and the circulation of GMO-related products. Given its significance, particular attention will be devoted to the analysis of this legislative act in subsequent section.

2.2. *Legal reform of GMO regulation in Ukraine*

The alignment of Ukrainian legislation, including the regulation of GMOs in agriculture, with EU law is a matter of considerable importance, particularly in light of Ukraine's obligations under the 2014 Association Agreement with the EU.[41] Moreover, in 2022, Ukraine advanced its EU integration process by obtaining candidate status for EU membership.[42,43] As a result, legislative reforms in key areas of EU integration have become strategic priorities of Ukraine's state policy and the Plan for Ukraine's Recovery from the Consequences of the War through 2032.[44]

[38] Cabinet of Ministers of Ukraine, "On Approval of the Procedure for Labelling Food Products Containing Genetically Modified Organisms or Produced Using Them and Placed on the Market," Resolution No 468 (13 May 2009) <https://zakon.rada.gov.ua/laws/show/468-2009-%D0%BF?lang=en> accessed 22 April 2025.

[39] Law of Ukraine "On the Basic Principles (Strategy) of the State Environmental Policy of Ukraine for the Period Until 2030" No 2697-VIII (28 February 2019) <https://zakon.rada.gov.ua/laws/show/2697-19#Text> accessed 22 April 2025.

[40] Law of Ukraine "On State Regulation of Genetic Engineering Activities and State Control over the Placement of Genetically Modified Organisms and Products on the Market" No 3339-IX (23 August 2023) <https://zakon.rada.gov.ua/laws/show/3339-20?lang=en#Text> accessed 22 April 2025.

[41] Association Agreement between the European Union and its Member States, of the one part, and Ukraine, of the other part (signed 27 June 2014, entered into force 1 September 2017) [2014] OJ L161/3.

[42] European Commission, *Commission Opinion on Ukraine's Application for Membership of the European Union*, COM(2022) 407 final (17 June 2022) <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022DC0407> accessed 22 April 2025.

[43] See on the legal requirements Kochenov DV and Basheska E, "Ukraine and the EU Enlargement: What Is the Law and Which Is the Way Forward?" (2025) *European Journal of Risk Regulation* 1.

[44] Ministry of Economy of Ukraine, *Plan for the Recovery of Ukraine from the Consequences of the War* (24 March 2023) <https://komprompol.rada.gov.ua/uploads/documents/31278.pdf> accessed 22 April 2025.

At present, the principal legislative act regulating the use of GMOs in Ukraine (including their cultivation within agricultural production) is the 2007 GMO Law. Although initially intended to provide a general framework for the regulation of GMOs, it has since become widely recognised (both by Ukrainian policymakers[45] and legal scholars[46,47]) as inadequate in the context of modern biosafety needs and Ukraine's obligations under the EU–Ukraine Association Agreement.

One of the most critical shortcomings of the 2007 GMO Law is that GMO-related activities in Ukraine remain largely unregulated and uncontrolled, because the Law lacks implementing procedures and institutional mechanisms necessary for its application. Although the Law formally requires state registration of GMOs, no GMO has ever been officially registered in Ukraine. As a result, GMO cultivation occurs outside of legal framework, creating a regulatory blind spot and enabling a shadow market beyond state oversight.

The presence of GM crop cultivation in Ukraine has been confirmed by international assessments. According to the 2022 USDA Biotechnology Report, positive GMO test results were recorded at export facilities for maize, rapeseed and soybeans.[48] Industry sources in Ukraine estimate that 50–65% of soybeans, 10–12% of rapeseed and a small share of maize contained GM events.[49] An investigation by a Romanian NGO in 2018 confirmed the presence of GM soybean plantings in the Ukrainian oblasts of Poltava, Khmelnytskyi, Kyiv, Kirovograd, Zhytomyr and Vinnytsia.[50] If extrapolated nationally, approximately 600,000 hectares of GM soy have been grown in Ukraine. In addition to soybeans, cases of GMOs have also been observed in other crops.[51] Yet no official registration existed. This situation occurred, not because an overly stringent authorisation regime prevented registration, but because the law lacked workable procedures, institutional clarity and the necessary implementing regulations.

Taken together, these findings confirm that current registration system is purely formal: it exists in law but is non-functional. As a result, a country's biosafety policy operates in a legal vacuum, producing a de facto unregulated GMO market. This regulatory void fosters an environment conducive to corruption, undermines effective oversight and hinders lawful participation in international trade. The deficiencies reflect both legislative shortcomings (vague, incomplete provisions) and implementation failures, as regulatory bodies lack coherent mandates and the required subordinate legislation to enforce the Law. In the absence of a transparent, enforceable and operational system for GMO governance, Ukraine's credibility with international trading partners and regulatory bodies is jeopardised.

Beyond registration issues, the institutional structure underpinning GMO regulation in Ukraine is highly fragmented. Regulatory authority is diversified across multiple state agencies, including the Ministry of Health, the Ministry of Environmental Protection and Natural Resources and the Ministry of Agrarian Policy and Food. This dispersion of responsibilities has led to overlapping mandates, conflicting competencies and significant

[45] "Rehulyuvannya sfery HMO v Ukrayini potrebuye osuchasnennya z urakhuvannyam yevropeyskoho dosvidu" (Agroexpert.ua, 20 October 2022) <https://agroexpert.ua/24044-2/> accessed 31 July 2025.

[46] Balasynovych B and Yaroshevska Yu, "HMO: vukluku syohodennya ta dosvid pravovoho rehulyuvannya." (ADF-Ukraine 2010).

[47] Tolkachenko O, "The consumer's right to information about GM products" (2022) 6 *Yuruduchnuy visnuk* 104.

[48] Sobolev D, *"Biotechnology and Other New Production Technologies Annual"* (USDA Foreign Agricultural Service, Report UP2022-0078, 14 November 2022) <https://apps.fas.usda.gov/newgainapi/api/Report/DownloadReportByFileName?fileName=Biotechnology%20and%20Other%20New%20Production%20Technologies%20Annual_Kyiv_Ukraine_UP2022-0078> accessed 21 April 2025.

[49] Ibid.

[50] Agent Green, *REPORT: Genetically engineered Soya in Ukraine, out of control.* (November 2018). <https://www.agentgreen.ro/wp-content/uploads/2018/11/2018_GM_soy_Ukraine_out_of_control.pdf> accessed 30 July 2025.

[51] Slasten R, *Ukraina bez GMO: skol'ko mozhno zakryvat' glaza na mirovye trendy i nashi realii* (Liga.net, 25 October 2021) <https://biz.liga.net/ekonomika/prodovolstvie/opinion/v-ukrainskoy-produktsii-net-gmo-skolko-mojno-zakryvat-glaza-na-ispolzovanie-gm-kultur> accessed 21 April 2025.

inefficiencies in enforcement. In practice, no single authority has emerged as a lead coordinator. This institutional fragmentation further explains why the statutory system for GMO registration functioned this way – no agency possessed a clear mandate, operational procedures, or capacity to implement the authorisation framework.

The 2007 GMO Law also fails to incorporate key features of the EU regulatory framework, including comprehensive risk analysis procedures, public consultation requirements and legally enforceable labelling standards. In contrast to the EU system, which is built on the precautionary principle and guided by the scientific risk assessment processes of the European Food Safety Authority (EFSA) in collaboration with Member State authorities, Ukraine's current legal framework lacks clearly defined procedures and centralised expertise to evaluate the potential risks posed by GMOs to human health and the environment. In the absence of legal registration and oversight mechanisms, regulatory authorities are unable to assess safety or environmental impact of these products, enforce traceability, or ensure compliance with labelling requirements. This not only weakens biosafety protections but also reduces consumer trust, market transparency and Ukraine's ability to align with EU standards, which mandates a rigorous authorisation procedure, centralised oversight and public access to information under regulations such as (EC) No 1829/2003[52] and No 1830/2003.[53]

Further analysis of Ukrainian legal scholarship reveals a series of internal structural flaws within the law itself. First, many provisions are largely descriptive in nature, stating policy goals (such as protecting human health or ensuring biosafety) without specifying concrete mechanisms to achieve them. For example, Article 4 of the Law outlines the principles of state biosafety policy but lacks binding obligations or procedural guidance, leaving implementation dependent on subordinate legislation that remains underdeveloped or absent. Second, legal definitions within the Law are often ambiguous or inconsistent,[54] particularly with respect to core terms such as "GMO product," "biosafety," and "risk assessment," which complicates regulatory interpretation and enforcement. It is also highlighted that there is an absence of risk classification regulations for GMOs.[55]

The impact of these legal deficiencies extends to all relevant stakeholders. Producers face legal uncertainty that discourages compliance and hinders legitimate innovation. Consumers are denied basic rights to information, as labelling and traceability obligations are not enforceable in practice. Regulatory agencies, meanwhile, operate without the legal tools or institutional clarity needed to effectively carry out their mandates. Consequently, the absence of registered GMOs in Ukraine should be understood not as evidence of strict biosafety controls but as proof of a non-functional regulatory system incapable of implementing its own requirements.

Lastly, the system of liability and sanctions under the 2007 GMO Law is highly underdeveloped. References to legal responsibility for violations of GMO regulations are mostly vague, merely stating that violators will be held accountable "in accordance with the law," without defining specific infractions or sanctions. This further diminishes the deterrent effect of the law and contributes to a culture of non-compliance. These deficiencies indicate a systemic misalignment between Ukraine's biosafety framework and the EU regulatory regime. The existing legal framework is insufficient to address the

[52] Regulation (EC) No 1829/2003 of the European Parliament and of the Council of 22 September 2003 on genetically modified food and feed. [2003] OJ L268/1.

[53] Regulation (EC) No 1830/2003 of the European Parliament and of the Council of 22 September 2003 concerning the traceability and labelling of genetically modified organisms and the traceability of food and feed products produced from genetically modified organisms and amending Directive 2001/18/EC. [2003] OJ L268/24.

[54] Yermolenko VM, "Problemy zakonodavchoho rehulyuvannia povodzhennia z henetuchno modyfikivanymy orhanizmamy" (*VI mizhnarodna naukovo-praktychna konferentsiya*) (Lutsk, 29-30 May 2009).

[55] Voloshchenko VV, "Pravove zabezpechennya biolohicnoyi bezpeky pry povodzhenni z GMO" (*Respublikan's'ka Naukovo-Praktychna Konferentsiya)* (Kharkiv, 25-26 November 2010).

complexities of modern genetic engineering and fails to meet the requirements for transparency, risk management and institutional coordination prescribed under EU law.

The problem of "unregistered GMOs" is therefore not the result of stringent or precautionary Ukrainian regime, but of a non-operational one. The 2007 GMO Law mandated registration but provided no functional way to achieve it. Thus, the absence of registered GMOs stems from the design flaws of the statute, amplified by institutional fragmentation and chronic under-implementation.

To address these deficiencies and advance the harmonisation of its national legislation with EU law, Ukraine adopted the new GMO Law. Its adoption raises important questions regarding the future direction of GMO regulation in Ukraine, the anticipated effectiveness of the new legal framework and the legislative and institutional adjustments required for its successful implementation. Addressing these issues will be essential for assessing Ukraine's capacity to comply with international standards and to maintain its competitiveness and credibility in global agri-food trade.

The explanatory note to the new GMO Law stipulates that "as of today, Ukraine's legislation in the field of GMO regulation remains incomplete, lacking a comprehensive and systematic approach to governing this sphere. Deficiencies in legal regulation regarding the handling of GMOs prevent the effective exercise of state control over the circulation of GM products and create preconditions for the illegal use of unregistered GM products."[56]

This Law aims to: a) introduce European mechanisms for state registration of GMOs; b) strengthen state control over GMO management and establish liability for violations in this field; c) enhance the risk assessment system for potential impacts of GMOs on human health and the environment; d) improve GMO product labelling requirements and introduce traceability rules for such products; among other measures. These reforms are expected to have a positive impact on ensuring the quality and safety of food products.

The fundamental legal principles underpinning the regulation of GMOs in Ukraine remain largely consistent with those set forth in the 2007 GMO Law. These include the mandatory state registration of GMOs, the differentiation between closed and open systems of GMO use, multi-institutional oversight and obligatory GMO labelling. However, the newly adopted legislation also introduces several significant innovations in this domain. A central point of clarification is that, although the new GMO Law continues to use the terminology of "state registration," the nature of this registration has fundamentally changed. Under the 2007 GMO Law, "registration" referred merely to the formal inclusion of GMOs and GMO-derived products in a state register, without defined requirements concerning dossier submission, scientific risk assessment, responsible authorities, or decision-making timelines. As it has been stated earlier, no GMOs were ever registered in practice. By contrast, the new GMO Law transforms "registration" into an EU-style authorisation process grounded in risk analysis, scientific evaluation and traceability.

The new GMO Law establishes a comprehensive legal and institutional framework for regulating genetic engineering activities, including a genuine state authorisation regime for placing GMOs and GMO-derived products on the market. It introduces mechanisms for state supervision and control over the use, distribution and circulation of GMOs, and eliminates overlapping functions among regulatory authorities.

It establishes streamlined procedures for the state registration (equivalent to EU authorisation) of GMOs[57] and the issuance of different types of permits (for the import

[56] Verkhovna Rada of Ukraine, *Draft Law on the Circulation of Genetically Modified Organisms in Ukraine*, Reg. No. 5839 (registered 27 August 2021) <https://itd.rada.gov.ua/billInfo/Bills/pubFile/874655> accessed 22 April 2025.

[57] Law of Ukraine "On State Regulation of Genetic Engineering Activities and State Control over the Placement of Genetically Modified Organisms and Products on the Market" No 3339-IX (23 August 2023) <https://zakon.rada.gov.ua/laws/show/3339-20?lang=en#Text> accessed 22 April 2025. Chapter 5.

of GMOs intended for genetic engineering activities of various risk levels in a closed system; for conducting research and testing of GMOs in an open system; for the movement of GMOs or GM products in transit through the customs territory of Ukraine),[58] issues labelling obligations for GMO products,[59] and sets out rules on traceability.[60] Furthermore, this Law explicitly introduces a science-based risk assessment procedure. Applicants must submit a technical dossier, which is evaluated by the newly created state body.[61] Additionally, the new GMO Law brings the existing system for assessing potential risks to human health and the environment more in line with the one of EU GMO laws.[62]

The new GMO Law establishes new administrative offenses. It makes the following violations subject to administrative liability:

(1) violation of biosafety requirements when carrying out genetic engineering activities in a closed system;
(2) violation of rules and requirements for handling GMOs when conducting research and testing in an open system;
(3) violation of requirements for placing on the market GMOs and GM products that are not food or feed;
(4) violation of requirements for placing on the market GMOs and GM products as food or feed.[63]

The new GMO Law further clarifies and refines core definitions, including "genetically modified product,"[64] "genetically modified product as feed,"[65] "genetically modified product as a food product,"[66] "genetically modified source,"[67] and "genetically modified organism."[68] It also introduces new definitions such as "microorganism,"[69] and establishes new regulatory instruments, including the State Register of Permits for Open-System Research[70] and the Register of Entities Engaged in Genetic Engineering Activities.[71]

Particular attention is given to the definition of the requirements for the scientific and methodological centre for GMO testing as well as for laboratories carrying out research (testing) on GMOs.[72] The State Commission for GMO Risk Assessment has been introduced.[73] The new GMO Law provides a separate legal regulation for implementation of genetic engineering activities in closed systems[74] and handling GMOs in open systems.[75] It also establishes a system of control actions of state bodies, including

[58] Ibid Art. 17, 19, 34.
[59] Ibid Art. 26.
[60] Ibid Art. 27.
[61] Ibid Art. 21.
[62] Ibid Art. 15.
[63] Ibid Art. 41.
[64] Ibid paragraph 6 part 1 of Art. 1.
[65] Ibid paragraph 7 part 1 of Art. 1.
[66] Ibid paragraph 8 part 1 of Art. 1.
[67] Ibid paragraph 9 part 1 of Art. 1.
[68] Ibid paragraph 10 part 1 of Art. 1.
[69] Ibid paragraph 21 part 1 of Art. 1.
[70] Ibid paragraph 15 part 1 of Art. 1.
[71] Ibid paragraph 16 part 1 of Art. 1.
[72] Ibid Chapter 8.
[73] Ibid Art. 13.
[74] Ibid, Chapter 3.
[75] Ibid, Chapter 4.

scheduled and unscheduled inspections,[76] as well as prescribes the maintenance in the electronic form of new registers:

(1) the State Register of subjects of Genetic Engineering activities;
(2) the State Register of Permits for conducting research and testing of GMOs in an open system;
(3) the State Register of GMOs.

The information in these registers shall be transparent and publicly accessible.[77] In order to prevent potential negative impacts, the Cabinet of Ministers of Ukraine determines the boundaries of territories where the production (cultivation) of GMOs and GM products is prohibited. Special attention is also paid to the rules for co-existence of GMOs, GM products and products that do not contain GMOs. Such rules are established for each specific type of registered GM plants, animals, fungi, microorganisms, taking into account their biological characteristics.[78]

The new GMO Law provides for a three-year implementation period, during which robust control mechanisms for the GMO sector must be developed, including regulations, criteria, procedures and rules. These include regulatory requirements for entities involved in genetic engineering, procedures for risk assessment of GMO sources and objects, the establishment of open dossiers, processes for public consultations and systems for post-registration monitoring.

These innovations have the potential to generate substantial benefits and strengthen Ukraine's position in the agri-food market. Establishing a functional, EU-compliant legal framework is expected to enhance Ukraine's standing in the EU accession process and facilitate agri-food exports to the EU market. Further clarifying and formalising the applicable registration and authorisation procedures may reduce the prevalence of the shadow market for unregistered GMOs and improve legal oversight of genetic engineering activities. Enhanced transparency, precise legal definitions and enforceable liability provisions are likely not only reinforcing regulatory credibility, but also to attract investment in biotechnology and promote a more stable and predictable business environment. In parallel, a science-based risk assessment process, comprehensive labelling and traceability measures and co-existence regulations would support alignment with EU legal requirements. Overall, the institutional modernisation envisaged under this law aims to strengthen national capacity, foster international cooperation and position Ukraine as a more reliable partner in the global agri-food trade.

While the adoption of the new GMO Law marks a pivotal moment in Ukraine's regulatory evolution, its long-term success will depend on the effectiveness of its implementation in a way that it will work for the requirements of the Ukrainian market.

3. Trade, regulation and integration: Ukraine's position in the global agri-food market

Ukraine has a highly developed agricultural sector that ensures both domestic food supply and strong export-oriented profile. Prior to the Russian invasion, Ukraine ranked among the world's top grain exporters, supplying around three-quarters of its grain harvest to global markets and accounting for 10% of the world's wheat exports, over 14% of global

[76] Ibid, Chapter 9.
[77] Ibid, Art. 20.
[78] Ibid, Art. 29.

maize exports and more than 47% of the world's sunflower oil exports.[79] Ukraine also supplied a substantial share of the UN World Food Programme's grain reserves,[80] underscoring its role as a key contributor to global food security.

The ongoing war in Ukraine has underscored the vulnerability of food supply chains in Europe and worldwide, as well as the fragility of Ukrainian food system in exporting agricultural products and contributing to global food security and food affordability in Europe. Wartime disruptions forced European states to seek alternative suppliers,[81,82] while countries in Africa and the Middle East experienced intensified food insecurity. Although the reopening of several Black Sea ports under the "Grain Deal" temporarily stabilised exports, repeated attacks and blockades have continued to constrain supply.[83]

The EU has played a pivotal role in supporting Ukraine, responding promptly to the outbreak of war by granting substantial trade concessions under the framework of the existing Association Agreement, specifically the Deep and Comprehensive Free Trade Area (DCFTA). Regulation (EU) 2022/870,[84] which entered into force on 30 May 2022, introduced autonomous trade measures in favour of Ukraine.

Between May 2022 and March 2023, the EU's "Solidarity Lanes" initiative[85] enabled the continued export of millions of tons of grain and oilseeds through alternative routes, providing a vital economic lifeline for Ukraine and stabilising global markets.

In a further effort to facilitate Ukrainian agricultural exports to EU Member States, the European Commission, in partnership with V_labs and Rail Cargo Group, launched the Grainlane digital trading platform on 16 June 2022, aimed at streamlining and optimising the export of Ukrainian grain.[86] Despite wartime constraints, Ukraine has maintained a significant presence in global agricultural markets. In 2023, it exported more than 16 million tons of wheat, 26 million tons of maize and nearly 6 million tons of sunflower oil to markets across the world.[87]

The strategic partnership between Ukraine and the EU has proven particularly robust. The EU remained the largest destination for Ukrainian agri-food products, and Ukraine continued to be the EU's third-largest supplier. Key export categories such as

[79] "Agricultural Sector of Ukraine in 2023: Components of Resilience, Challenges, and Prospective Tasks" (National Institute for Strategic Studies, 14 February 2024) <https://niss.gov.ua/doslidzhennya/ekonomika/ahrarnyy-sektor-ukrayiny-u-2023-rotsi-skladovi-stiykosti-problemy-ta> accessed 22 April 2025.

[80] European Council, "Ukrainian grain exports explained" (9 October 2025) <https://www.consilium.europa.eu/en/infographics/ukrainian-grain-exports-explained/> accessed 20 November 2025.

[81] "Supermarkets set limits on sale of cooking oil" (BBC News, 23 April 2022) <https://www.bbc.com/news/business-61193141> accessed 22 April 2025.

[82] Pavlish O, "Yevropeys′ki fermery perekhodyatki fermery perekhodyat′ na HMO-kormy cherez blokadu importu kukurudzy z Ukrayiny" (Ekonomichna pravda, 4 April 2022) <https://www.epravda.com.ua/news/2022/04/4/685208/> accessed 22 April 2025.

[83] "Rosiya oholosyla viynu svitu, blokuyuchy Odes'kyy mors'kyy port – OON" (Agropolit.com, 27 July 2023) <https://agropolit.com/news/24012-rosiya-ogolosila-viynu-svitu-blokuyuchi-odeskiy-morskiy-port-oon?sef=24012-rosiya-ogolosila-viynu-svitu-blokuyuchi-odeskiy-morskiy-port-oon&page=2> accessed 22 April 2025.

[84] Regulation (EU) 2022/870 of 30 May 2022 on Temporary Trade-Liberalisation Measures Supplementing Trade Concessions Applicable to Ukrainian Products under the Association Agreement between the European Union and the European Atomic Energy Community and Their Member States, of the One Part, and Ukraine, of the Other Part [2022] OJ L152/103.

[85] European Commission, "EU–Ukraine Solidarity Lanes" (European Commission, 22 April 2025) <https://transport.ec.europa.eu/ukraine/eu-ukraine-solidarity-lanes_en> accessed 22 April 2025.

[86] Danube Commission, "GrainLane: Digital Solution for Agricultural Trading & Transport" (Danube Commission, 15 June 2022) <https://www.danubecommission.org/dc/en/2022/06/15/grainlane-digital-solution-for-agricultural-trading-transport/> accessed 22 April 2025.

[87] "Threat to Global Food Security" (Ministry of Foreign Affairs of Ukraine, 1 April 2023) <https://mfa.gov.ua/protidiya-agresiyi-rf/zagroza-prodovolchij-bezpeci-svitu> accessed 22 April 2025.

cereals (21.9% of total exports), vegetable oils (9.2%) and oilseeds (8.2%) retained strong market shares within the EU.[88]

Ukrainian agricultural exports are primarily directed toward Poland, Germany, Spain and Italy. Germany, in particular, has recorded a marked increase in grain imports from Ukraine since 2022.[89] Prior to the full-scale invasion, imports of Ukrainian wheat were minimal. By 2023, German imports had risen substantially, reflecting both wartime supply shifts and growing EU reliance on Ukrainian commodities.[90]

In light of the foregoing, the deepening of economic integration and trade cooperation between Ukraine and the EU is essential for mitigating global food security risks, ensuring stable and affordable food prices and strengthening the resilience of the EU's agricultural sector. At the same time, continued access to the EU market (as well as the stability of Ukrainian agricultural export sector during and after the war) depends not only on logistical support but also on the compatibility of Ukrainian agri-food regulations with international and EU standards. Alignment with biosafety, traceability and quality requirements is therefore essential. Moreover, considering continuation of the military actions on its territory and the large-scale contamination of agricultural land due to military operations underscores the importance of adopting modern, land-preserving technologies, including biotechnology solutions such as GM crops, where appropriate and scientifically justified. Against this backdrop, Ukraine's trade performance and future market integration increasingly hinge on the establishment of a coherent and internationally credible regulatory framework governing GMOs.

4. Robust GMO legal framework as prerequisite for international agri-food trade

Ukraine's GMO legislation needs to comply with its broader obligations resulting from international trade law. This concerns the country's obligations under the WTO, particularly the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) and the Agreement on Technical Barriers to Trade (TBT Agreement).

It is often observed that, when it comes to GMO laws, the EU interprets WTO obligations stricter compared to other Members, which is particularly due to the stricter application of the precautionary approach.

This ongoing regulatory tension underscores a fundamental dilemma for Ukraine. As a WTO member, Ukraine is obliged to ensure that any restrictions on the import, production, or marketing of GMOs are grounded in sound scientific evidence and are neither discriminatory nor unnecessarily trade restrictive. At the same time, Ukraine is working to align its legislation with the EU acquis in preparation for accession, including the adoption of the EU's precaution-oriented regulatory approach. The new GMO Law must therefore strike a careful balance: ensuring consistency with the EU framework to facilitate legal harmonisation and market access, while avoiding regulatory measures that could expose Ukraine to WTO dispute settlement proceedings or undermine its credibility as a rules-based trading partner.

Ukraine's legislative decisions in the field of GMOs should be regarded not solely as matters of domestic policy matter or steps toward EU accession, but also as elements of

[88] European Commission, "EU Trade Relations with Ukraine – Facts, Figures and Latest Developments" (4 April 2025) <https://policy.trade.ec.europa.eu/eu-trade-relationships-country-and-region/countries-and-regions/ukraine_en> accessed 22 April 2025.

[89] Koch J, "Ukraine-Getreide: Deutschland importiert immer mehr" (*Wochenblatt*, 30 October 2024) <https://www.wochenblatt-dlv.de/politik/ukraine-getreide-deutschland-importiert-immer-mehr-578615> accessed 22 April 2025.

[90] Ibid.

strategic positioning within the global trading system. As Ukraine undertakes reforms to its GMO regime under wartime conditions and in preparation for post-war reconstruction, ensuring alignment with both EU standards and WTO obligations will be essential to securing long-term access to diversified agri-food markets and avoiding the legal and trade disputes experienced by the EU itself.

The new GMO Law represents a step forward, as it introduces a structured authorisation procedure based on scientific evaluation, establishes risk-assessment institutions, clarifies labelling and traceability rules, and creates national registers needed for effective oversight. However, it should not be viewed as a fundamental reform. Critically, it does not yet provide a fully integrated scientific risk assessment framework nor mechanisms to ensure that regulatory procedures are free from undue delay, which could raise concerns under WTO disciplines if challenged.

Moreover, the law does not fully incorporate key provisions of core EU legal acts such as Directive 2001/18/EC (on the deliberate release of GMOs into the environment) or Regulation (EC) No. 1829/2003[91] (on GM food and feed). As Ukraine continues its reform process under difficult wartime conditions, two critical areas require attention regarding legislative and institutional reform. First, the legal framework governing detection and identification mechanisms remains underdeveloped, limiting the ability of authorities and FBOs to ensure traceability and compliance. Second, the regulation of co-existence between GM, conventional and organic crops lacks coherence and enforceability, raising concerns for domestic producers and international partners alike. The following sections explore these legal gaps in more detail and assess the extent to which they hinder Ukraine's progress toward a harmonised and internationally credible GMO regulatory regime.

4.1. Legal gaps in detection and identification of GMOs

The EU has established one of the most rigorous regulatory frameworks for the food supply chain globally.[92] This applies to the regulation of GMOs, which is characterised, among other elements, by stringent authorisation procedures, mandatory labelling and comprehensive traceability requirements.

These regulatory standards significantly influence the EU's trade relations with third countries, many of which do not impose comparable requirements for the labelling, authorisation, or registration of GMOs.[93] Consequently, the EU's policy framework imposes substantial obligations on exporters, including Ukraine, to ensure that agricultural and food products destined for the European market are thoroughly tested, accurately labelled and free from contamination by unauthorised or unapproved GMOs.

A fundamental component of effective GMO regulation is the capacity to detect, identify and quantify GMOs in food and agricultural products. These three processes constitute the technical foundation of any robust monitoring and enforcement system. They are essential for ensuring the accuracy of labelling, verifying compliance with established GMO content thresholds, and safeguarding organic and conventional supply chains from unintended or unauthorised contamination.

Detection refers to the initial screening process, where testing is performed to determine the presence or absence of any GMO material in each sample. This is typically

[91] Regulation (EC) No 1829/2003 of the European Parliament and of the Council of 22 September 2003 on genetically modified food and feed. [2003] OJ L 268/1.

[92] Schebesta H and Purnhagen K, *EU Food Law* (Oxford University Press 2024).

[93] Hubar-Kołodziejczyk A and Purnhagen KP, "Regulatory Requirements for the Identification, Detection and Quantification of Gene-Edited Products in Light of the (R)evolution of New Genomic Techniques: State of the Art and Prospects for Changes" (2025) *European Journal of Risk Regulation* 1.

done using highly sensitive molecular techniques such as Polymerase Chain Reaction (PCR), which can amplify specific DNA sequences associated with genetic modifications.[94] Screening methods often target common elements in GMO constructs, such as promoter or terminator sequences (e.g., the CaMV 35S promoter or the NOS terminator), which are frequently used in genetic engineering.

Once a GMO has been detected, the next step is identification, which aims to determine exactly which GMO event is present. Identification is crucial for verifying whether the detected GMO is authorised for cultivation, import, or sale, particularly under EU law, where only certain GMOs have been approved and others are banned.

The final stage is quantification, which determines how much GMO content is present in a sample.[95] This is particularly important for compliance with threshold limits. Ukrainian legislation includes provisions for labelling based on GMO content, which means the development of reliable quantification methods is critical for enforcement. Quantitative PCR (qPCR) is commonly used for this purpose, offering accurate measurements of GMO concentration expressed as a percentage of the total DNA. In more advanced settings, digital PCR and next-generation sequencing (NGS) technologies are also being used for higher precision.

As part of its EU accession process, Ukraine is expected to progressively adopt and implement the EU acquis in Chapter 12 (Food Safety, Veterinary and Phytosanitary Policy),[96] which includes the legal and technical conditions required for the free movement of agricultural goods within the EU. This includes ensuring that national testing protocols and laboratory networks are fully aligned with EU methodologies and quality assurance systems. Moreover, Ukraine should demonstrate the ability to segregate GMO, non-GMO and organic products along the entire supply chain – a requirement that hinges on the robustness of detection and identification systems.

In this regard, it should be noticed that Ukraine has already taken initial steps toward regulatory alignment through bilateral agreements and recognition mechanisms. A notable milestone in this trajectory is Council Decision 2003/17/EC,[97] which recognises the equivalence of field inspections and seed certification systems of certain third countries, including Ukraine. Although primarily focused on seed production, the decision serves as an important precedent for mutual recognition and regulatory convergence in the broader field of agri-food safety and biosafety.

Unfortunately, in Ukraine many laboratories lack modern equipment, validated testing protocols, or accreditation to perform GMO testing in accordance with EU standards. The establishment of a national network of certified laboratories, along with training for specialists and the development of a national reference laboratory, is essential to address this gap. Moreover, clear procedural guidelines for sampling, testing and reporting must be developed in line with EU regulations to ensure the credibility and legal defensibility of results.

In the absence of effective detection, identification and quantification systems in Ukraine, the risk of non-compliance with EU import requirements increases. For example, if Ukrainian grain or processed food contains traces of GMOs that are not approved in the

[94] European Network of GMO Laboratories (ENGL), *Overview on the Detection, Interpretation and Reporting on the Presence of Unauthorised Genetically Modified Materials* (EUR 25008 EN, Joint Research Centre, 2011) <https://gmo-crl.jrc.ec.europa.eu/doc/2011-12-12%20ENGL%20UGM%20WG%20Publication.pdf> accessed 22 April 2025.

[95] European Commission, Joint Research Centre, and European Network of GMO Laboratories, *Detection of Food and Feed Plant Products Obtained by Targeted Mutagenesis and Cisgenesis.* (Publications Office 2023) 6.

[96] European Commission, *Ukraine 2024 Report* (Commission Staff Working Document SWD (2024) 699 final, 30 October 2024) <https://enlargement.ec.europa.eu/document/download/1924a044-b30f-48a2-99c1-50edeac14da1_en?filename=Ukraine%20Report%202024.pdf> accessed 22 April 2025.

[97] Council Decision 2003/17/EC of 16 December 2002 on the equivalence of field inspections carried out in third countries on seed-producing crops and on the equivalence of seed produced in third countries [2003] OJ L8/10.

EU (or if the GMO content exceeds labelling thresholds without proper disclosure) shipments may be rejected at the border, recalled from shelves, or face legal challenges. Such incidents not only lead to immediate financial losses but also damage Ukraine's reputation as a reliable trade partner.

According to the Ukrainian Grain Association (UGA) and the Ukrainian Seed Association, allowing the cultivation of GMO grains without effective regulation and control will lead to the uncontrolled spread of GMO crops.[98] This could result in legal repercussions with the EU, delay Ukraine's accession to the EU and have economic consequences, including a potential ban on the import of Ukrainian grain into the EU if GMO grains of unregistered GMO lines are found in the shipment.[99] The *ineffective legal regulation* regarding the handling of GMOs hampers effective enforcement against the circulation of GM products and creates conditions for their illegal use in Ukraine. As a result, this may lead to the loss of market access, causing *overproduction*, loss of foreign exchange earnings and budgetary losses.

Moreover, EU buyers (particularly in the organic and premium food sectors) demand high levels of assurance regarding the GMO status. Robust and credible testing capacity will form a cornerstone of legal harmonisation with the EU and serve as a precondition for deeper economic and political integration. Without internationally recognised certification and testing standards, Ukrainian producers and exporters may find themselves excluded from valuable market segments. Conversely, improving GMO regulation, testing infrastructure and transparency could position Ukraine as a trusted source of GMO-free or clearly labelled agricultural products, opening doors to new contracts and long-term partnerships with European distributors and retailers.

4.2. Gaps of legal regulation of co-existence of genetically modified, conventional and organic crops

Co-existence can be considered as a legal and practical ability of farmers to cultivate GM, conventional and organic crops in proximity without infringing on each other's rights or economic interests. Co-existence regulations make certain that GM, conventional and organic crops can be kept segregated from one another during cultivation, harvest, transport, storage and processing.[100] Co-existence is mentioned in the EU's legal and policy framework on GMOs[101,102] and national laws across Member States.[103,104]

At present, Ukrainian legislation acknowledges the importance of biosafety and introduces mechanisms for the state registration, labelling and monitoring of GMO products. However, it does not yet provide a detailed regulatory basis for the legal

[98] Ivashchenko S, "*HMO v Ukraini yak pereshkoda do shvydkoi intehratsii v YeS*" (*Ekonomichna Pravda*, 15 March 2023) <https://epravda.com.ua/columns/2023/03/15/698034/> accessed 21 April 2025.

[99] Ibid.

[100] Alessandrini M and van Zeben J, "Genetically Modified Organisms: Is the Proof in the Pudding or in the Process?" in L Reins and A Zahar (eds), *Climate Technology and Law in the Anthropocene* (Bristol University Press 2025).

[101] Directive (EU) 2015/412 of the European Parliament and of the Council of 11 March 2015 amending Directive 2001/18/EC.

[102] European Commission, *Commission Recommendation of 13 July 2010 on Guidelines for the Development of National Co-existence Measures to Avoid the Unintended Presence of GMOs in Conventional and Organic Crops* [2010] OJ C200/1.

[103] Hungary, Decree *86/2006. (XII. 23.) FVM rendelet a géntechnológiával módosított, a hagyományos, valamint az ökológiai gazdálkodással termesztett növények egymás mellett folytatott termesztéséről* (2006) <https://gmo.kormany.hu/download/8/f6/50000/86_206_fvm.pdf> accessed 22 April 2025.

[104] Italy, *Decreto Legislativo 8 luglio 2003, n. 224 – Attuazione della direttiva 2001/18/CE concernente l'emissione deliberata nell'ambiente di organismi geneticamente modificati* (Gazzetta Ufficiale, 22 August 2003) <https://www.normattiva.it/uri-res/N2Ls?urn:nir:stato:decreto.legislativo:2003;224> accessed 22 April 2025.

co-existence of different crop types. Unlike many EU Member States, Ukrainian legislation lacks explicit provisions governing isolation distances, buffer zones, temporal separation, post-harvest segregation or liability for contamination.

In the EU, co-existence is governed by a combination of Directive 2001/18/EC on the deliberate release of GMOs into the environment and Regulation (EC) No 1829/2003[105] and 1830/2003[106] on GMO food and feed, labelling and traceability. While these legal acts do not prescribe uniform co-existence rules across the Union, they allow Member States to adopt national measures, based on risk analysis, to prevent the unintended presence of GMOs in other crops. Consequently, many Member States have enacted national co-existence legislation, including detailed obligations regarding spatial and temporal isolation, notification requirements and mechanisms for liability and compensation in cases of economic loss resulting from GMO admixture. Almost all EU countries have implemented rules that hold the GM crop holder liable for failing to implement segregation measures.[107]

In accordance with Article 26a(1a) of Directive 2001/18/EC as from 3 April 2017 Member States in which GMOs are cultivated shall take appropriate measures in border areas of their territory with the aim of avoiding possible cross-border contamination into neighbouring Member States in which the cultivation of those GMOs is prohibited, unless such measures are unnecessary in the light of particular geographical conditions. Such measures have been taken by Czechia, Spain, Slovakia and Romania.[108] Hungary employs the use of minimum compulsory buffer zones, which are established in border regions between Member States that allow GMO cultivation and those that do not.[109] It may also be noted that Ukrainian legislation incorporates the possibility of implementing such regulatory measures. Pursuant to Article 29 of the new GMO Law, the Cabinet of Ministers of Ukraine is authorised to establish territorial boundaries (measured from the state border) within which the production (cultivation) of GMOs and GMO-derived products is prohibited. However, as of yet, these boundaries have not been formally defined or adopted through secondary legislation.

With respect to other aspects of co-existence regulation, it must be noted that Ukrainian legislation remains silent on the legal definition of "co-existence" in the context of GMO and non-GMO agricultural production. Furthermore, the current legal framework lacks binding standards and enforceable obligations to manage the risks associated with gene flow, cross-contamination, or commingling of GM and conventional or organic crops. This legal vacuum creates the potential for conflicts among agricultural producers, particularly in cases where GMO cultivation may jeopardise the certification status of organic farms or compromise export contracts for non-GMO products.

In the absence of statutory provisions concerning isolation distances, buffer zones or post-harvest segregation requirements, the allocation of liability and burden of proof remains undefined. This regulatory ambiguity undermines the practical enforceability of biosafety principles and may erode public and stakeholder confidence in the governance of GMOs.

[105] Regulation (EC) No 1829/2003 of the European Parliament and of the Council of 22 September 2003 on genetically modified food and feed. [2003] OJ L 268/1.

[106] Regulation (EC) No 1830/2003 of the European Parliament and of the Council of 22 September 2003 concerning the traceability and labelling of genetically modified organisms and the traceability of food and feed products produced from genetically modified organisms and amending Directive 2001/18/EC. [2003] OJ L268/24.

[107] Beckmann V, Soregaroli C and Wesseler J, "Coexistence" in David Castle, Peter Phillips and Stuart Smyth (eds), *Handbook on Agriculture, Biotechnology and Development* (Edward Elgar 2014) 372.

[108] European Commission, *Summary of Cross-Border National Measures under Article 26a(1a) of Directive 2001/18/EC* (2023) <https://food.ec.europa.eu/document/download/4f4a9b34-d49a-4dff-be94-ae62612dc17f_en?filename=plant_gmo_auth_nat-measures_summary-cross-border-national-measures.pdf> accessed 22 April 2025.

[109] Sirsi E, "Coexistence: A New Perspective, a New Field" (2016) 8 *Agriculture and Agricultural Science Procedia* 449.

Additionally, Ukraine's legal framework does not provide for a co-existence registry or any notification mechanism (features commonly mandated in EU Member States) whereby GMO producers are required to inform neighbouring farmers and relevant authorities of their planting intentions. The lack of any governance of spatial mapping of GMO cultivation areas to coordinate planting and harvesting between different production systems further complicates management of co-existence.

In view of Ukraine's strategic objective of aligning its agricultural legislation with the *acquis communautaire* under the EU–Ukraine Association Agreement and the DCFTA, the development of a comprehensive legal framework on co-existence is advisable. The concrete policy actions are within Ukraine's discretion. The country may choose among different options such as:

- Definition of co-existence and its objectives in the context of biosafety and agricultural market integrity;
- Binding minimum isolation distances for key crops, based on scientific and agronomic criteria;
- Notification obligations and registries to enable transparent land-use planning;
- Technical standards for post-harvest handling, transport and storage to prevent admixture;
- Liability and compensation provisions for economic losses caused by GMO contamination;
- Mechanisms for monitoring and enforcement, supported by administrative and judicial remedies;
- Post-marketing liability regulation, maybe connected to an insurance solution.

This regulatory approach would be fully consistent with Article 26a of Directive 2001/18/EC, which empowers EU Member States to adopt measures to avoid unintended GMO presence in other products and with broader principles of environmental precaution and consumer protection embedded in EU law.

Such a regulatory choice is crucial for market players as it determines what behaviour is expected from them. A regulatory framework such as this one determines when and how market participants' trust in regulation will be rewarded.[110]

Up to now, the legal regime in Ukraine remains partially harmonised with the EU in the area of GMOs, lacking a key pillar required for the effective and equitable management of agricultural biotechnology. The establishment of clear and enforceable co-existence rules would significantly enhance the coherence of Ukraine's biosafety legislation and promote legal certainty for agricultural producers, improve agricultural trade relations.

Harmonising Ukrainian GMO legislation with *EU law* is not merely a formal obligation under the *Association Agreement*, but a *strategic necessity* for Ukrainian agricultural sector and food trade. Further update and improvement of legislation (combining legislative approximation, institutional strengthening and improved enforcement) will help Ukraine *ensure biosafety, enhance public trust and secure access to high-value EU markets*. Furthermore, as biotechnology evolves, Ukraine must adopt a *flexible and forward-looking legal approach*, balancing innovation, biosafety and public interest in line with international best practices taking into account the necessity of post-war recovery.

[110] Purnhagen K and Wesseler J, "The Principle(s) of Co-existence in the Market for GMOs in Europe: Social, Economic and Legal Avenues" in Nicholas Kalaitzandonakes, Peter WB Phillips, Justus Wesseler and Stuart J Smyth (eds), *The Coexistence of Genetically Modified, Organic and Conventional Foods* (Springer 2016) 71.

5. Robust GMO legal framework as prerequisite for enabling of bioeconomy as part of post-war recovery

The extensive destruction resulted by the Russian invasion of Ukraine has had profound consequences for the country's agricultural sector, particularly in terms of land availability and productivity. Traditionally referred to as the "breadbasket of Europe," Ukraine possesses over 32.7 million hectares of arable land, much of which is composed of rich chernozem (black soil).[111] Moreover, the country holds nearly a third of Europe's black soil reserves and 27% of its arable land.[112] However, ongoing military operations and occupation have severely degraded large masses of this land, compromising both food security and economic recovery.

As of late 2023, the war has impacted a cumulative area of 499,000 hectares of agricultural land,[113] which can be rendered as temporarily or permanently unusable. The analysis by oblasts reveals that the most significant damage occurred in Donetsk oblast, where approximately 149,000 hectares or 30% of the total damaged agricultural area were affected by the war. Following that, Kharkiv oblast experienced damage to approximately 98,000 hectares (19.65%). Kherson and Zaporizhzhia oblasts recorded damages on 90,000 hectares (18.1%) and 68,000 hectares (13.72%) respectively.[114]

Such degradation mainly occurred due to:

- soil contamination with heavy metals, fuel residues and unexploded ordnance;
- physical destruction of irrigation systems, silos and grain storage facilities;
- landmine contamination across thousands of square kilometres, particularly in southern and eastern oblasts;
- occupation of fertile territories, which remains a legal and logistical barrier to farming operations.

These disruptions carry significant legal and policy implications. It may take many years for Ukraine to restore its agricultural lands after the war.[115] The loss of arable land raises urgent questions about the legal duty of the state to facilitate adaptive mechanisms, in particular, growing GM crops as a part of the development of bioeconomy.

The bioeconomy is generally understood as an economic model based on the sustainable production, use and regeneration of biological resources to generate food, materials, energy, and services. It integrates advances in biotechnology, the efficient use of bio-resources across agriculture, forestry and related sectors, and ecological principles supporting circularity and reduced environmental impact. As highlighted in the scientific literature, contemporary bioeconomy frameworks aim not only to drive technological

[111] Albaladejo Román A, "*Ukrainian Agriculture: From Russian Invasion to EU Integration*" (European Parliamentary Research Service, April 2024) <https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2024)760432> accessed 22 April 2025.

[112] Zemel'nyy dovidnyk Ukrayiny 2020 – baza danykh pro zemel'nyy fond Ukrayiny (AgroPolit.com, 2020) <https://agropolit.com/spetsproekty/705-zemelniy-dovidnik-ukrayini–baza-danih-pro-zemelniy-fond-krayini> accessed 22 April 2025.

[113] Kussul N, Lavreniuk M, Shelestov A and Skakun S, "Assessing Damage to Agricultural Fields from Military Activities Using Satellite Data" (2023) 293 *Remote Sensing of Environment* 113386.

[114] Ibid.

[115] "Bombs, mines and chemicals: How agricultural soils in Ukraine have been ravaged by war" (Wageningen University & Research, 2023), available at < https://www.wur.nl/en/news-wur/show-1/bombs-mines-and-chemicals-how-agricultural-soils-in-ukraine-have-been-ravaged-by-war.htm> accessed 22 April 2025.

innovation and economic growth but also to address resource scarcity, biodiversity loss and broader environmental challenges.[116,117,118]

The concept of the bioeconomy holds particular significance for Ukraine – a country with historically strong agricultural and scientific capacities that is currently facing the complex task of rebuilding key sectors amid resource constraints and ecological degradation. The development of a bioeconomy presents a strategic opportunity for Ukraine to address interrelated challenges such as land degradation, food insecurity and economic instability, while simultaneously advancing alignment with the EU's priorities as articulated in the Green Deal[119] and the EU Bioeconomy Strategy.[120]

Increasingly, the bioeconomy is viewed not only as a vehicle for promoting global economic growth through technological innovation, but also as a framework for responding to critical issues such as resource scarcity, biodiversity loss, the depletion of raw materials and their cumulative impact on food security in the context of accelerating population growth.[121]

In retrospect, and with an eye toward the future, it is evident that innovative technologies, particularly those emerging from biotechnology and subsequently integrated into the broader framework of the bioeconomy, have made, and will continue to make, significant contributions to the advancement of humanity.[122]

As Ukraine rebuilds in the aftermath of war, the development of a resilient and innovation-driven bioeconomy is emerging as a strategic pathway for sustainable recovery. The main goals of sustainable agriculture are to produce high yield of healthy crop products, efficiently use the environmental resources with minimal damages, enhance the quality of life within society through the just distribution of food and provide economic benefits for the farmers.[123] In this context, the controlled and transparent introduction of GM crops should be seriously considered as a means to enhance agricultural productivity, energy independence and industrial development. With the advent of introducing favourable traits into crops, biotechnology has created a path for the involvement of GM crops into sustainable food production systems.[124] This approach can create a more efficient, sustainable and integrated agricultural production system that actively uses biological resources and innovative technologies.[125] In the face of shrinking agricultural capacity, bioeconomy with advanced food technology

[116] Bugge MM, Hansen T and Klitkou A, "What Is the Bioeconomy? A Review of the Literature" (2016) 8(7) *Sustainability* 691.

[117] D'Amato D, Droste N, Allen B, Kettunen M, Lähtinen K, Korhonen J, Leskinen P, Matthies BD and Toppinen A, "Green, circular, bio economy: A comparative analysis of sustainability avenues" (2017) 168 *Journal of Cleaner Production* 716.

[118] Patermann C and Aguilar A, "A bioeconomy for the next decade" (2021) 1 *EFB Bioeconomy Journal* 100005.

[119] European Commission, *The European Green Deal* (Communication) COM(2019) 640 final, 11 December 2019 <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52019DC0640> accessed 22 April 2025.

[120] European Commission, *A sustainable bioeconomy for Europe: strengthening the connection between economy, society and the environment* (Updated Bioeconomy Strategy) COM (2018) 673 final, 11 October 2018 <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52018DC0673> accessed 22 April 2025.

[121] Pülzl H, Kleinschmit D and Arts B, "Bioeconomy – an Emerging Meta-Discourse Affecting Forest Discourses?" (2014) 29 *Scandinavian Journal of Forest Research* 386.

[122] Aguilar A and Twardowski T, "Bioeconomy in a changing world" (2022) 2 *EFB Bioeconomy Journal* 100041.

[123] Tseng M, Roel A, Deambrosi E, Zorrilla G, Riccetto S, Pittelkow C, "Towards actionable research frameworks for sustainable intensification in high-yielding rice systems" 2020 10 (1) *Scientific Reports* 9975.

[124] Abdul Aziz M, Brini F, Rouached H and Masmoudi K, "Genetically engineered crops for sustainably enhanced food production systems" (2022) 13 *Frontiers in Plant Science* 1027828.

[125] Petrukha N, "Post-war restoration of the agricultural sector of the economy on the basis of the bioeconomy" (2023) 33(4) *Economic Analysis* 49.

(including genetic engineering) can provide a viable strategy to maximise yields on reduced or damaged land. Such technologies can help to:

- increase productivity per hectare, mitigating the effects of lost territory;
- enable the cultivation of crops resilient to poor soil quality, salinity and drought;
- reduce dependence on external inputs such as fertilisers and pesticides, the supply of which is currently unstable due to war-related trade disruptions.

Notably, GM crops represent a particularly powerful tool. By enabling cultivation in less-than-optimal environments, GMOs can serve as a form of technological compensation for war-induced land loss. Moreover, as it is stated in scientific literature, the adoption of GM crops leads to economic, environmental and health benefits.[126,127,128]

While it is essential for Ukraine to preserve its reputation as a producer of traditional agricultural products, the country should also seriously consider the potential benefits of cultivating GM crops. Biotechnology and GMOs offer promising tools for addressing global food security challenges. Given their capacity to accelerate production, reduce agricultural risks and improve efficiency, the adoption of biotechnological innovations could lead to a substantial increase in the production of both food and agricultural raw materials. Here we should apply to the research by Barrows, Sexton and Zilberman, who examined the impacts of GM crop production on the supply and use of land, finding that GM crops saved 13 million hectares of land from conversion to agriculture in 2010.[129]

Under wartime and post-conflict conditions, GM crops can provide critical benefits, including higher yields on degraded or resource-limited land, reduced dependence on imported agricultural inputs and improved tolerance to drought, pests and other stressors. As it is stated in scientific literature, crops, engineered to resist pests, diseases and environmental stressors, have the potential to increase yields significantly.[130] These traits can help stabilise food production in conflict-affected regions and support food security, particularly where traditional agricultural methods have been rendered less viable.

Furthermore, enhanced agricultural productivity through GM technologies can contribute directly to the bioeconomy by increasing the availability of raw biomass to produce biofuels, bioplastics, animal feed and other bio-based materials. For example, the production of biofuels can generate a more stable demand for raw materials (especially for those multi-annual crops), generating an additional sales channel that allows for expansion in the supply of raw materials involved in the process.[131] 16% of maize production worldwide, 20% of sugar beets, 19% of soybean oil and 16% of palm oil were destined towards biofuels.[132] As stated by the scholars, obtaining authorisation for

[126] Qaim M, "Role of New Plant Breeding Technologies for Food Security and Sustainable Agricultural Development" (2020) 42 *Applied Economic Perspectives and Policy* 129.

[127] Smyth SJ, "The Human Health Benefits from GM Crops" (2020) 18 *Plant Biotechnology Journal* 887.

[128] Barrows G, Sexton S and Zilberman D, "Agricultural Biotechnology: The Promise and Prospects of Genetically Modified Crops" (2014) 28 *Journal of Economic Perspectives* 99.

[129] Barrows G, Sexton S and Zilberman D, "The impact of agricultural biotechnology on supply and land-use" (2014) 19 (6) *Environment and Development Economics* 676.

[130] Ngongolo K and Mmbando GS, "Necessities, environmental impact, and ecological sustainability of genetically modified (GM) crops" (2025) 3 *Discover Agriculture* 29.

[131] Trigo E, Chavarria H, Pray C, Smyth SJ, Torroba A, Wesseler J, Zilberman D and Martinez JF, "The Bioeconomy and Food System Transformation" in: J von Braun, K Afsana, LO Fresco and MHA Hassan (eds), *Science and Innovations for Food Systems Transformation* (Springer 2023).

[132] Torroba A, "Atlas de los biocombustibles líquidos 2019–2020" 2020. San José. <https://repositorio.iica.int/bitstream/handle/11324/13974/BVE20128304e.pdf?sequence=1&isAllowed=y> accessed 31 July 2025.

field trials and conducting research on GM energy crops is a complex and resource-intensive process.[133] But Ukraine has enough potential to deal with it. GM crops optimised for high starch or oil content (such as maize, sugar beets or rapeseed) could become essential feedstocks for Ukraine's expanding biogas, biomethane and biodiesel industries. These biofuels are not only vital for replacing disrupted fossil fuel imports but also support broader climate goals aligned with Ukraine's ambitions for EU integration. In addition to energy applications, GM technologies underpin innovations in industrial biotechnology, such as the production of pharmaceuticals, enzymes and biodegradable materials. Supporting legal and institutional frameworks for these applications would allow Ukraine's scientific and industrial base to participate more fully in the growing global bioeconomy.

Moreover, climate adaptation remains a critical challenge for Ukraine, especially in light of ecological damage resulting from war and increasing climatic volatility. GM crop varieties that exhibit traits such as drought tolerance, saline soil resistance and nutrient-use efficiency can offer sustainable solutions for maintaining agricultural output under changing environmental conditions.

Globally, 71 countries regulate and define GM crops at the legislative level, with 29 countries permitting their cultivation and 42 authorising official imports, including 26 EU Member States. According to data from the International Service for the Acquisition of Agri-biotech Applications (ISAAA), in 2019, GM crops were cultivated on 190.4 million hectares across 29 countries, representing approximately 14% of the world's arable land.[134] The global supply of GM plant-derived products (such as soybeans, maize, rapeseed, rice, wheat, potatoes and sugar beets) continues to expand, despite regulatory resistance from certain jurisdictions.

There is considerable international demand for GM crops. Recent survey data presented at the Ukrainian Agrarian Congress in Kyiv indicates that approximately 68% of Ukrainian agribusinesses would support the legalisation and adoption of GMO cultivation.[135] These findings highlight the sector's readiness to embrace biotechnology, provided an appropriate and reliable regulatory framework is established.

At present, Ukraine may be regarded by leading global biotechnology companies as a promising and strategically attractive market for the cultivation of transgenic agricultural products. This potential is likely to increase foreign investor interest in Ukrainian agricultural land, driven by a unique convergence of favourable conditions for agricultural development. These include:

(1) comparatively low labour costs;
(2) relatively lenient environmental regulations;
(3) access to state budget subsidies aimed at supporting the agrarian sector;
(4) legal mechanisms that facilitate the accumulation of large land parcels, including land lease agreements, emphyteusis and joint activity arrangements;
(5) low land rental rates;[136]

[133] Alessandrini M and van Zeben J, "Genetically Modified Organisms: Is the Proof in the Pudding or in the Process?" in L Reins and A Zahar (eds), *Climate Technology and Law in the Anthropocene* (Bristol University Press 2025).

[134] ISAAA, *Global Status of Commercialized Biotech/GM Crops: 2019* (ISAAA Brief No. 55, 2020) <https://www.isaaa.org/resources/publications/briefs/55/default.asp> accessed 22 April 2025.

[135] "Ukraina – krupneyshiy proizvoditel' soi v Evrope" (*APK-Inform*, 2022) <https://www.apk-inform.com/ru/exclusive/opinion/1047293> accessed 22 April 2025.

[136] Fedchyshyn D, Ignatenko I and Leiba L, "Land-use rights for agricultural land in Ukraine" (2020) 9(1) *Ius Humani Law Journal* 151.

(6) the existence of substantial areas of agricultural land with relatively low levels of anthropogenic pollution, many of which remain significantly less contaminated than comparable regions in Western Europe;
(7) strong export potential, particularly due to Ukraine's geographic proximity to the EU market.[137]

These factors collectively enhance Ukraine's attractiveness as a destination for biotechnological investment and the expansion of GMO-based agricultural production, provided that an appropriate and transparent regulatory framework is in place.

However, any consideration of GM crop adoption must be approached with care. Such solutions cannot be deployed without an enabling legal framework. The absence of a reliable, science-based GMO regulatory system in Ukraine means that these potentially transformative innovations can remain underutilised or legally ambiguous. Their effective implementation requires a strong, transparent regulatory system, public engagement and robust mechanisms for risk assessment and traceability. Recent legal reforms in Ukraine (including the adoption of the new GMO Law aimed at harmonisation with EU requirements) represent important steps toward building public trust and institutional capacity. It is equally important to ensure that the introduction of GM crops does not undermine Ukraine's growing organic sector or disadvantage smallholder farmers, who are central to domestic food production.

Enabling the cultivation of GM crops in Ukraine under well-regulated, participatory and science-based conditions could significantly strengthen the country's bioeconomy. In particular, in the context of war and post-war recovery, GM crops should be viewed as a strategic tool for agricultural resilience, energy independence and industrial innovation. Their inclusion in national policy discussions on bioeconomy development may offer Ukraine a path toward more sustainable, autonomous and future-ready growth.

Ukraine possesses considerable potential to expand its agri-food trade beyond traditional bulk commodity exports. The development of a value-added, innovation-driven bioeconomy, centred around products such as plant-based proteins, functional foods and bio-based materials, can contribute to the diversification of export portfolios and increase profitability per hectare. In addition, regulatory alignment with EU standards in the fields of food safety and biotechnology can facilitate Ukraine's integration into sustainable value chains, further embedding its economy within the European and global bioeconomy.

As part of Ukraine's broader post-war recovery strategy, a pragmatic and legally coherent approach to agricultural modernisation must be prioritised. The establishment of a transparent, science-based regulatory framework for GMOs is not only a matter of national interest but also a legal obligation arising from Ukraine's international commitments. By embracing biotechnological innovation and aligning its regulatory practices with those of the EU, Ukraine can contribute meaningfully to global food security, attract foreign direct investment and reaffirm its position as a reliable and strategic agricultural partner on both the European and international stage.

Conclusion

Our research has demonstrated that the effective regulation of GMOs in Ukraine constitutes a pivotal dimension of the country's broader strategic trajectory toward EU

[137] Fedchyshyn D, Ignatenko I, Danilik D and Chyryk A, "Development of the organic production in Ukraine: problems and perspectives" (2022) 21(3) *Revista de Ciências Agroveterinárias* 324.

accession, legal harmonisation and post-war economic recovery. Drawing upon a detailed investigation of Ukraine's historical, legal, institutional and technical landscape, the analysis reveals both substantial progress and persistent deficiencies in Ukraine's GMO regulatory framework.

From a historical perspective, the legacy of Ukraine's post-Soviet legal development, which is characterised by institutional fragility, fragmented legislative efforts and limited enforcement capacity, has contributed to an enduring regulatory gap in the governance of GMOs. While Ukraine formally committed to biosafety obligations under international instruments such as the Cartagena Protocol and WTO, the domestic implementation of these commitments remained largely declarative. The 2007 GMO Law, though significant as a foundational text, proved inadequate in addressing emerging challenges associated with GMO cultivation, monitoring and trade compliance.

The adoption of the new GMO Law in August 2023 marks a notable legislative advance. It introduces a suite of regulatory instruments (such as mandatory state registration, risk assessment, labelling, traceability and administrative liability) modelled upon core elements of the EU acquis. However, the law's delayed entry into force (September 2026) underscores the necessity of implementing measures to close critical enforcement gaps by that time. Absence of the effective detection and monitoring systems makes Ukraine vulnerable to the circulation of unregistered GMOs. This also leads to arising of trade disruptions for non-compliance with EU import standards.

In the article we have also identified shortcomings in the areas of GMO detection and identification, as well as in the legal regulation of co-existence between GM, conventional and organic crops. The absence of a national network of accredited laboratories, validated testing protocols, and harmonised procedural guidelines limits the capacity of both regulatory authorities and FBOs to ensure compliance with EU traceability and labelling requirements. Similarly, the lack of governance on spatial isolation, liability for contamination and notification mechanisms may undermine the integrity of non-GMO production chains, posing uncertainty for domestic producers and international trade partners alike.

Moreover, the article has situated these regulatory challenges within the broader context of Ukraine's agri-food trade and post-conflict recovery. As one of the largest global exporters of grain, oilseeds and vegetable oils the competitiveness of Ukrainian agriculture is increasingly contingent upon its ability to meet stringent biosafety and food quality standards. Harmonisation with EU law must be balanced with Ukraine's obligations under WTO agreements. Ukraine must navigate a complex legal landscape that requires simultaneous alignment with precaution-oriented EU norms and trade-liberal WTO disciplines.

Finally, the investigation has underscored the strategic role that biotechnology together with a coherent GMO regulatory regime can play in Ukraine's post-war recovery. With large areas of arable land rendered temporarily or permanently unusable due to military action, the adoption of GM crops may offer a pragmatic solution to productivity loss, input scarcity and environmental stress. The potential integration GMO-enabled agriculture into Ukrainian bioeconomy framework could facilitate not only agricultural modernisation but also foreign direct investment, industrial diversification and sustainable economic growth. But this can be achieved when governed by transparent, science-based and internationally aligned legal norms.

GMO legal reform is not merely a matter of compliance or technical alignment. It is a foundational pillar of transition of Ukraine to a rules-based, innovation-oriented and resilient agri-food system. Effective implementation of the new GMO Law should be combined with institutional capacity-building, secondary legislation and international

cooperation. All these will be indispensable to ensuring biosafety, market access and regulatory credibility. The harmonisation of Ukrainian GMO regulation with EU and international standards represents a critical juncture in the further legal, economic and geopolitical integration of the country into the European and global order.

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