



# The Reality of Pesticides: Addressing the Food Safety Gap in Armenia

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# Abstract

The food safety system in Armenia exhibits several gaps; specifically, the optimal level of protection for consumers from risks associated with pesticide exposure has yet to be attained. This is due to both contamination issues involving banned substances and an inadequate monitoring system for modern pesticides.

The article examines the current state of pesticide contamination in Armenia, highlighting three main challenges: the inconsistency between national and international regulatory frameworks, persistent organic pollutants (POPs) “inherited” from the Soviet era, and the necessity of modernizing monitoring, control, and risk assessment systems for pesticide residues to safeguard food safety and public health.

## **Key Words:**

Pesticide contamination,  
food safety,  
monitoring,  
regulatory conflicts,  
public health.

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# Introduction

In Armenia, agriculture serves as the primary source of employment in rural regions and plays a vital role in the national economy; its significance is undeniable. However, this sector entails “hidden costs.” While farmers utilize plant protection products – pesticides – to treat their crops, they often perceive their produce as inherently “organic.” Meanwhile, consumers in supermarkets and local markets prefer fruits and vegetables with an impeccable appearance, often unaware of the latent dangers posed by potential pesticide residues. Although various chemical hazards, such as pesticides (insecticides, herbicides, fungicides, etc.), enhance agricultural productivity, they introduce not only environmental concerns, but also significant threats to public health and safety [3].

Pesticides are biologically active compounds that can lead to the accumulation of residual amounts within various environmental components such as soil and water, as well as within agricultural produce. These compounds can also accumulate in the human body, impairing vital physiological functions. The adverse impact depends primarily on the active substance, which may induce various toxicological effects, including neurotoxicity, carcinogenicity, teratogenicity, and endocrine disruption [5, 6]. Consequently, the regulation and control of pesticides, alongside the assessment and management of associated health risks, require urgent attention.

# Legal Regulation of Pesticides: The Contrast between National and International Approaches.

## Lost in a “Legal Maze”

From the perspective of ensuring adequate protection for human health and the environment, a primary challenge remains the relevance and applicability of pesticide legislation. While the laws governing Armenia’s food sector [1, 2] establish general principles, systemic gaps persist in pesticide management. These gaps stem from both legislative ambiguities and contradictions between various international obligations.

Responsibility for food safety is divided among several bodies, primarily the Ministry of Economy and the Food Safety Inspection Body (FSIB). The latter, however, operates with limited resources, resulting in an insufficient frequency of pesticide residue monitoring and limited transparency regarding results.

As a member state of the Eurasian Economic Union (EAEU), Armenia is mandated to apply uniform technical regulations that carry legal force rather than being mere recommendations. Specifically, the Technical Regulation on Food Safety (TR CU 021/2011) [4] establishes maximum permissible limits, albeit for a restricted number of pesticide compounds. However, this regulatory framework often responds slowly to emerging scientific

data and toxicological evidence. Consequently, several pesticides banned in the EU due to health and environmental risks remain permitted within EAEU member states, including Armenia. These divergent legal frameworks can create a scenario where products exported from Armenia to the EU must meet more stringent requirements than those sold on the domestic market. This discrepancy is particularly problematic for substances categorized as hazardous by leading international scientific assessments. A notable example is the insecticide chlorpyrifos; while it was banned in the EU due to its neurotoxic effects – including developmental neurotoxicity [9, 16] – it remains permitted within the EAEU, with established maximum residue levels for certain products [12].

In the EU, the pesticide management system is founded upon the principles of rigorous regulation and scientific justification. Active substances intended for use in plant protection products undergo a comprehensive, multi-stage scientific evaluation to exclude unacceptable risks to human health and the environment. The EU employs a dual regulatory system: the scientific evaluation of active substances is conducted at the European level by the European Food Safety Authority (EFSA), while the evaluation and authorization of specific commercial products occur at the national level [17, 18].

The current legal framework for regulating plant protection products in the EU is Regulation (EC) No 1107/2009, which establishes uniform rules for their sale, use, and control within the EU. This ensures the protection of human and animal health, the environment, and food safety, while maintaining the effective functioning of the internal market. This regulation replaced Directive 91/414/EEC, introducing a more stringent, science-based and precautionary approach. EU regulations establish clear criteria for banning active substances that are carcinogenic, mutagenic,

toxic to the reproductive system, or endocrine-disrupting, as well as those classified as persistent, bioaccumulative, and toxic (PBT) substances [7, 8].

The EU-Armenia Comprehensive and Enhanced Partnership Agreement (CEPA) outlines clear commitments for Armenia to gradually align and harmonize its national legislative and institutional mechanisms with EU standards. This applies specifically to sanitary and phytosanitary requirements [10, 11], entailing the improvement of control systems and the development of risk assessment capabilities. Although Armenia has aligned its food safety laws with EU legislation and adopted key principles – such as risk analysis, where decisions are informed by risk assessments – the lack of an authorized center for food safety risk assessment means that risk-based decision-making is not yet practiced in Armenia.

# “Inherited Pollution.” The Problem of Persistent Organic Pollutants (POPs)

In Armenia, issues concerning pesticides are not limited to contemporary application. The country also faces contamination from persistent organic pollutants (POPs), which represent a significant legacy of the Soviet era. Organochlorine pesticides, now classified as POPs, were once widely utilized but subsequently banned due to their extreme hazards – specifically, their high environmental persistence, bioaccumulation, and acute toxicity to both humans and ecosystems [15].

Armenia is a signatory to the Stockholm Convention on POPs, thereby assuming international obligations to control and mitigate the impact of these substances. Nevertheless, the country continues to struggle with organochlorine contamination, as evidenced by recent scientific research [14]. A study by Armenian scientists examined the concentrations of organochlorine and organophosphorus pesticides in 252 agricultural soil samples collected from 25 rural communities, analyzing the associated potential hazards. It was established that 39 samples from agricultural lands across 12 communities contained total DDT ( $\Sigma$ DDT), with concentrations in 26 samples exceeding the maximum permissible limit by 1.03-464.9 times.

Notably, 6 of these 12 communities were located near former pesticide storage sites. The highest exceedances were recorded in soil samples adjacent to these historical sites. The study further clarified that the total concentration of DDT detected was primarily composed of the metabolite p,p'DDE, indicating historical contamination. While the health risk assessment for DDT exposure showed that the non-carcinogenic risk remains within acceptable limits ( $HQ < 1$ ), the calculated carcinogenic risk exceeded the acceptable threshold of  $10^{-4}$  in Jrashen (Ararat Province), Aramus (Kotayk Province), and Khanjyan (Armavir Province) [14]. Thus, decades after its discontinuation, DDT contamination remains a critical issue, posing potential health risks through chronic exposure.

# Current Pesticide Contamination: Residues in Food and Public Health Risks

Research indicates that the presence of pesticide residues in Armenian agricultural produce and the resulting health risks are urgent concerns. A recent study [13] evaluated the levels of chlorpyrifos residues in tomatoes and cucumbers – two dietary staples in Armenia – and assessed the potential health implications. The results demonstrated that the consumption of these vegetables contributes significantly to chlorpyrifos exposure, highlighting the necessity for expanded research into other plant-based foods and chemical agents [13].

Pesticide residues were also identified in fruits and vegetables tested under the FSIB’s monitoring program in 2019 and 2021 (identifying 17 types in 2019 and 13 in 2021), with several samples exceeding maximum residue levels [19]. Monitoring data confirmed the presence of residues in a wide range of produce, including tomatoes, cucumbers, eggplants, potatoes, melons, apples, peaches, and grapes. The most frequently detected substance was chlorpyrifos, which has been banned in the EU for several years. Other detected substances included bifenthrin, propargite, dimethoate, imidacloprid, malathion, zineb, trifloxystrobin, thiamethoxam, lambda-cyhalothrin, penconazole, deltamethrin, triadimefon, etc. Notably, several of these – such as bifenthrin, dimethoate, and imidacloprid – are strictly prohibited in the EU.

These findings expose a problematic situation regarding pesticide regulation and oversight in Armenia. Systemic gaps remain; most notably, monitoring programs are not conducted annually. For instance, studies from 2019 and 2021 were only published years later, in 2024. Furthermore, the variety of produce tested is insufficient to provide a comprehensive overview of the situation. Current monitoring programs exclude greenhouse-grown fruits and vegetables, which are staples during the winter months. While a monitoring program was reportedly conducted in 2024, its results have yet to be summarized or made public [19]. This lack of transparency indicates significant communication failures, as the public is not informed in a timely manner about pesticide prevalence in the marketplace. Consequently, consumer awareness regarding pesticide exposure and its associated health risks remains critically low.

# Conclusion

The analysis presented in this article, based on a comparative study of national and international legal frameworks, national monitoring data, and scientific research, demonstrates that without the implementation of urgent and systemic reforms, both the viability of sustainable agriculture and the integrity of public health in Armenia are at risk.

The fragmentation of regulatory oversight, limited monitoring capabilities, and the absence of a comprehensive risk management strategy have created a scenario where the hazards associated with agrochemical use are not effectively mitigated. Consequently, a comprehensive, multi-dimensional framework founded upon risk prevention, scientific evidence, and transparent management is now imperative.

At the policy level, the priority must be the development and implementation of a national action plan aimed at reducing pesticide-related risks, complete with a definitive timeline and aligned with the precautionary principle enshrined within food safety legislation. This plan should mitigate risks at the primary production stage and ensure the gradual introduction and practical application of Good Agricultural Practices (GAP). The current lack of such a structured approach in the primary sector limits effective oversight and increases the probability of adverse health out-

comes for both producers and consumers. It is essential to establish clearly defined, practical guidelines for growers regarding the proper application of chemicals, including accessible information on their potential health effects.

To promote sustainable agriculture, the government should redirect subsidies and support toward the development of agroecology and the adoption of Integrated Pest Management (IPM) standards. Under this framework, chemical interventions are initiated only upon established necessity, with priority consistently given to non-chemical methods.

Another critical pillar of national policy involves strengthening control over the entire distribution and application chain. This requires regular, representative, and transparent monitoring of pesticide residue levels, alongside the provision of adequate information regarding risk assessment processes. Independent scientific research must be supported, particularly national programs focused on pesticide biomarkers within vulnerable populations, to provide a clear assessment of actual exposure and associated health risks.

In the context of regional and international cooperation, it is vital for Armenia to take a proactive stance within the EAEU to promote evidence-based regulatory reforms. Specifically, the state should advocate for the phased restriction and ultimate prohibition of active substances already banned in the EU due to toxicological risks. Such alignment would reduce regulatory discrepancies and enhance consumer protection.

The role of international partners, particularly the EU, remains central to national capacity building. Targeted programs designed to introduce risk assessment methodologies, modernize monitoring systems, and develop sustainable agricultural techniques can effectively bridge sectoral gaps. Furthermore, the involve-

ment of academia, civil society, and the media is crucial for raising public awareness and accountability. Large-scale information campaigns should highlight the environmental and health risks associated with pesticides, alongside broader food safety concerns.

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19. <https://www.efsa.europa.eu/en/topics/topic/pesticides> the environmental and health risks associated with pesticides, alongside broader food safety concerns.

