LEGAL REGULATION OF WASTE MANAGEMENT IN RUSSIA AND CHINA: MAIN DIRECTIONS

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Abstract – The high-tech development of modern societal relations and various sectors of the economy increases the production of goods and services, demanding more natural resources and energy. This leads to resource depletion, environmental damage, and rising waste volumes. A new paradigm for eco-friendly production and consumption is urgently needed, covering design to waste management, especially household waste. National policies and laws are crucial. In Russia and China, strategic and legislative frameworks address these issues. This comparative legal study of their approaches holds theoretical and practical value for improving waste regulation and bilateral cooperation. The analysis reveals shared principles and distinct features in managing production, consumption, and municipal solid waste in both countries. It also identifies opportunities to promote a circular economy and enhance collaboration. Based on the findings, the article offers conclusions, proposals, and recommendations to improve legal regulation and waste management systems.

Keywords: industrial and consumer waste management; integrated solid waste management; environment; pollution; prevention

INTRODUCTION

Environmental protection and human health protection from the anthropogenic impact of industrial and other activities, including waste generation and accumulation, are among the areas of Russian-Chinese cooperation. In the Joint Statement on the twentieth anniversary of the signing of the Treaty of Good-Neighborliness and Friendship between the Russian Federation and the People's Republic of China on June 29, 2021, the Russian Federation and the People's Republic of China agreed to advance cooperation in ecology and environmental protection, prompt notification and exchange of information on transboundary environmental emergencies, the rational use and protection of transboundary water bodies, biodiversity conservation and the creation of transboundary specially protected natural areas, and solid waste management. They also agreed to expand exchanges in environmental protection and climate change response within the UN, BRICS, SCO, and other multilateral formats[1].

The persistent, decades-long trend of increasing waste generation and its negative impact on the environment and living conditions have led to the inclusion of industrial and consumer waste management, including municipal solid waste (MSW), among the strategic interests of the national policies of Russia and China.

To improve waste management efficiency, achieve priority goals, address a range of environmental and other waste-related challenges, and improve legislation, the key areas, specific features, existing challenges, and positive experiences of legal regulation and enforcement in this area in Russia and China are of significant theoretical and practical importance. This is also significant for the further

[1]Joint Statement on the twentieth anniversary of the signing of the Treaty of Good-Neighborliness and Friendship between the Russian Federation and the People's Republic of China. Available at: https://rus.yidaiyilu.gov.cn/p/178760.html [Accessed 10.03.2026]

development of Russian-Chinese cooperation in environmental and related fields. These issues are examined in this study, resulting in conclusions, proposals, and recommendations that can be used in rulemaking, management, and law enforcement activities in Russian and Chinese legal scholarship and practice.

1. LEGAL BASIS FOR WASTE REGULATION AND MANAGEMENT IN RUSSIA

Waste management in Russia is regulated by a legislative framework comprising laws and bylaws adopted at the federal and regional levels, as well as municipal legislation, which simultaneously establishes legal foundations and takes local conditions into account. This framework is also supported by organizational structures formed in accordance with these laws and implements management activities in this area. Specific regulation of these relations was enshrined in the Federal Law No. 89-FZ "On Production and Consumption Waste," adopted in 1998. Its concept implements a comprehensive approach to regulating waste management at all stages (phases), from collection, accumulation, transportation, and processing to disposal, rendering harmless, and placement (storage and burial) of both production and consumption waste, including municipal solid waste (MSW). Regarding MSW, the Law contains numerous articles providing for regulation at the subordinate level, including establishing rules for their management, defining accumulation standards, the procedure for developing, approving, and adjusting investment and production programs for MSW management, information disclosure standards in this area, rules for the development of waste accumulation sites and rules for maintaining a register of such waste, and other financial, economic, organizational, and information requirements.

Regarding the improvement of the Law "On Production and Consumption Waste," an important addition is the inclusion of the concept of "secondary resources" in 2022, as well as the establishment of requirements for their management, including the extraction and use of secondary raw materials. Thus, the Law has not only significant environmental and social significance in preventing the harmful impact of production and consumption waste on human health and the environment, but also economic significance, aimed at integrating such waste into economic circulation as additional sources of raw materials. At the same time, existing gaps in terminology and conceptual frameworks must be addressed, including the definition and legal codification of the concepts of "consumer waste" (including identifying its characteristics that distinguish it from municipal solid waste), "separate accumulation," and "separate collection."

Environmental protection requirements for handling production and consumption waste are also provided for by the 2002 Federal Law No. 7-FZ "On Environmental Protection," Article 51 of which establishes a number of prohibitions regarding waste of hazard classes I-IV and radioactive waste. The Law introduces the concept of "by-products of production," which may include substances or objects generated during the production of the main product, if they are suitable as raw materials in production or for consumption as a product in accordance with Russian legislation. Article 51.1 of the Law introduced in 2022 defines the requirements for handling by-products of production, which are generated as a result of the economic and/or other activities of legal entities and individual entrepreneurs. These entities must maintain separate records of them, reflect information on the types of by-products of production, the volumes of their formation, their use in their own production, or their transfer to other persons in the industrial environmental control program and reporting documents. The Law provides for environmental protection requirements when handling by-products of production, if they are recognized as waste. The Government of the Russian Federation has established a list of substances and/or objects that cannot be classified as by-products of production. These standards are an important condition for the transition to a closed-loop economy and the involvement of additional sources of raw materials in economic circulation.

Improvements to Russian legislation reflect the general trend toward building an economic model based on the concept of sustainable development, aimed at achieving a balance between the economic, social, and environmental needs of society. The provisions of this concept are consistent with the norms of other federal laws containing requirements for certain types of waste, including the Law "On Radioactive Waste Management and Amendments to Certain Legislative Acts of the Russian Federation" (2011), Article 49 of the Law "On the Fundamentals of Protecting Citizens' Health in the Russian Federation" (2011) regarding medical waste, the handling of which is regulated by the Law "On the Sanitary and Epidemiological Welfare of the Population" (1999). Accordingly, the legislative framework for regulating relations in the field of waste management in Russia is represented by both specialized legislation and includes environmental, sanitary-epidemiological, and other sectoral legislation, which allows for more effective waste management on a systemic, comprehensive, intersectoral legal basis.

1.1. Principles of Russian legislation in the field of waste management

The fundamental principles of waste regulation and management, enshrined in industry-specific and environmental legislation of the Russian Federation, are of significant theoretical and practical importance, as they serve as official guidelines for all parties involved in waste management, provide stability to the organizational structure of public administration in this sector, and help maintain environmental law and order. These established principles are also important for the development and implementation of state waste management policy. According to Article 3 of the Law "On Production and Consumption Waste," these principles include:

- protection of human health, maintenance or restoration of a favorable state of the environment and conservation of biological diversity;

- scientifically based combination of environmental and economic interests of society in order to ensure sustainable development of society;

- use of the best available technologies in waste management;

- comprehensive processing of material and raw material resources in order to reduce the amount of waste;

- the use of methods of economic regulation of activities in the field of waste management in order to reduce the amount of waste and involve it in economic circulation;

- access in accordance with the legislation of the Russian Federation to information in the field of waste management;

- participation in international cooperation of the Russian Federation in the field of waste management.

The first principle directly reflects constitutional provisions enshrining the environmental and legal status of individuals and citizens in the Russian Federation, including the right to health protection, a favorable environment, reliable information about its condition, and compensation for damage caused to health or property by environmental violations. These constitutional principles served as the basis for enshrining the principle aimed at ensuring access to information on waste management. Directly related to the implementation of these principles are the constitutionally enshrined powers of the Government of the Russian Federation to implement measures aimed at creating favorable living conditions for the population, reducing the negative impact of economic and other activities on the environment, preserving the country's unique natural and biological diversity, and fostering a responsible attitude toward animals in society.

A principle consistent with the concept of sustainable development, enshrined in Russian legislation as a scientifically based combination of the environmental, economic, and social interests of society and reflecting the ecosystem relationships between natural resources and environmental

components, is essential for Russia's domestic and foreign public environmental policy, including in the area of waste management. The implementation of this concept is linked to the Sustainable Development Goals (SDGs), for the achievement of which indicators have been developed at the international and national levels. Work is also underway in Russia to develop and gradually introduce such indicators (for more detailes see (Vyphanova, 2016)). Among them, for achieving SDG 11 "Sustainable Cities and Communities," are indicators 14.6.1 "The share of municipal solid waste collected and disposed of at controlled sites from the total mass of municipal solid waste, by city." This indicator is currently not being developed in Russia; however, its parameters[2] can and should be used in the development of strategic planning documents and in making management decisions regarding municipal solid waste management in cities. The implementation of the concept and goals of sustainable development is also linked to the principles of Russia's participation in international cooperation in waste management, including with the People's Republic of China. An ecosystem approach, also consistent with achieving sustainable development goals, is particularly important to consider when planning measures for production and consumption waste management, including recycling, to improve the environmental situation in cities and other populated areas, improve living conditions for the population, and ensure citizens' right to a healthy environment.

These and other principles fully align with the principles of state policy in the field of waste management, which is objectively expressed in strategic planning documents and environmental legislation, the provisions of which also enshrine the corresponding principles. Thus, the Federal Law " On Environmental Protection" contains principles for the legal regulation of environmental relations, creating a legal basis for regulating waste management, consistent with the principles of state policy in this area: respect for human environmental rights, including the right of everyone to a favorable environment; ensuring favorable living conditions for people; and a scientifically sound combination of the environmental, economic, and social interests of individuals, society, and the state to ensure sustainable development and a favorable environment.

1.2. Strategic planning as a function of production and consumption waste management

Strategic planning documents play a key role in waste management in Russia. They define priorities, targets, and objectives for the development of this area of public policy and management activities carried out by state and local government bodies at the federal, regional, and municipal levels. Strategies, which are strategic planning documents developed within the framework of goal-setting, also outline key areas, mechanisms, and other measures, which are further specified in program documents containing a list of specific activities, indicators, deadlines for their achievement, and responsible executors, including public authorities. The system of such documents, their development, approval, and implementation are stipulated by the Federal Law "On Strategic Planning in the Russian Federation" (2014), which gives them a normative nature, which is also reflected in the monitoring and control of the implementation of the indicators contained therein, thereby influencing the effectiveness and efficiency of management (for more details see (Vypkhanova, 2024)).

Russia is conducting systematic and consistent work on strategic planning for waste management. Over the past decade, a system of strategic planning documents has been created, implemented, and is currently being developed to guide waste management.

Certain waste management areas are reflected in federal projects included in the Russian Federation's state program "Environmental Protection" (2014): "Clean Country," "Integrated Municipal Solid Waste Management System," which are included in the national project "Ecology," "General Cleaning," and "Closed-Loop Economy"—a federal project developed to implement the main priority

[2] The following parameters are highlighted: the total amount of solid waste generated and collected (tons/day); the composition of solid waste; the total amount of solid waste disposed of at controlled sites (tons/day); the proportion of the population with access to basic solid waste collection services in the city (%).

of state policy in the area of environmental quality regulation. From January 1, 2025, the effective targets and objectives directly related to waste management defined in the national project "Environmental Well-Being" will be specified and implemented within the framework of the federal projects included therein: "Clean Country," "Integrated Municipal Solid Waste Management System," and "Infrastructure for Handling Hazard Class I and II Waste" (for more details see (Vypkhanova, 2025; Viphanova, 2023; Kvanina et al., 2023; Vipkhanova, Martynenko, 2025)).

Overall, this system of strategic planning documents is aimed at achieving priority waste management goals: eliminating accumulated hazardous waste (for more details see (Vypkhanova, 2020)); transitioning to a new solid municipal waste management system; introducing separate waste collection; creating a modern waste management, recycling, and disposal industry; transitioning to a closed-loop economy, implementing the "polluter pays" principle, and applying an extended producer responsibility mechanism.

A special place in ensuring the specified priority goals is occupied by the Strategy for the development of the industry for the processing, recycling and disposal of production and consumption waste for the period up to 2030 , which is the basis For formation and implementation of a modern state industrial and scientific-technological Russian policy at the federal, regional, municipal and industrial levels levels in the field of waste processing, disposal and neutralization, resource conservation and waste recycling. The main objectives of the Strategy are: the formation and future development of an industrial sector for the processing, recycling, and disposal of waste, ensuring its maximum use in production and the systematic minimization of waste not subject to further recycling, applying the global 3R principle (waste prevention, reuse, recycling). It also establishes and further develops a Russian technological and mechanical engineering base that provides this sector with modern, high-tech equipment with high export potential. The Strategy covers the main types of production waste (from manufacturing industries, agriculture, forestry, the electric power industry, etc.) and consumption, including municipal solid waste and food waste. It contains key target indicators, areas of activity, and measures to achieve these objectives, as well as organizational and other measures.

2. BASIC PRINCIPLES AND TRENDS OF SOLID WASTE LEGAL REGULATION AND MANAGEMENT IN CHINA

Since the revision and enactment of the Law of the People's Republic of China on the Prevention and Control of Environmental Pollution by Solid Waste, the legal regulatory system in this area has undergone a transition from the traditional final-treatment model to a systemic management approach based on the principle of managing the entire waste lifecycle. Its institutional structure is guided by three fundamental principles: waste generation reduction, rational use, and environmentally sound recycling. Through the coordinated functioning of typological regulations and a system of distributed responsibilities, a legal network is formed that encompasses waste reduction at the source, management of waste management processes, final-stage recycling, and resource reuse. This system not only reflects the maturity and internal consistency of China's environmental legislation but also creates a solid regulatory foundation for the legal formulation of a waste recycling system.

2.1. Basic principles of prevention and control of environmental pollution by solid waste

The legal principles for preventing environmental pollution by solid waste are based on the fundamental provisions of the Environmental Protection Law of the People's Republic of China (2014). In accordance with the specific nature of solid waste pollution, the Law on the Prevention and Control of Environmental Pollution by Solid Waste (2020) establishes more targeted and specialized regulatory principles.

First, the prevention and control of environmental pollution from solid waste is based on three institutional principles— **waste reduction, rational use of resources, and environmentally sound**

recycling —which form the fundamental basis of the entire legal regulation system in this area. Article 4 of the Law explicitly states that pollution prevention must be based on the principles of waste reduction, reuse, and safe recycling. The principle of reduction aims to control waste generation at the source, which is achieved through the implementation of clean technologies, improved production processes, and eco-design of products. The principle of rational use of resources presupposes the reuse of waste in economic circulation and the restoration of its economic value. The principle of environmentally sound recycling ensures the reliable handling of waste at the final stage, eliminating secondary environmental pollution. These principles are interrelated and embody the legal logic of integrated regulation, covering the entire life cycle of waste—from its generation to final disposal.

Secondly, **the principle of managing the entire process**. Given the hidden, persistent, and cumulative nature of environmental risks associated with solid waste management, the Law provides for the establishment of a comprehensive control and information tracking system at all stages—from waste generation and collection to transportation, storage, use, and disposal. Furthermore, legal mechanisms for permitting, registration, information disclosure, and environmental risk prevention are introduced. Through a system of state oversight and a legal liability mechanism, control is ensured at all stages of waste management, thereby establishing a stable legal framework for regulation, ensuring transparency and accountability.

Third, **the principles of differentiated management and regional coordination**. As the structure of waste generation sources becomes more complex, a differentiated approach becomes a key element of the regulatory system. The law differentiates solid waste types by their nature and hazard level, distinguishing between general industrial, hazardous, household, and construction waste, and establishes special management regimes for each category. Article 9 of the Law also enshrines the requirement for coordination between urban and rural areas and coordinated regional planning. To this end, interregional mechanisms for joint pollution prevention and control are being established, aimed at preventing the transboundary movement of waste and eliminating gaps in the distribution of management responsibilities.

2.2. Typology and institutional distribution of integrated solid waste management system

The diversity of solid waste types, the differences in their polluting characteristics and levels of environmental risk predetermine the formation of a typologically structured system of legal regulation in the area of their management.

First, **a strict control regime for hazardous waste management**. Given their toxic, corrosive, reactive, and infectious properties, hazardous waste poses an increased threat to the environment and public health. Current legislation ensures regulation at all stages of its management through a three-component system, including **a permitting system, a system of transport invoices, and information tracking**. The Regulation on the Management of Licenses for Activities Related to Hazardous Waste establishes a licensing regime that ensures that entities collecting, storing, using, and disposing of hazardous waste possess the appropriate technical and organizational capabilities. The Regulation on the Management of Transport Invoices for the Transportation of Hazardous Waste ensures traceability of their interregional movement. At the same time, the Ministry of Ecology and Environment is promoting the creation of a national hazardous waste management information system aimed at strengthening dynamic state control and increasing the effectiveness of the environmental risk prevention system.

Second, **a system for classifying and reducing the generation of household waste**. Household waste management is a key area requiring public participation and a cooperative management mechanism. Article 43 of the Law on the Prevention and Control of Pollution by Solid Waste establishes the legal basis for the formation of a unified national system providing for the separate collection, transportation, and treatment of household waste. At the regional level, legal acts such as the

Shanghai Municipal Regulations on Household Waste Management and the Beijing Municipal Regulations on Household Waste Management have facilitated a practical transition from waste disposal at the final stage to waste sorting and resource utilization at the generation stage.

Third, **a system for the resource utilization of construction and industrial solid waste**. Construction waste, characterized by significant volumes and widespread occurrence, has long remained on the periphery of legal regulation. In recent years, the legislative and regulatory framework has acquired a distinct resource-oriented focus. According to Article 60 of the Law on the Prevention and Control of Environmental Pollution by Solid Waste, people's governments at and above the county level are required to ensure the sorting, collection, transportation, and comprehensive utilization of construction waste. The Opinions on Measures to Accelerate the Formation of a System for the Utilization of Waste as a Resource (Document No. 7 of the General Office of the State Council, 2024) emphasizes the need to establish construction waste recycling bases in key cities and implement standardized use of products made from recycled materials, including recycled aggregates and recycled concrete.

Industrial solid waste regulation is based on the principle of the unity of cleaner production, integrated use and pollution control, forming an interconnected institutional chain: **registration of waste generation – approval of its use – control of emissions and discharges**.

3. RESPONSIBILITY INSTITUTE FOR SOLID WASTE POLLUTION PREVENTION AND CONTROL

Improving the liability system is a key condition for ensuring legal effectiveness in solid waste management. Based on clearly defined responsibilities among the government, economic entities, and society, current legislation aims to transition from primarily end-of-life control to comprehensive management at all stages of waste management through the institution of integrated liability and an information oversight mechanism.

First, **the Extended Producer Responsibility (EPR) system**. To implement the principles of preventing pollution at source and developing a circular economy, the law requires manufacturers to bear environmental responsibility at all stages of the product lifecycle — from design and production to sales and disposal. The Ministry of Ecology and Environment, together with the National Development and Reform Commission and other agencies, approved the Extended Producer Responsibility Implementation Plan,[3] which provides for the development of industry-wide systems for the recycling and reuse of electrical and electronic equipment, vehicles, lead-acid batteries, packaging materials, and other products. This ensures a closed-loop waste management system within the framework of the product lifecycle concept.

Second, **coordinated responsibility among government bodies at various levels and departments**. According to Article 7 of the Law on the Prevention and Control of Environmental Pollution by Solid Waste, people's governments at and above the county level bear overall responsibility for organizing waste pollution prevention measures within their administrative areas. Environmental supervision agencies exercise unified leadership and oversight, while departments in charge of development and reform, housing and urban development, industry, and information technology exercise their powers within their respective areas of competence. This creates a multi-layered system of distributed responsibility, reflecting the institutional principle of "unified supervision and interdepartmental cooperation" within the modern environmental governance model.

Third, **public participation and the obligation to disclose information**. The law requires government agencies and businesses to ensure transparency in waste pollution prevention activities, guaranteeing

[3] 国办发〔2016〕99号，2025年10月15日访问。 Notice of the State Chancellery of the People's Republic of China on the Extension of the Implementation Scheme for the Extended Producer Responsibility System (No. 99 of the State Chancellery (2016). Available at: https :// www . gov . cn / gongbao / content /2017/ content_5163453 . htm [Accessed 15.03.2026].

citizens' rights to receive environmental information and to participate in public oversight. In this regard, a national waste management information platform is being created, aimed at developing digital monitoring, visual traceability, and real-time data exchange. This system combines legal liability with public oversight, facilitating the development of a sustainable model of accountable environmental governance.

4. EVOLUTION OF THE INSTITUTIONAL SYSTEM OF SOLID WASTE MANAGEMENT

"Solid waste management is a comprehensive, interdepartmental, interregional, and inter-environmental process. It encompasses key stages such as reducing waste generation at the source, using waste as a resource, and its environmentally safe disposal. This activity extends to all stages of the production, consumption, and distribution cycles and is a complex systemic process requiring the coordination of multiple participants and management levels" (Xiaoyan, 2024). Compared to traditional pollution control methods, the complexity of solid waste management lies in the combination of its environmental, economic, and social characteristics, which requires maintaining a dynamic balance between pollution prevention, rational use of resources, and the protection of public interests.

At the stage **of transition from isolated pollution control to rational use of resources and system management,** there is A shift in solid waste management objectives reflects the evolution of environmental law from a "risk control" approach to a "resource management" approach. The Law of the People's Republic of China on the Prevention and Control of Pollution by Solid Waste (1995) initially aimed to reduce pollution and ensure environmental safety, and its legal nature was primarily focused on "prevention and control" through a permit system, administrative regulations, and sanctions. However, after the idea of ecological civilization became a fundamental state strategy, the target structure of solid waste legislation gradually transformed from a single focus on pollution control to a comprehensive model combining rational resource use, environmental safety, and sustainable ("green") development.

The concept of "systemic (whole-process) management" suggests that legal regulation of solid waste should cover all stages — generation, collection, storage, transportation, use, and disposal — ensuring a closed-loop management process from source reduction to safe disposal at the final stage. The Law on the Prevention and Control of Environmental Pollution by Solid Waste, revised in 2020, established a full-process management system for the first time. Combined with the Law on the Promotion of Economic Development and the Law on the Promotion of Cleaner Production, it forms a coordinated regulatory framework aimed at achieving a balance between environmental protection, resource efficiency, and the prevention of environmental risks. Thus, this legal mechanism not only institutionalizes the principles of ecological civilization but also marks the transition from defensive legal regulation to proactive legal policies that promote green transformation and resource recovery.

From a functional perspective, the system of legal objectives is developing in two interrelated directions: "greening" and "systematization." First, there is a shift from combating pollution to promoting the rational use of resources and their optimal distribution, which ensures the unity of the values of "pollution reduction, resource restoration, and environmental safety." Second, there is a shift from sectoral governance to a systemic model, in which legislation coordinates the interaction of production, consumption, the market, and public participation, creating a comprehensive mechanism of legal regulation that integrates policy, standards, and technological means.

The further evolution of China's solid waste management system is associated with **a shift from administrative regulation to an integrated approach combining legal norms, market mechanisms, and technological tools,** reflecting the trend toward diversification of environmental management tools. While the "administrative order-permit-sanction" model played a key role in early solid waste pollution containment, an approach based on administrative oversight requires specialized

environmental agencies to exercise multi-layered control over a wide range of entities and their activities. The high costs and low effectiveness of this approach make it inappropriate for the objectives of rational resource use and ensuring high-quality development (Cao, 2025). In response to the increasing complexity of environmental risks, legislation is gradually integrating market and technological instruments, marking an institutional shift from "control law" to "new type management law."

First, improving legal norms. The 2020 revision of the Law on the Prevention and Control of Environmental Pollution with Solid Waste strengthened the legal mechanisms for declaration and registration, record-keeping, issuing transport manifests, and the permitting system. A comprehensive oversight system with traceability at all stages of waste management was created. Institutions for corporate environmental credit assessment and information disclosure were introduced, ensuring a transition from empirical law enforcement to procedural legality through the formalization of administrative discretion.

Second, market mechanisms are integrated. Economic instruments, including emissions charges, resource taxes, green credits, and carbon and waste trading systems, are integrated into the governance system. Of particular importance is the implementation of an extended producer responsibility system, which requires manufacturers to be responsible for the disposal and reuse of waste generated throughout the product life cycle. This marks an institutional shift to the principle of "whoever produces, bears responsibility." Subsequently, the National Development and Reform Commission, together with the Ministry of Ecology and Environment, approved the Implementation Plan for the Extended Producer Responsibility System, which calls for the creation of waste recycling systems in electrical and electronic products, packaging materials, automobiles, and other industries, emphasizing the need for the participation of all of society.

Third, the use of technological tools. Digital regulation, big data systems, and information platforms have become a key pillar in solid waste management. The Ministry of Ecology and Environment has created a national solid waste management information platform, ensuring end-to-end digital oversight of hazardous and household waste, as well as integrating risk monitoring, enforcement coordination, and public oversight. The introduction of digital technologies has transformed the logic of environmental law enforcement, making management verifiable, predictable, and evaluable.

Thus, **the modern solid waste management system forms a triune model of interaction: legal norms, market mechanisms, and technological tools.** This integrated system not only overcomes the limitations of administrative control but also reflects the structural evolution of environmental law—from a model based on restrictions to one aimed at expanding opportunities and improving management efficiency.

The current stage of the evolutionary development of the solid waste management system is characterized by a shift from **the priority of economic efficiency to environmental priority and a "green" transition.**" All resources are limited in time" (Yuhai, Dan, 2011). Inefficient use not only increases pressure on the resource base but also exacerbates environmental stress and degradation. Early environmental legislation was based on the need to reconcile the contradictions between economic development and pollution control, while its value orientation was primarily determined by the inherent logic of economic efficiency.

In the context of the legal development of an ecological civilization, legislation in the field of solid waste management demonstrates a shift from "efficiency-oriented rationality" to "ecological rationality." The legal emphasis is gradually shifting from the priority of economic growth to ensuring environmental safety and promoting a "green" transformation, shaping a new value system in which key principles include environmental priority, sustainable development, equitable participation, and intergenerational justice. This value paradigm orients institutional design toward maximizing public

welfare through the development of green technologies, public engagement, and the rational allocation of resources.

Guiding opinions on the construction of a modern environmental management system (2020) explicitly state that ecosystem resilience and the controllability of environmental risks should be considered criteria for assessing legal effectiveness. This means formally enshrining environmental values as the basis for legal interpretation and public policy development.

At the same time, legislation on solid waste management reflects a focus on intergenerational equality and public co-management. Strengthening institutions of public participation, environmental information disclosure, and public litigation on environmental issues transforms environmental law from a sphere of unilateral state control into a mechanism for the joint creation, management, and distribution of public goods. Thus, the law acquires the function of strengthening social trust and environmental responsibility, becoming an important public institution for building an ecological civilization.

"The law must be stable, but it must not prohibit change" (Pound, 2003). Dynamic updating of solid waste management legislation represents an institutional response to societal development and the transformation of environmental risks. Its stability is expressed in the continuity of core values and governance structures, while openness is reflected in the capacity for institutional innovation in response to new forms of pollution and technological challenges.

Consequently, the evolution of the legal system for solid waste management is not simply an expansion of regulatory content, but a profound rethinking of the value foundations of the national legal system, reflecting the transition from a model oriented towards economic growth to a model based on the principles of ecological civilization.

5. LEGAL AND INSTITUTIONAL PROBLEMS OF THE SOLID WASTE MANAGEMENT SYSTEM

Although China's legal system for solid waste pollution prevention has already come very close to the transition from a "final treatment" model to a "life-cycle management" model at the regulatory level, institutional maturity alone does not guarantee effective enforcement.

5.1. Regulatory contradictions and structural imbalances in the legislation on solid waste pollution prevention

The current Environmental Protection Law of the People's Republic of China, the Soil Pollution Prevention and Control Law of the People's Republic of China, the Law of the People's Republic of China on the Prevention and Control of Pollution from Solid Waste, and the Law of the People's Republic of China on Promoting the Circular Economy contain a number of institutional provisions aimed at the comprehensive management of solid waste and form a multi-layered system comprising laws, administrative regulations, departmental rules, and technical standards. However, the lack of a unified legislative framework and systemic institutional design leads to internal fragmentation, duplication, and inconsistency of legal norms. As a result, solid waste management is characterized by typical "structural fragmentation," and the low operational effectiveness of most provisions leads to insufficient legal regulation (Zhongmei, 2025).

The main shortcomings of the legislative framework can be identified.

Among these, **the model of separate legislation and the lack of regulatory coherence are noteworthy.** "The focus of environmental law on achieving 'harmlessness' and regulating individual elements of the environment has not yet undergone any fundamental changes" (Lu, 2023). Currently, the solid waste management sector operates under a model of "separate legislation," which outwardly reflects a differentiated approach to various policy objectives, but in reality leads to divergent regulatory logic and a lack of coordination mechanisms. The Law on the Prevention and Control of Pollution by Solid Waste falls under the sphere of administrative law and aims to prevent pollution and protect public health through administrative oversight measures. In contrast, the Law on the

Promotion of the Circular Economy and the Law on the Promotion of Cleaner Production belong to the sphere of economic law and implement their goals through macroregulation and economic incentives (Xuejun, 2006). Although these acts share the common goal of "resource conservation and reuse," they have fundamental differences in their legal nature, value orientation, and regulatory tools: the former is based on prohibitive and restrictive norms, while the latter relies on incentives and incentives. This inconsistency hinders the alignment of regulatory force and enforcement logic.

Deficiencies in legislation in the regulated sector include **the regulatory overlap between legal acts and departmental regulations, which contributes to the fragmentation of governance.** The distinction between "separate" and "fractional" legislation is largely theoretical and has no decisive impact on the overall legislative philosophy (Canfa, Zhe, 2015). In practice, environmental law represents a process of mutually intertwining policy and law. In the field of solid waste management, the regulatory system has a pronounced multi-level hierarchy: upper-level laws enshrine principles, secondary legislation specifies rules, and departmental regulations and technical standards determine the procedures for their implementation. However, the logical relationship between the levels of regulation does not form a coherent system. The legal mechanism for delegating authority exhibits two typical problems: "hierarchical inconsistency" and "blurred boundaries." In some cases, administrative decrees and departmental regulations introduce significant provisions regarding waste classification, transportation permits, and disposal licensing without a proper legal basis, leading to the phenomenon of "rule-making in excess of authority." Meanwhile, in areas such as resource conservation and market entry of secondary products, insufficient regulation and a low level of regulatory enforcement are observed, leading to a pattern of "administrativization of key issues." Thus, the regulatory system for solid waste management is characterized by a "proliferation of bylaws while the content of laws is becoming impoverished," which reduces the integrating role of the law and the predictability of law enforcement.

Equally significant is **the hierarchical imbalance between central and local legislation and problems with regional coordination.** The functioning of the solid waste management system is limited not only by interdepartmental fragmentation but also by the disparity in the distribution of powers between central and local authorities. According to the Law of the People's Republic of China on the Prevention and Control of Pollution by Solid Waste and related regulations, uniform standards are established at the central level, while local governments are responsible for their specification and implementation. In practice, the implementation of legislative goals varies significantly depending on the economic structure, budgetary capabilities, and political priorities of regions. The interregional movement of solid waste requires "dual approval" from the competent environmental authorities of both the sending and receiving regions, which is aimed at mitigating environmental risks. However, the lack of uniform standards and inconsistent procedures leads to the creation of "hidden barriers" that restrict waste movement, increasing costs for businesses and encouraging illegal transportation. Despite the central government's implementation of the "Waste-Free City" pilot project, which aims to establish a national information exchange platform and interregional environmental compensation mechanisms, incompatibility of data standards and administrative restrictions continue to hinder the development of an effective system of interregional cooperation.

5.2. Functional barriers to coordinated operation of an integrated solid waste management system

The multidimensionality of solid waste management objectives stems from the intersection of resource, environmental, and governance characteristics. This area is simultaneously linked to pollution prevention, resource reuse, and economic reproduction, creating a "coordination dilemma" in institutional design. The delineation of authority between administrative, market, and public actors remains unclear, and the governance system itself takes on the characteristics of "multi-centeredness without a single regulator." This manifests itself, firstly, in **the structural shortcomings of multi-agency regulation as a source of governance fragmentation.**

Although the Law of the People's Republic of China on the Prevention and Control of Pollution by Solid Waste stipulates that "the competent department of the State Council for ecology and environmental protection shall exercise unified supervision,"[4] the actual institutional regulatory structure still involves multiple departments—development and reform, housing and urban-rural development, natural resources, industry, and information technology, among others. Each department carries out its own functions in supervision, planning, processing, and disposal based on various regulations. Due to blurred legal boundaries and overlapping regulations, a situation of "multiple administration and cross-enforcement" often arises in practice.

Because each agency develops policies based on its own objectives and mandates, these differences are enshrined in legislation, leading to an institutional gap between the authorized bodies. Although individual laws delineate competencies between "lead" and "supporting" departments, a unified value system and effective mechanisms for interdepartmental coordination are lacking. As a result, a typical "everyone is responsible for their own area" situation develops: the same issues are regulated by different agencies under different legal frameworks, creating a vacuum of responsibility at key stages. For example, with regard to hazardous waste, environmental protection agencies issue permits for its transportation in accordance with the Solid Waste Pollution Prevention and Control Act, while development and reform departments approve recycling projects under the Circular Economy Promotion Act. These parallel procedures, pursuing different objectives, give rise to duplicative licensing and multiple compliance requirements.

Secondly, **the extended producer responsibility system and corporate information disclosure are insufficiently implemented.** The extended producer responsibility system is a key legal instrument for ensuring the full cycle of waste management and promoting recycling (Jie, 2025). Although the Law on the Prevention and Control of Environmental Pollution by Solid Waste enshrines the principle of extended responsibility, it does not specify the scope of producer responsibilities, recycling targets, cost-sharing mechanisms, or oversight instruments. Implementation of this system is primarily based on administrative initiatives and is not legally binding. In practice, the extended producer responsibility mechanism operates primarily within the framework of administrative regulations and departmental documents — "temporary measures," "management standards," and "pilot schemes" — that do not have the status of law. Insufficient institutionalization, a low hierarchical level of legal regulation, and a lack of effective incentives and sanctions mean that producers only formally fulfill their responsibilities in product design, waste recycling, and environmental information disclosure.

Third, **the inadequacy of legal mechanisms is the reason for the low effectiveness of public oversight.** Public participation is the third key element of a modern environmental management

[4] 中华人民共和国固体废物污染环境防治法》第9条：国务院生态环境主管部门对全国固体废物污染环境防治工作实施统一监督管理。国务院发展改革。交通运输、农业农村、商务、卫生健康、 。

Home Home然资源管部门在各自职责范围内负责固体废物污染环境防治的监督管理工作。

Article 9 of the Law of the People's Republic of China "On the Prevention of Environmental Pollution by Solid Waste" The competent authority of the State Council for Ecology and Environment carries out unified supervision and management of work on preventing environmental pollution by solid waste throughout the country.

The competent departments of the State Council for development and reform, industry and information technology, natural resources, housing and urban-rural affairs, transportation, agriculture and rural affairs, commerce, health, customs and other matters shall, within the scope of their authority, be responsible for the supervision and management of work on the prevention of environmental pollution by solid waste.

The competent departments of local people's governments for ecology and environment shall exercise unified supervision and management over the work of preventing environmental pollution by solid waste within their administrative areas.

The competent departments of local people's governments in charge of development and reform, industry and information technology, natural resources, housing and urban-rural affairs, transportation, agriculture and rural affairs, commerce, health and other matters are responsible for supervising and managing the work of preventing environmental pollution by solid waste within the scope of their powers.

system, compensating for the limited capacity of the state and the imperfections of market mechanisms (Wu, Huijuan, 2009). However, in the area of solid waste management, this mechanism remains largely formal. Although the Law on the Prevention and Control of Environmental Pollution by Solid Waste and related regulations provide for provisions on information transparency, public complaints, and hearings, limited legal authority and excessive procedural barriers prevent public oversight from having a real impact.

On the one hand, data on the origin, movement, and disposal of waste is often treated as commercial or internal administrative information, depriving the public of reliable data and making oversight virtually impossible. On the other hand, participation procedures are excessively dependent on administrative bodies, and public associations and citizens lack sufficient autonomy. As a result, public oversight lacks legal significance and fails to create effective external constraints on government and business.

Thus, solid waste management faces an "institutional triple paradox": strong but inflexible administrative regulation; weak and dysfunctional market mechanisms; and broad but formal public participation. The tension between administrative, market, and social rationality has not yet been resolved at the institutional level. As a result, the system appears to be "legally supported," but in reality remains "ineffective and dysfunctional."

5.3. The Gap between Technological Management and Legal Regulation

Article 16 of the Law of the People's Republic of China on the Prevention and Control of Pollution by Solid Waste stipulates that the competent authority for ecology and environment shall establish a system for public disclosure of solid waste information[5]. Digitalization does indeed open up new opportunities for solid waste management, but the existing legal system has not yet achieved structural integration with technological tools. Legal regulation is based on procedures and order, while technological management is focused on efficiency and predictability. As a result, despite the superficial technologicalization of management practices, at their core, they often deviate from the principles of legality and legal certainty.

Problematic regulatory deficiencies also include **the lack of mechanisms for tracking solid waste flows and data management.** The current Law on the Prevention and Control of Pollution by Solid Waste requires the creation of an information system, but does not establish legal boundaries or responsibility mechanisms for tracking waste flows, collecting, and exchanging data. Consequently, digital oversight platforms, while technically feasible, remain institutionally unstructured: responsibility for data reliability and verification mechanisms do not form a closed loop. Initially, data management was intended to facilitate the transition of state oversight from extensive to targeted, from reactive to predictive (Lixin, Da, 2022), and from empirical to analytical methods. However, in the absence of regulatory support, digitalization is becoming a "technological showcase." Integrated solid waste management is characterized by a long production chain, multiple participants, and highly complex processes, requiring unified technical standards and standardized data interfaces. The lack of mandatory institutional norms has led to disparate information systems being developed across regions , hindering interregional data exchange and preventing digital surveillance from fulfilling its preventive and precise management functions.

Furthermore, there is a **discrepancy between technical standards and legal norms.** Big data technologies, intelligent monitoring systems, and blockchain have already found partial application

[5] 《中华人民共和国固体废物污染环境防治法》第16条：国务院生态环境主管部门应当会同国务院有关部门建立全国危险废物等固体废环境防治信息平台，推进、转移、处置等全过程监控和信息化追溯。 Article 16 of the Law of the People's Republic of China "On the Prevention of Environmental Pollution by Solid Waste" The competent authority of the State Council for ecology and environment shall, together with the relevant departments of the State Council, establish a nationwide information platform on the prevention of environmental pollution by solid waste, including hazardous waste, ensuring full monitoring and information traceability of the processes of collection, transportation and disposal of solid waste.

in hazardous waste transportation, approval of disposal methods, and recycling. However, standardization systems and compliance rules are still at the experimental stage: requirements for the procedural legitimacy of technological management have not been defined, and legal mechanisms for algorithm transparency and data verification have not been developed. As a result, management exhibits a high level of automation, but from a legal perspective, it is excessively dependent on administrative discretion. The essence of technological management lies in restructuring management logic through algorithms and data, while legal regulation relies on a clear delineation of rights and responsibilities and established procedures. The lack of a unified legal mandate and technological guidelines leads to enterprises operating in a climate of regulatory uncertainty, and supervisory authorities lack sufficient legal grounds for enforcement. An institutional mismatch arises, where "technological efficiency" is not matched by "legal effectiveness." The development of big data technologies is stimulating a trend toward "personalized law," in which legal decisions and regulations are optimized to achieve the best possible results.

A key issue is **the symmetry between digital governance and legal guarantees.** Data security encompasses both the protection of the data itself and the security of the technologies used. The former concerns the integrity and confidentiality of data during collection, transmission, storage, and analysis; the latter concerns the reliability of algorithms and resilience to external influences. Both aspects are crucial for national environmental security and the protection of enterprises' commercial interests. However, relevant technical standards remain unaligned with regulations such as the Data Security Law of the People's Republic of China and the Personal Information Protection Law of the People's Republic of China. Consequently, ensuring data security remains at the level of political declarations.

As the collection, transmission, and exchange of solid waste data expands, the asymmetry between technological governance and legal safeguards becomes increasingly apparent. This data contains information on both industrial activities and waste streams, as well as public participation and environmental risks, making it particularly sensitive and interrelated. Current legislation lacks systematic regulation of the limits of environmental data collection, the conditions of its use, and safety standards. The lack of legal mechanisms for data protection and privacy increases the risks of technological governance, while regulatory frameworks lag behind, calling into question the legitimacy of digital governance as a whole.

CONCLUSION

An examination of the features and main directions of legal regulation of waste management in Russia and China showed that this area, which is the subject and object The theoretical, legal, and applied research of conceptual approaches, the main directions of state environmental policy, public administration, strategic planning, and legislation, has a complex, intersectoral, multi-level, and multi-faceted nature, which should be taken into account when optimizing the legal framework for waste regulation and management, taking into account national specifics.

As a scientific and methodological basis for legal regulation, strategic planning and management in the field of waste management, it is necessary to use the provisions of the concept of sustainable development, an ecosystem approach based on the existing interrelations of environmental components, with the application of a program-target method underlying an integrative model for managing the sphere of production and consumption waste management, including all stages, as well as system-structural and structural-functional methods that make it possible to take into account the complex nature of the relations arising in the field of waste management, which are in economic, social and environmental interrelations.

To improve waste management efficiency, it is necessary to further refine the system of strategic planning documents for production and consumption waste management, including MSW, based on the principles of continuity, consistency, and balance between these documents and with approved

strategies and programs in related areas (sectors of the economy), interlinked by targets, objectives, target indicators, and metrics. This also requires harmonizing federal and regional documents. Within the framework of Russian-Chinese cooperation, the issue of aligning targets, objectives, and priority areas of national waste management planning systems is becoming increasingly important for the development, coordination, and implementation of joint activities.

Effective waste management requires addressing existing gaps in terminology and conceptual frameworks related to waste management, including defining and legally codifying the concepts of "consumer waste" (including identifying its characteristics that distinguish it from municipal solid waste), "separate accumulation," "separate collection," and others. Correlating the substantive features of legalized concepts also facilitates the identification of priority areas for joint Russian-Chinese activities in this area and their successful implementation.

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